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ANTITRUST FOR THE ECONOMY OF IDEAS: THE LOGIC OF TECHNOLOGY MARKETS

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TABLE OF CONTENTS

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I. INTRODUCTION

When the Federal Trade Commission ("FTC") and the Department of Justice ("DOJ") issued the *Antitrust Guidelines for the Licensing of Intellectual Property* ("*IP Guidelines*") several years ago,[1] there was a spirited debate over the role of antitrust market definition in the analysis of intellectual property licensing arrangements. But while the *IP Guidelines* refer both to markets for "innovation" and for "technology," it was innovation markets — that is, the application of antitrust relevant market analysis to competition in research and development — that captured the imagination of commentators.[2] Technology markets, by contrast, were all but ignored.[3] While innovation market analysis of

1. *See* U.S. DEP'T OF JUSTICE & FEDERAL TRADE COMM'N, ANTITRUST GUIDELINES FOR THE LICENSING OF INTELLECTUAL PROPERTY § 2.0 (Apr. 6, 1995) (general principles focusing on actual effects of licensing restraints), *reprinted in* 4 Trade Reg. Rep. (CCH) ¶ 13,132 [hereinafter IP GUIDELINES].

2. *See, e.g.*, Thomas N. Dahdouh & James F. Mongoven, *The Shape of Things to Come: Innovation Market Analysis in Merger Cases*, 64 ANTITRUST L.J. 405 (1996); Nicholas A. Widnell, Comment, *The Crystal Ball of Innovation Market Analysis in Merger Review: An Appropriate Means of Predicting the Future?*, 4 GEO. MASON L. REV. 369 (1996); FTC Commissioner Roscoe B. Starek, Innovation Markets in Merger Review Analysis: The FTC Perspective, Address Before the Florida Bar (Feb. 23, 1996), *available at* http://www.ftc.gov/speeches/sta1.htm; Richard M. Brunell, *A Critical Appraisal of the "Innovation Market" Approach*, 64 ANTITRUST L.J. 1 (1995); Richard J. Gilbert & Steven C. Sunshine, *Incorporating Dynamic Efficiency Concerns in Merger Analysis: The Use of Innovation Markets*, 63 ANTITRUST L.J. 569 (1995).

3. *But see* Azam H. Aziz, Note, *Defining Technology and Innovation Markets: The DOJ's Antitrust Guidelines for the Licensing of Intellectual Property*, 24 HOFSTRA L.

research and development ("R&D") competition certainly merits the attention it has received, technology market analysis of intellectual property licensing deserves no less, particularly now that technology markets are beginning to play a significant role in antitrust cases. Indeed, technology market analysis, with its primary focus on technology licensing transactions in existing markets for intellectual property rights, is already proving to be the more consequential of the two market definition inquiries.

The ongoing prosecution of Microsoft, in which the DOJ alleges, among other things, harm to competition in markets for intellectual property rights to computer software programs, may be fairly characterized as a technology market case.[4] The FTC's recent enforcement action against Summit Technology and VISX, in which the monopolization of a relevant market for the "licensing of [laser vision correction] *technology*" was expressly alleged in the agency's complaint, is another notable example.[5] Although the number of cases is still small, with the growing significance of technology licensing in the U.S.

REV. 475 (1995) (arguing that both technology and innovation market analysis are fundamentally flawed and unworkable).

4. United States v. Microsoft Corp., No. 98–1232, ¶¶ 54–56 (D.D.C. May 18, 1998), *available at* http://www.usdoj.gov/atr/cases/f1700/1763.htm.

5. In the matter of Summit Technology, Inc. and VISX, Inc., No. 9286, Complaint ¶ 23 (FTC Mar. 24, 1998) (emphasis added), *available at* http://www.ftc.gov/os/1998/9803/summit.cmp.htm ("The licensing of technology related to PRK is a relevant line of commerce."). The case concerned patents related to photorefractive keratectomy ("PRK"), a form of excimer laser eye surgery used to correct the common vision disorders of myopia (nearsightedness) and hyperopia (farsightedness). *See id.* at ¶ 4. PRK and Lasik — now the most popular form of excimer laser vision correction surgery — have been covered extensively in the financial and popular press. *See,e.g.*, Christine Gorman, *R U Ready to Dump Your Glasses?*, TIME , Oct. 11, 1999, at 58; Mary Murray, *Should You Have Your Eyes Lasered?*, FORTUNE, Sept. 27, 1999, at 194 (describing Lasik and alternative vision correction methods); Ann Marsh, *A Poke in the Eye*, FORBES.COM, Oct. 18, 1999 (describing Lasik procedure), *at* http://www.forbes.com/forbesglobal/99/1018/0221087a.htm; Michael Moretti, *Summit and VISX Increase Patient Acquisition*, EYEWORLD, Oct., 1999 (reporting that in 1999, an estimated 80% of excimer laser vision correction procedures were performed on VISX lasers and the rest on lasers manufactured by Summit Technology), http://www.eyeworld.org/may99/13363.html.

economy,[6] the emergence of technology market analysis in recent cases signals an important trend for the future of antitrust.

This Article offers a critical exploration of technology market analysis as it has developed in antitrust law and enforcement policy. Section I reviews traditional antitrust relevant market definition and traces the evolution of technology market analysis in the intellectual property and antitrust case law and the antitrust enforcement policies of the DOJ and the FTC. Section II explains the economics of technology market definition and shows how defining technology markets can help the courts and the antitrust enforcement agencies to identify competition or market power that might otherwise be missed if the analysis were limited to markets for goods. Section III analyzes recent technology market cases, classifying them in relation to markets for goods, as well as in relation to other, potentially substitutable, technologies. This Section also highlights how two recent cases — the FTC enforcement action against Intel and the DOJ prosecution of Microsoft — respectively illustrate some of the problems of classifying technology markets, and the challenges of applying technology market analysis in a way that fully accounts for competition among alternative

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6. *See, e.g.*, KEVIN G. RIVETTE & DAVID KLINE, REMBRANDTS IN THE ATTIC: UNLOCKING THE HIDDEN VALUE OF PATENTS 1–2 (2000) ("The old industrial era has been supplanted by a new knowledge-based economy in which ideas and innovation rather than land or natural resources have become the principal wellsprings of economic growth and competitive business advantage."); Peter C. Grindley & David J. Teece, *Managing Intellectual Capital: Licensing and Cross-Licensing in Semiconductors and Electronics*, 39 CAL. MGMT. REV. 8 (1997) ("Patents and trade secrets have become a key element of competition in high-technology industries."); Stephen A. Degnan, *The Licensing Payoff from U.S. R&D*, RES. TECH. MGMT., Mar.–Apr. 1999, at 22 (noting that total income received in the U.S. from intellectual property licensing amounted to $136.3 billion in 1996); Rodney Ho, *Patents Hit Record in '98 as Tech Firms Rushed to Protect Intellectual Property*, WALL ST. J., Jan. 15, 1999, at A2 ("The number of patents issued by the U.S. Patent and Trademark Office is skyrocketing, as giant technology companies scramble to shelter their intellectual property in today's tech-crazed marketplace."); ASHISH ARORA ET AL., MARKETS FOR TECHNOLOGY AND THEIR IMPLICATIONS FOR CORPORATE STRATEGY 1 (Carnegie Mellon University, Heinz School of Public Policy and Management Working Paper, 2000) ("In the past two decades or so, there has been a rapid growth in a variety of arrangements for the exchange of technologies or technological services, ranging from R&D joint ventures and partnerships, to licensing and cross-licensing agreements, to contract R&D").

Recently, several World Wide Web sites have been established for the purpose of brokering intellectual property licensing transactions. *See, e.g.*, Kevin J. Delaney, *Technology Becomes Auction Market's New Draw*, WALL ST. J., Jan. 24, 2000, at B13 (reporting the launch of auction web sites, such as "PatentAuction.com" and "The Patent & License Exchange, Inc.," for the sale of intellectual property rights); Karen Jacobs, *Honeywell, P&G and Other Large Firms Offer Their Intellectual Property Online*, WALL ST. J., Feb. 28, 2000, at B6 (reporting that large companies are using "Yet2.com" and other technology licensing web sites to license their intellectual property).

technologies. The final Section addresses three of the most significant arguments against technology market analysis.

II. SOURCES OF TECHNOLOGY MARKET ANALYSIS

The principal sources of current technology market analysis are: (1) traditional antitrust market definition doctrine; (2) patent and antitrust case law; (3) the 1988 *Antitrust Enforcement Guidelines for International Operations*;[7] and (4) the 1995 *IP Guidelines*.[8]

A. Traditional Antitrust Market Definition

The definition of relevant markets is an essential step in the analysis of most antitrust claims.[9] The purpose of market definition is to identify the economic "space" in which a firm or combination of firms may be able to exercise market power.[10] As the Supreme Court has observed, "Without a definition of that [relevant] market, there is no way to measure [a defendant's] ability to lessen or destroy competition."[11]

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7. U.S. DEP'T OF JUSTICE, ANTITRUST ENFORCEMENT GUIDELINES FOR INTERNATIONAL OPERATIONS (Nov. 10, 1988), *reprinted in* 55 BNA Antitrust & Trade Reg. Rep. No. 1391 (special supplement) [hereinafter INTERNATIONAL GUIDELINES].

8. *Supra* note 1.

9. Antitrust analysis under Section 7 of the Clayton Act requires the assessment of the likely competitive effects of proposed mergers and acquisitions in a "line of commerce." FTC v. Staples, Inc., 970 F. Supp. 1066, 1072 (D.D.C. 1997) (citing United States v. Marine Bancorp., Inc., 418 U.S. 602, 618–23 (1974)); *see also* FTC v. Cardinal Health, Inc., 12 F. Supp. 2d 34, 45 (D.D.C. 1998) ("Defining the relevant market is the starting point for any merger analysis."). Relevant market determinations are also required for the assessment of monopolization, *see generally* United States v. Grinnell Corp., 384 U.S. 563 (1966) (discussing relevant market determination required for monopolization claims), attempted monopolization, *see, e.g.*, Acme Precision Products, Inc. v. Am. Alloys Corp., 484 F.2d 1237, 1240 (8th Cir. 1973) ("It seems to this court clear, both on authority and logic, that when a charge is made of [an] attempt to monopolize, the first question would be — 'to monopolize what?'") (quoting Diamond Int'l Corp. v. Walterhoefer, 289 F. Supp. 550, 576–577 (D. Md. 1968)), most vertical restraint claims, *see* Continental T.V., Inc. v. GTE Sylvania, Inc., 433 U.S. 36, 45 (1977) (requiring assessment of the competitive effects of a vertical restraint), and finally, for horizontal restraint cases analyzed under the rule of reason. *See, e.g.*, Times-Picayune Publ'g Co. v. United States 345 U.S. 594, 611–13 (1953); United States v. Columbia Steel Co., 334 U.S. 495, 527 (1948). Market definition is not mandated for the antitrust analysis of *per se* unlawful horizontal restraints. *See* FTC v. Superior Court Trial Lawyers Ass'n, 493 U.S. 411, 432–36 (1990).

10. Although relevant market has both a product dimension and a geographic dimension, *see* Brown Shoe Co. v. United States, 370 U.S. 294, 324 (1962), this Article deals exclusively with the relevant product dimension of the relevant market inquiry.

11. Walker Process Equip., Inc. v. Food Mach. & Chem. Corp., 382 U.S. 172, 177 (1965); *see also* Berkey Photo, Inc. v. Eastman Kodak Co., 603 F.2d 263, 268 (2d Cir.

Relevant market definition is therefore integral to the analysis of antitrust claims for which a showing of actual or likely anticompetitive effect is an element.[12]

Traditional relevant product market analysis is substantially derived from the two most influential Supreme Court cases to address antitrust market definition: *United States v. E.I. du Pont de Nemours & Co.*,[13] (known popularly as the "*Cellophane Case*") and *Brown Shoe Co. v. United States*.[14] In *Brown Shoe*, the Court explained that "[t]he outer boundaries of a product market are determined by the reasonable interchangeability of use or the cross-elasticity of demand between the product itself and substitutes for it."[15] In other words, if buyers judge two products to be reasonably interchangeable — taking into consideration price, use, and other qualities — the products are deemed to be in the same relevant product market.[16] The analytical focus of product market definition is on the availability of substitutes because the ability of a seller to charge supra-competitive prices (i.e., to exercise market power) is constrained when customers can turn to close substitutes in response.[17] In contrast, "[w]hen a product is controlled by

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1979) (noting that the first step in a court's analysis of a monopolization claim must be a definition of the relevant market(s)); Morgenstern v. Wilson, 29 F.3d 1291, 1296 (8th Cir. 1994) ("An actual monopolization claim often succeeds or fails strictly on the definition of the product or geographic market.").

12. Although the definition of relevant market(s) is necessary, the determination is often difficult to make. *See* U.S. Healthcare, Inc. v. Healthsource, Inc., 986 F.2d 589, 598 (1st Cir. 1993) ("There is no subject in antitrust law more confusing than market definition.").

13. 351 U.S. 377 (1956).

14. 370 U.S. 294 (1962).

15. *Id.* at 325; *see also* FTC v. Staples, Inc., 970 F. Supp. 1066, 1076 n.8 (D.D.C. 1997) ("The analytical framework set forth in the [U.S. Department of Justice and Federal Trade Commission, *Horizontal*] *Merger Guidelines* approaches the inquiry regarding *reasonable interchangeability of use or cross-elasticity of demand* by asking whether a 'hypothetical monopolist . . . would profitably impose at least a 'small but significant nontransitory' [price] increase.") (emphasis added) (citing U.S. Department of Justice and Federal Trade Commission, *Horizontal Merger Guidelines* § 1.11 (product market definition inquiry)).

16. *E.I. du Pont*, 351 U.S. at 404; *see also Staples*, 970 F. Supp. at 1074 ("Interchangeability of use and cross-elasticity of demand look to the availability of substitute commodities, i.e., whether there are other products offered to consumers which are similar in character or use to the product or products in question, as well as how far buyers will go to substitute one commodity for another.").

17. FTC v. Cardinal Health, Inc., 12 F. Supp. 2d 34, 46 (D.D.C. 1998); *see also* SmithKline Corp. v. Eli Lilly & Co., 575 F.2d 1056, 1063 (3d Cir. 1978) ("Defining a relevant product market is a process of describing those groups of producers which, because of the similarity of their products, have the ability — actual or potential — to take significant amounts of business away from each other.").

one interest, without substitutes available in the market, there is monopoly power."[18]

The Court's product market inquiry into "reasonable interchangeability of use or the cross-elasticity of demand between the product itself and substitutes for it" subsumes both the *functional* interchangeability of products and the actual propensity of buyers to switch from product A to product B in response to changes in price.[19] Products are "functionally interchangeable" if they can be used for the same purpose or to perform a similar function.[20] Thus cellophane wrap was found to be functionally interchangeable with wax paper and other "flexible wrappings."[21] Similarly, sugar and high fructose corn syrup have been judged functionally interchangeable for some industrial applications.[22]

Proving that two products serve a similar function is a necessary, but not always sufficient, predicate to establishing that the products are in the same relevant market.[23] Products may serve one or more similar functions (e.g., bicycles and automobiles, paper cups and crystal glassware, pocket calculators and personal computers) without being sufficiently *close* substitutes to be deemed competitors.[24] Even if the

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18. *E.I. du Pont*, 351 U.S. at 394.

19. *See, e.g., Staples*, 970 F. Supp. at 1074 (in defining relevant product market, "the general question is 'whether two products can be used for the same purpose, and if so, whether and to what extent purchasers are willing to substitute one for the other'") (quoting Hayden Pub. Co. v. Cox Broad. Corp., 730 F.2d 64, 70 n.8 (2d Cir. 1984)).

20. *See, e.g., E.I. du Pont*, 351 U.S. at 399 (noting "considerable degree of functional interchangeability exists between" cellophane and other flexible packaging materials).

21. *Id.* at 400 (concluding that "cellophane's interchangeability with . . . other [packaging] materials . . . suffices to make it a part of . . . [a] flexible packaging material market").

22. *See* United States v. Archer-Daniels-Midland Co., 866 F.2d 242, 246 (8th Cir. 1988).

23. ABA SECTION OF ANTITRUST LAW, ANTITRUST LAW DEVELOPMENTS 508 (4th ed. 1997) ("[The case law] makes clear that the relevant inquiry remains whether the differences in type render the products poor substitutes, and that the resolution of this question depends on the evidence in the case.").

24. *See, e.g., Staples*, 970 F. Supp. at 1074 (relevant product market limited to "sale of consumable office supplies through office supply superstores," despite perfect functional interchangeability with consumable office supplies sold through other channels); FTC v. Coca Cola Co., 641 F. Supp. 1128, 1133 (D.D.C. 1986) (limiting relevant market to "carbonated soft drinks," while acknowledging that other beverages accomplish the same function of quenching thirst); United States v. Mrs. Smith's Pie Co., 440 F. Supp. 220, 229 (E.D. Pa. 1976) (relevant product market consisting solely of "frozen dessert pies"); United States v. Am. Technical Indus., 1974 Trade Cas. (CCH) ¶74,873 (M.D. Pa. 1974) (natural Christmas trees excluded from artificial Christmas tree product market, despite interchangeability of use); VISX, Inc., FTC Dkt. No. 9286 ¶¶ 517–531 (filed May 27, 1999) (initial decision) (concluding that despite some functional interchangeability between glasses and contact lenses, on the one hand, and

functional interchangeability of two products is established, there remains the question of cross-elasticity of demand: Are buyers likely to substitute product B for product A in response to an increase in the price of product A?[25] If buyers are likely to substitute B for A in response to an increase in the price of A, that propensity to substitute one for the other is evidence tending to show that products A and B are in the same relevant market.[26]

In conjunction with the functional interchangeability and cross-elasticity of demand inquiries, traditional relevant market analysis also directs the consideration of certain "practical indicia" that may reveal the existence of "distinct," narrow product markets (referred to by the Supreme Court as "submarkets")[27] within otherwise competitive "broad market[s]."[28] These "practical indicia" of the existence of narrow product "submarkets" include "industry or public recognition of the submarket as a separate economic entity, the product's peculiar characteristics and uses, unique production facilities, distinct customers, distinct prices, sensitivity to price changes, and specialized vendors."[29]

For purposes of the present discussion, several aspects of traditional relevant product market definition should be noted. The first is the emphasis on predictive judgments regarding the likelihood of demand-side substitution in response to changes in price.[30] Although courts and

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laser vision correction on the other, glasses and contact lenses are not close substitutes for LVC), *available at* http://www.ftc.gov/os/1999/9906/index.htm.

25. *See E.I. du Pont*, 351 U.S. at 400 ("An element for consideration as to cross-elasticity of demand between products is the responsiveness of the sales of one product to price changes of the other.").

26. *See* Eastman Kodak v. Image Technical Serv., 504 U.S. 451 (1992); F.T.C. v. R. R. Donnelley & Sons Co., 1990–2 Trade Cas. (CCH) ¶ 69,239, 64,854 (D.C.C. 1990).

27. *Brown Shoe*, 370 U.S. at 325. The *Brown Shoe* Court's choice of the term "submarket" is unfortunate because it is not clear how a "well-defined" market can be "within" yet another properly defined market. If the "well-defined submarkets" of the Court's formulation possess the economic attributes of markets, they are, whether narrow or broad, "*markets*." No precision is added by referring to such lines of commerce as "*submarkets*," rather than "markets." *See, e.g.*, Allen-Myland, Inc. v. Int'l Bus. Mach. Corp., 33 F.3d 194, 208 n.16 (3d Cir. 1994), ("The use of the term 'submarket' is somewhat confusing and tends to obscure the true inquiry"); PepsiCo, Inc. v. Coca-Cola Co., 1998–2 Trade Cas. (CCH) ¶ 72,257 (S.D.N.Y. 1998) (avoiding the term "submarket" in favor of "market"); PHILIP AREEDA ET AL., IIA ANTITRUST LAW ¶ 533c (1995) (referring to delineation of submarkets in antitrust cases as "both superfluous and confusing").

28. *Brown Shoe*, 370 U.S. at 325 ("[W]ithin this broad market [defined by interchangeability of use or cross-elasticity of demand], well-defined submarkets may exist which, in themselves, constitute product markets for antitrust purposes.").

29. *Id.*

30. *See* Gregory J. Werden, *The History of Antitrust Market Delineation*, 76 MARQ. L. REV. 123, 130–39 (1992) (describing the emergence of cross-elasticity of demand as

antitrust enforcement agencies consider a range of factors, the single most important consideration in antitrust relevant market definition is the consumer's ability and propensity to substitute one product for another.[31] Second, traditional relevant product market definition deals principally with markets for *goods*, and to a lesser (but significant) extent, services or combinations of goods and services.[32] Third, traditional relevant market definition is relatively static; that is, concerned primarily with competitive effects in the relatively short term.[33] Although the courts have not mandated rigid, uniform rules on the subject, the typical time horizon for relevant product market definition is a present-tense "snapshot" of the competitive landscape at roughly the time of the court's analysis.[34]

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a central concept in antitrust market definition).

31. *See, e.g.*, SmithKline Corp. v. Eli Lilly & Co., 575 F.2d 1056, 1063 (3d Cir. 1978) ("[D]efining a relevant product market is a process of describing those groups of producers which, because of the similarity of their products, have the ability — actual or potential — to take significant amounts of business away from each other."); *Staples*, 970 F. Supp. at 1074 (noting that in defining relevant product market, "the general question is 'whether two products can be used for the same purpose, and if so, whether and to what extent purchasers are willing to substitute one for the other'") (quoting Hayden Pub. Co. v. Cox Broadcasting Corp., 730 F.2d 64, 70 n.8 (2d Cir. 1984)); *see also* U.S. DEP'T OF JUSTICE AND FEDERAL TRADE COMM'N, HORIZONTAL MERGER GUIDELINES § 1.11 (product market definition inquiry focusing on cross-elasticity of demand) [hereinafter "HORIZONTAL MERGER GUIDELINES"].

32. *See generally* Anthony D. Becker, The Antitrust Case Browser, *at* http://www.antitrustcases.com (last visited Nov. 18, 2000) (indexing major Supreme Court antitrust cases by product).

33. *See, e.g.*, HORIZONTAL MERGER GUIDELINES, *supra* note 31, at § 3.2 (when evaluating the likelihood that post-merger entry may mitigate the potentially anticompetitive effects of a merger, the FTC and the DOJ generally will only consider entry that will occur within two years of the transaction); *see also* ANTITRUST, INNOVATION AND COMPETITIVENESS 3, 7 (Thomas M. Jorde & David J. Teece eds., 1992) ("There is no area where antitrust policy so clearly displays its focus on static competition than in its treatment of market definition.") [hereinafter Jorde & Teece]. *But see* United States v. Gen. Dynamics Corp., 415 U.S. 486, 499–504 (1974) (where firms principally compete for long-term supply contracts, analysis of potential competitive effects of merger properly focuses on future capacity to compete in long-term supply); FTC v. Cardinal Health, Inc., 12 F. Supp. 2d 34, 58 (D.D.C. 1998) ("In analyzing the probabilities of entry or expansion in the future, it is critical to maintain a dynamic view of the relevant market.").

34. The question of whether future market developments will address present competitive concerns does not typically play a substantial role in antitrust conduct cases because of the retrospective focus upon determining whether a violation has been committed. However, the question is integral to merger cases — where the inquiry focuses prospectively on the likely competitive effects of the proposed transaction — and is generally considered under the rubric of entry analysis. *See, e.g.*, United States v. Baker Hughes, Inc., 908 F.2d 981, 987 (D.C. Cir. 1990); *Cardinal Health*, 12 F. Supp. 2d at 55–56 (applying the two-year time horizon from the *Horizontal Merger Guidelines* for

B. Patent and Antitrust Case Law as a Source of Technology Market Analysis

Although there have been antitrust cases involving intellectual property licensing for almost as long as there has been a Sherman Act,[35] technology market definition is a relatively recent phenomenon.[36] The traditional approach of the federal courts and the antitrust enforcement agencies to intellectual property licensing arrangements was, for much of the twentieth century, to condemn or uphold licensing restraints based largely upon *a priori* categorization of such provisions as within or without the intellectual property holder's statutory rights.[37] Where liability is based solely on proscribed conduct, as opposed to competitive effect, it follows that the relevant market is of little consequence to the decision-maker.[38] While technology markets may be discernable in the subtext of some traditional intellectual property licensing antitrust cases,[39] expressly delineated relevant markets for intellectual property rights in such cases are not to be found.[40]

Over the last decade or so, there has been a shift away from the "litany-of-licensing-sins" (or exclusively conduct-based) approach, in favor of focusing instead on the competitive effects of licensing

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determining whether potential entry will be "timely"); *Staples*, 970 F. Supp. at 1086–87 (no specific time horizon for timeliness of entry).

35. 15 U.S.C. §§ 1–7.

36. While antitrust technology market *definition* is a recent phenomenon, commercial markets for patented technology can be traced at least as far back as the first half of the nineteenth century. *See generally* NAOMI R. LAMOREAUX & KENNETH L. SOKOLOFF, INVENTIVE ACTIVITY AND THE MARKET FOR TECHNOLOGY IN THE UNITED STATES, 1840–1920 (1999), *available at* http://www.nber.org/papers/w7107.

37. *See* Willard K. Tom & Joshua A. Newberg, *Antitrust and Intellectual Property: From Separate Spheres to Unified Field*, 66 ANTITRUST L.J. 167 (1997); *see also* James B. Kobak, Jr., *Running the Gauntlet: Antitrust and Intellectual Property Pitfalls on the Two Sides of the Atlantic*, 64 ANTITRUST L.J. 341 (1996); Charles F. Rule, *Patent-Antitrust Policy: Looking Back and Ahead*, 59 ANTITRUST L.J. 729 (1991).

38. *See, e.g.*, United States v. Besser Mfg. Co., 96 F. Supp. 304, 314 (E.D. Mich. 1951) ("[I]t is now generally recognized that no trust or monopoly obtained by illegal means should be permitted to exist whether it is good or bad.") (citations omitted); United States v. Nat'l Lead Co., 63 F. Supp. 513, 525 (S.D.N.Y. 1945) (refusing to weigh increased output and technological advances against presumptively anticompetitive effect of international patent pool because "the major premise of the Sherman Act is that the suppression of competition in international trade is in and of itself a public injury") .

39. *See, e.g.*, Automatic Radio Mfg. Co., Inc. v. Hazeltine Research, Inc., 339 U.S. 827 (1950) (tying case involving the package licensing of radio technology patents).

40. *Cf.* Warren G. Lavey, *Patents, Copyrights, and Trademarks as Sources of Market Power in Antitrust Cases*, 27 ANTITRUST BULL. 433 (1982) (noting that courts have generally failed to distinguish rigorously between concept of "legal monopoly" and economic "market power" that may have been attributable to intellectual property rights).

restraints in relevant antitrust markets.[41] The relevant market provisions of the 1995 *IP Guidelines* mark one of the most significant steps in this evolution.[42] There are, however, important antecedents of the *IP Guidelines* that may be understood as sources of current technology market analysis. These include the case law applying antitrust analysis to patent pooling arrangements[43] and the fraudulent patent procurement monopolization cases beginning with the Supreme Court's *Walker Process* decision.[44]

1. Patent Pooling Cases

Although the opinions never use the term "technology market," some federal court decisions applying antitrust scrutiny to patent pooling arrangements can be viewed as foreshadowing current technology market analysis. In the typical patent pooling agreement, firms agree to cross-license — and thereby effectively share rights to — patents covering an industrial process.[45] Because pools are comprised of two or more firms, cartel and restraint-of-trade issues tend to dominate the antitrust analysis of such agreements.[46] However, pooling cases can involve monopolization (particularly conspiracy to monopolize) claims

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41. *See* Tom & Newberg, *supra* note 37, at 189–195.

42. *See* IP GUIDELINES, *supra* note 1.

43. Leading cases applying antitrust analysis to patent pooling arrangements include: United States v. Singer Mfg. Co., 374 U.S. 174 (1963); United States v. New Wrinkle, Inc., 342 U.S. 371 (1952); United States v. Line Material Co., 333 U.S. 287 (1948); *Nat'l Lead Co.*, 332 U.S. 319 (1947); Hartford-Empire Co. v. United States, 323 U.S. 386 (1945); Standard Oil Co. v. United States, 283 U.S. 163 (1931); Motion Picture Patents Co. v. Universal Film Mfg. Co., 243 U.S. 502 (1917); Bement v. Nat'l Harrow Co., 186 U.S. 70 (1902); Carpet Seaming Tape Licensing Corp. v. Best Seam Inc., 616 F.2d 1133 (9th Cir. 1980); Duplan Corp. v. Deering Milliken, Inc., 444 F. Supp. 648 (D.S.C. 1977), *aff'd in part and rev'd in part*, 594 F.2d 979 (4th Cir. 1979); International Mfg. Co. v. Landon, Inc., 336 F.2d 723 (1964); Sbicca-Del Mac, Inc. v. Milius Shoe Co., 145 F.2d 389 (8th Cir. 1944); United States v. Krasnov, 143 F. Supp. 184 (E.D. Pa. 1956), *aff'd per curiam*, 355 U.S. 5 (1957); *see also* Roger B. Andewelt, *Analysis of Patent Pools Under the Antitrust Laws*, 53 ANTITRUST L.J. 611 (1984); George L. Priest, *Cartels and Patent License Arrangements*, 20 J.L. & ECON. 309 (1977).

44. Walker Process Equip., Inc. v. Food Mach. & Chem. Corp., 382 U.S. 172 (1965).

45. *See, e.g.*, United States v. Assoc'd Patents, Inc., 134 F. Supp. 74 (E.D. Mich. 1955) (defendants pooled patents used in the manufacture of machine tools); United States v. Besser Mfg., Inc., 96 F. Supp. 304 (E.D. Mich. 1951) (defendants pooled patents used in the manufacture of concrete block-making machines).

46. *See, e.g.*, *Singer Mfg.*, 374 U.S. at 174 (pooling arrangement established to exclude competitors from the manufacture and sale of sewing machines); *Hartford-Empire*, 323 U.S. at 400 (patent pooling arrangement formed the basis of a cartel controlling the manufacture of glass containers).

as well.[47] With regard to the cartel and restraint-of-trade issues analyzed under Section 1 of the Sherman Act, the principal concern in patent pooling cases is that by sharing intellectual property rights, firms will diminish or eliminate competition that might have existed in the absence of a pooling arrangement.[48] In such cases, agreements to share patent rights can be facilitating devices for horizontal collusion that may take the form of price-fixing, market allocation, output restriction, or collective exclusion of potential market entrants.[49] With regard to monopolization issues analyzed under Section 2 of the Sherman Act, courts have sometimes found pooled patent rights to have been unlawfully used to acquire, extend, or maintain monopoly power, typically by excluding (or conspiring to exclude) potential competitors from a market.[50]

Patent pooling cases may be understood as antecedents of technology market analysis: first, because they apply antitrust scrutiny to transactions in intellectual property rights covering technology; and second, because they suggest, at least by implication, the potential importance of power in markets for technology that may be distinguished from power in markets for goods or services produced with that

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47. *See Hartford-Empire*, 323 U.S. at 386 (holding that pooling arrangement violated Sections 1 and 2 of the Sherman Act); *see also* Mason City Tent & Awning Co. v. Clapper, 144 F. Supp. 754 (W.D. Mo. 1956); United States v. Krasnov, 143 F. Supp. 184 (E.D. Pa. 1956); *Besser Mfg.*, 96 F. Supp. 304; United States v. Gen. Instrument Corp., 87 F. Supp. 157 (D.N.J. 1949); United States v. Gen. Elec. Co., 80 F. Supp. 989 (S.D.N.Y. 1948); United States v. Motion Picture Patents Co., 225 F. 800 (E.D. Pa. 1915).

48. *Compare New Wrinkle*, 342 U.S. at 373–75 (holding that arrangement to pool patents and fix prices for the products made with the pooled technology "plainly violate[s] the Sherman Act"), *with* United States v. Birdsboro Steel Foundry & Mach. Co., 139 F. Supp. 244, 260 (W.D. Pa. 1956) (holding that pooling arrangement did not violate Section 1 because the firms were not "actual or potential competitors").

49. *See, e.g.*, United States v. Glaxo Group Ltd., 410 U.S. 52 (1973) (pooling of patents for manufacture of bulk form and dosage form of fungicide allowed pool members to coordinate limit on the number of dosage form manufacturer-licensees); *New Wrinkle*, 342 U.S. at 373–75 (pooling of patents covering industrial surface finishing process facilitated horizontal price-fixing arrangement); *Associated Patents*, 134 F. Supp. at 74 (E.D. Mich. 1955) (pooling of machine tool manufacturing patents facilitated coordination of market division, anticompetitive exclusion of potential entrants, and suppression of technological development); *Besser Mfg.*, 96 F. Supp. at 311 (pooling arrangement provision requiring both pool members to consent to any licensing of either party's patents to any outside firm held to be "a means whereby control of the industry could be acquired and competition eliminated"); United States v. Nat'l Lead Co., 63 F. Supp. 513, 521–27 (S.D.N.Y. 1945) (patent pooling arrangement facilitated international geographic market division among manufacturers of titanium pigments).

50. *See supra* note 47.

technology.[51] The patent pooling arrangement is a commercial exchange, not of goods or services, but of intangible intellectual property rights. It is, in other words, a distinctive type of joint venture in which firms agree to share, not in the production or distribution of goods or services, but in the possession and disposition of technology protected as intellectual property. While patent pooling decisions tend to focus on effects in the product markets for *goods* produced with the pooled technology, it can often be inferred from the reported facts of such cases that some, if not all, of the defendants' economic power is derived from control over an upstream market for patented manufacturing *technology*.[52] The Supreme Court's *Hartford-Empire*[53] decision is a case in point.

In *Hartford-Empire*, the DOJ successfully challenged a series of agreements pursuant to which four glassmaking firms cross-licensed over 600 glassmaking machinery patents to create "a pool which effectively controlled the [U.S. automatic glassmaking] industry."[54] Finding that the pooling arrangement violated both Sections 1 and 2 of the Sherman Act, the Court, without making detailed relevant market determinations, nevertheless suggested harm to competition in both a market for goods and a market for technology:

> It is clear that, by cooperative arrangements and binding agreements, the appellant corporations, over a period of years, *regulated* and suppressed *competition in the use of glassmaking machinery* and *employed their joint patent position to allocate fields of manufacture* and to maintain prices *of unpatented glassware*.[55]

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51. Although the law is not entirely consistent, patent pooling arrangements are generally analyzed under the rule of reason. *See, e.g.*, Standard Oil Co. v. United States, 283 U.S. 163 (1931).

52. *See, e.g.*, Krasnov, 143 F. Supp. at 202 (E.D. Pa. 1956) ("That the defendants in combination and cross-licensing created a situation in the industry which, particularly by agreement for joint action respecting the patents, effectively hindered newcomers in the field is . . . established . . . ."); United States v. Gen. Elec. Co., 80 F. Supp. 989, 1015 (S.D.N.Y. 1948) (noting that the pooled patents "defined a whole new industry" and that "defendants used their patents as a lever to win domination over the entire cemented carbide business").

53. *Hartford-Empire*, 323 U.S. at 386.

54. *Id.* at 400.

55. *Id.* at 406–07 (emphasis added). The court notes earlier in its opinion: "The [defendant] corporations are the leaders in automatic glassmaking machinery and in the glassware industry." *Id.* at 392.

Since "competition in the use of glassmaking machinery" was virtually impossible without access to the pooled patents,[56] the facts suggest an upstream relevant product market for glassmaking machinery *technology*.[57] Though not expressly identified as such, the agreements forming the pool, as well as agreements between the pool and non-member manufacturer-licensees, can be understood as transactions in a market for glassmaking machinery *technology*, a relevant product market that may be distinguished from product markets for the glassmaking machinery and the goods produced with those machines.

2. *Walker Process* Cases

The Supreme Court's *Walker Process* decision and its progeny, like the patent pooling cases, anticipate technology market definition, while refraining from actually defining technology markets. *Walker Process* cases typically arise from antitrust counterclaims brought by defendants in actions for patent infringement. Upon being sued for infringement, the defendant argues that: (1) the patent sued upon was fraudulently procured and is therefore invalid, and (2) that the invalid patent confers or contributes to the unlawful acquisition or maintenance of monopoly power on the part of the patentee.[58] Since *Walker Process* cases are brought under Section 2 of the Sherman Act, relevant market definition is a mandatory element of the court's analysis.[59]

Although the *Walker Process* Court was primarily concerned with possible competitive effects in a relevant market for "devices," i.e., goods, produced with the technology embodied in a fraudulently-procured patent, the Court's discussion of market definition suggests that the patented *technology*, and its relationship to possible substitutes, substantially defines the boundaries of that market. Outlining the relevant market inquiry to be pursued on remand, the Court explained:

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56. *Id.* at 400 (finding that as a result of the pooling arrangement "94% of the glass containers manufactured in this country on [automatic] feeders and formers were made on machinery licensed under the pooled patents"). Competition in the use of glassmaking machinery could not occur without access to the patents covering glassmaking machinery *technology*. Access to the glassmaking machinery patents was effectively controlled by the pool, which exercised market power as a monopolist in the market for glassmaking machinery technology.

57. *See infra* Part II.B.

58. *See, e.g.*, Northlake Mktg. & Supply, Inc. v. Glaverbel, S.A., 861 F. Supp. 653 (N.D. Ill. 1994); Tapeswitch Corp. of Am. v. Recora Co., Inc., 196 U.S.P.Q. (BNA) 348 (N.D. Ill. 1977).

59. *See* Walker Process Equip., Inc. v. Food Mach. & Chem. Corp., 382 U.S. 172, 177 (1965).

> To establish monopolization or attempt to monopolize a part of trade or commerce under § 2 of the Sherman Act, *it would then be necessary to appraise the exclusionary power of the illegal patent claim in terms of the relevant market for the product involved.* Without a definition of that market there is no way to measure [the patentee's] ability to lessen or destroy competition. It may be that the device [made with the technology covered by the invalid patent] . . . does not comprise a relevant market. There may be effective substitutes for the device which do not infringe the patent. This is a matter of proof . . . .[60]

The Court's notion of defining the relevant product market in terms of the exclusionary power of the patented technology has been followed and refined in subsequent cases.[61] Indeed, failure to plead a relevant market in which the exclusionary power of the challenged patent can be meaningfully assessed has proved fatal to many *Walker Process* claims.[62]

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60. *Id.* at 178–79 (emphasis added).

61. *See, e.g.*, Abbott Labs. v. Brennan, 952 F.2d 1346, 1354–55 (Fed. Cir. 1991) ("Determination of whether the patentee meets the Sherman Act elements of monopolization or attempt to monopolize is governed by the rules of application of the antitrust laws to market participants, with due consideration to the exclusivity that inheres in the patent grant."); Brunswick Corp. v. Riegel Textile Corp., 752 F.2d 261, 265 (7th Cir. 1984) ("The [fraudulently procured] patent must dominate a real market."); Am. Hoist & Derrick Co. v. Sowa & Sons, Inc., 725 F.2d 1350, 1366–67 (Fed. Cir. 1984) (accord); Kearney & Trecker Corp. v. Cincinnati Milacron, Inc., 562 F.2d 365, 373 (6th Cir. 1977) ("Walker Process requires an appraisal of the exclusionary power of an illegal patent in terms of the relevant market"); Acme Precision Prod., Inc. v. Am. Alloys Corp., 422 F.2d 1395, 1396 (8th Cir. 1970) (*Walker Process* claimant must prove "dominant position" of the patentee in a relevant market.).

62. *See, e.g., Abbott Labs.*, 952 F.2d at 1354–55 (holding that *Walker Process* claimant may not rely on asserted presumption of market power deriving from the mere existence of the challenged patent, in lieu of pleading relevant market in which the exclusionary power of the patent can be measured); Mayview Corp. v. Rodstein, 620 F.2d 1347, 1355–56 (9th Cir. 1980) (affirming dismissal of *Walker Process* claim where plaintiff failed to adduce evidence of, *inter alia*, patentee's power to control or exclude competition from a relevant market); *Northlake Mktg.*, 861 F. Supp. at 663 (dismissing *Walker Process* claim for lack of evidence regarding, *inter alia*, availability of substitutes for industrial process covered by challenged patent); Papst Motoren GMbH & Co. v. Kanematsu-Goshu (U.S.A.), Inc., 629 F. Supp. 864, 872 (S.D.N.Y. 1986) (same); *Tapeswitch Corp.*, 196 U.S.P.Q. (BNA) at 351 (dismissing *Walker Process* claim for failure to define scope of relevant market and the patentee's "share therein"); Curvcraft, Inc. v. Chromcraft, Inc., 193 U.S.P.Q. (BNA) 371, 373–74 (1976) (dismissing *Walker Process* claim for failure to allege relevant market and that patentee "has obtained economic domination or the power to fix prices in or exclude competitor's from the relevant market").

To be sure, by focusing on the capacity of patents to exclude competition from markets for *goods* produced with the patented technology, *Walker Process* analysis eliminates the possibility that patented technology and its substitutes could comprise a separate relevant product market meriting separate antitrust scrutiny.[63] Nevertheless, by linking the relevant market determination to the assessment of the exclusionary power of the challenged intellectual property, i.e., a patent's capacity to dominate a relevant market, *Walker Process* lights at least part of the path toward technology market analysis.

C. The Antitrust Enforcement Guidelines for International Operations

Another major source of technology market analysis came, not from the courts, but from the DOJ in the form of the *Antitrust Enforcement Guidelines for International Operations* ("*International Guidelines*") issued in 1988.[64] While lacking the force of statutory or decisional law,[65] the statement of DOJ enforcement policy in the *International Guidelines* offers the most detailed official articulation of technology market analysis to date.[66] Lifting technology markets from the realm of the implied and ancillary to that of the express and primary, the *International Guidelines* analysis of intellectual property licensing arrangements takes as its starting point the identification of competitors and competitive effects in relevant markets, not for goods or services,

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63. A few lower court *Walker Process* cases more closely foreshadow technology market analysis by inquiring into the availability of substitutes for patented *processes* in addition to substitutes for goods. *See, e.g., Northlake Mktg.*, 861 F. Supp. at 663 (dismissing *Walker Process* claim for failure to offer evidence of whether the relevant market is limited to the industrial process covered by the challenged patent, or inclusive of other methods that may be "reasonably interchangeable" with that process).

64. *See* INTERNATIONAL GUIDELINES, *supra* note 7.

65. The impact and influence of the *International Guidelines* may have been further limited by two other factors: first, it was a statement of enforcement policy issued unilaterally by a single agency, rather than jointly by both the DOJ and the FTC. Second, the INTERNATIONAL GUIDELINES were nominally directed to "businesses engaged in *international* operations," raising a measure of uncertainty regarding the extent to which the analysis in the *International Guidelines* might apply to intellectual property licensing arrangements in the U.S. *Id.* § 1.0 (emphasis added).

66. DOJ's technology market analysis is set forth principally in § 3.6, parts of § 2.4, and Cases 6 and 12 of the *International Guidelines*.

but for *technology*.[67] Specifically, the *Guidelines* explain that when analyzing intellectual property licensing arrangements:

> The Department first identifies all technologies with which the technology or technologies covered by the license compete. This process is analogous to the process the Department uses to define markets for purposes of its merger analysis. The relevant market includes all technologies to which users would turn if the price of the licensed technology (e.g., the license royalty) increased by five to ten percent. The relevant market includes both functional substitutes for a particular technology as well as technologies used to manufacture substitute products.[68]

What is most striking about the *International Guidelines* approach to technology markets is its structural similarity to the traditional relevant product inquiry employed to define markets for goods and services.[69] As with traditional product market definition, the analytical emphasis is on functional interchangeability and the likelihood of demand-side substitution in response to a supra-competitive price increase.[70] The primary measure of functional interchangeability and likely cross-elasticity of demand is the relative efficiency of the licensed technology and the technologies that are candidates for inclusion in the relevant technology market.[71] The inquiry is also largely focused on current competition, with the consideration of potential entries that might defeat the exercise of market power limited to the same two-year time horizon used in the DOJ's standard merger analysis.[72]

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67. *See id.* § 3.63 (when analyzing intellectual property licensing restraints, "[t]he Department seeks to determine whether such restrictions would likely create, enhance, or facilitate the exercise of market power beyond that which is conferred unilaterally by each party's intellectual property *in a relevant market for technology*") (emphasis added).

68. *Id.* The next step in the *International Guidelines* analysis looks at the competitive effects of the licensing arrangement in markets other than the technology market. This would be the point at which the effects of the license on downstream markets for goods and/or services would be considered. *Id.* § 3.64, at 19 ("Next, the Department seeks to determine whether the license would likely create, enhance, or facilitate the exercise of market power in any other market in which the licensor and licensee (or licensees) compete or would compete in the absence of the license.").

69. *See supra* Section I.A.

70. *See* INTERNATIONAL GUIDELINES, *supra* note 7, § 3.63 n.135, at 17 ("Technologies compete if consumers regard them as substitutes.").

71. *See id.* § 3.63, at 17–19.

72. *See id.* (if it is determined that the licensing arrangement would be anticompetitive, the DOJ considers, among other factors, the likelihood of expanded

Technology market definition, then, as it emerged in the DOJ's enforcement policy, did not offer a radically new model for the analysis of intellectual property licensing arrangements. Rather, it was the formal transposition of traditional relevant product analysis to transactions in markets for intellectual property rights. However, in expressly delineating technology markets that are conceptually separate and distinct from related markets for goods or services, the *International Guidelines* took the pivotal step toward an inquiry that is fully recognizable as technology market analysis.

D. Technology Market Analysis Defined in the IP Guidelines

The market definition provisions of the 1995 *IP Guidelines* build on the *International Guidelines* to offer the most authoritative statement of technology market analysis to date.[73] While the *IP Guidelines*, like the *International Guidelines*, lack the force of law, they articulate the current enforcement policy of both the Antitrust Division of the DOJ and the FTC with regard to intellectual property licensing arrangements.
The *IP Guidelines* list three types of markets that may be affected by licensing arrangements: (1) traditional "goods" markets;[74] (2) "innovation" markets ("consisting of the research and development directed toward new or improved goods or processes");[75] and (3) "technology" markets defined as follows:

> Technology markets consist of the intellectual property that is licensed (the "licensed technology") and its close substitutes — that is, the technologies or goods that are close enough substitutes significantly to constrain the exercise of market power with respect to the intellectual property that is licensed . . .

To identify a technology's close substitutes and thus to delineate the relevant market, the Agencies will, if the data permit, identify the smallest group of technologies and goods over which a hypothetical monopolist of those technologies and goods likely would exercise

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output from fringe firms and the entry of new "comparably efficient technologies" within two years) (citing ANTITRUST DIVISION, U.S. DEP'T OF JUSTICE, MERGER GUIDELINES § 3.3 (1984), *reprinted in* 4 Trade Reg. Rep. (CCH) ¶ 13,103 (consideration of entry in merger analysis)).

73. *See* IP GUIDELINES, *supra* note 1, § 3.2.
74. *See id.* § 3.2.1.
75. *See id.* § 3.2.3.

market power — for example, by imposing a small but significant and nontransitory price increase.[76]

The *IP Guidelines* version of technology market analysis follows the *International Guidelines* in essentially transposing to intellectual property the relevant product market inquiry traditionally applied to goods and services.[77] In specifically delineating the three types of markets, however, the latter policy statement presents the relevant product market inquiry in slightly different terms.[78] Significantly, the three categories — "goods," "innovation," and "technology" — overlap. The definition of "technology markets" in the *IP Guidelines* encompasses, for example, not only "technology" protected by licensed intellectual property, but also substitutable goods and technologies that are not protected as intellectual property. A "razor blade technology" market might include, for example, the intellectual property rights to a patented razor blade-manufacturing process ("the licensed technology"), as well as razor blades ("goods") produced with unpatented know-how. In this example the blades made with unpatented know-how would be included in the "razor blade technology" market if they were sufficiently close substitutes for blades made with the patented technology to constrain the ability of the patented technology holder to exercise market power.

A further nuance tending to blur the distinctions between the three categories arises in the *IP Guidelines* treatment of markets for goods embodying technology. The *IP Guidelines* state that where there is no separate market for technology embodied in a good, agencies will analyze the competitive effects of a licensing arrangement in the goods market only, without defining a separate technology market.[79] This point, which parallels similar language in the *International Guidelines*,[80]

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76. *See id.* § 3.2.2. The technology market analysis set forth in § 3.2.2 of the *IP Guidelines* has also been incorporated into the agencies' joint venture guidelines. *See* U.S. DEP'T OF JUSTICE & THE FEDERAL TRADE COMM'N, ANTITRUST GUIDELINES FOR COLLABORATION AMONG COMPETITORS § 3.32(b) (Apr. 2000).

77. *See* INTERNATIONAL GUIDELINES, *supra* note 7, § 3.63, at 17 ("The relevant market should include all technologies to which users would turn if the price of the licensed technology (e.g., the license royalty) increased by five to ten percent.").

78. The *International Guidelines* allude to "emerging technologies" without using the term "innovation market" or distinguishing innovation markets from future-goods technology markets. *Id.* § 3.63 ("In cases that involve emerging technologies . . . the DOJ must make a qualitative assessment based on the best available evidence of the likely future strength of those technologies in the market.").

79. IP GUIDELINES, *supra* note 1, § 3.2.2 n.20 (noting that where intellectual property is licensed, sold, or transferred "as an integral part of a marketed good . . . there is no need for a separate analysis of technology markets to capture relevant competitive effects").

80. INTERNATIONAL GUIDELINES, *supra* note 7, § 3.62 n.132 ("[W]here the

is at one level unremarkable, in that it reduces to the tautological proposition that "where there is no separate market for technology, the agencies will not define a separate market for technology." It is moreover consistent with common usage of the word "technology,"[81] which may refer either to a technical process for making or doing something, or alternatively to the good or combinations of goods and services that embody the technical process.[82] For example, we may use the term "computer technology" interchangeably to refer on the one hand to the processes that allow us to manufacture computers, or on the other to the manufactured computer products.

Nevertheless, drawing the distinction between separately licensed technology and technology embodied in goods raises the question of how to account for technology that is not *currently* the subject of separate licensing transactions, but which *could* be readily licensed or sold.[83] This can be a matter of some importance because a decision by a firm to license a previously unlicensed technology can increase (or create) competition in the market for the technology and in the downstream market for goods manufactured with the licensed technology. Consider, for example, a hypothetical industry in which three vertically integrated firms use their respective proprietary technologies to manufacture laser printers, but none of the three licenses its technology to any third parties. Under these circumstances there is no technology market (because there are no transactions in the laser printer technologies) and the goods market for laser printers is highly concentrated. If, however, one of the three firms chooses to license its technology to third party manufacturer-licensees, the effect on the industry could be dramatic. First, it would create a market for laser printer technology where none existed before, one in which the other two firms might also have an incentive to participate in order to garner some of the licensing revenue that would otherwise flow exclusively to their competitor. Second, depending on the number of licenses granted,

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technology and a product [using the technology] are largely coextensive," the DOJ would only define and analyze a single market.).

81. The term is never defined in either the *International Guidelines* or the *IP Guidelines*, so it is presumably intended to carry the meaning it has in standard usage.

82. Dictionary definitions of "technology" that correspond with common usage include "a scientific method of achieving a practical purpose," WEBSTER'S NINTH NEW COLLEGIATE DICTIONARY 1211 (1990), "[t]he application of science," and "[t]he entire body of methods and materials used to achieve such objectives." THE AMERICAN HERITAGE DICTIONARY OF THE ENGLISH LANGUAGE 1321 (1981).

83. *Cf.* Initial Decision, E.I. Dupont De Nemours & Co., 96 F.T.C. 653, 663 n.11 (1979) (finding that Dupont could not separately license one of several technologies used to produce titanium dioxide because potential licensees lacked "the advanced technology necessary to create a feasible commercial manufacturing operation using that process").

it could significantly increase competition in the market for goods embodying the laser printer technology.

Although the issue of potentially licensable technology is not directly addressed, the *IP Guidelines* indicate that defining a relevant market for technology "is conceptually analogous to the analytical approach to goods markets under the 1992 Horizontal Merger Guidelines."[84] If we apply the market definition approach of the 1992 *Horizontal Merger Guidelines* to an existing technology market, a firm that would begin licensing its technology in response to a "small but significant and nontransitory" increase in the price of the technology (or competing alternative technologies) would be properly included in the relevant technology market as an "uncommitted entrant."[85]

The *IP Guidelines* technology market analysis, then, summarizes and integrates the antecedent elements discussed above, while adding to them the imprimatur of official enforcement policy. The framework which bases market definition on likely demand-side substitution in response to the exercise of market power — subsuming functional interchangeability and cross-elasticity of demand — is drawn from the traditional antitrust market definition inquiry that has been, and continues to be, applied to markets for goods and services. The *IP Guidelines*' concern with the potential exercise of market power derived from control over intellectual property rights can be traced, at least in part, to the antitrust case law analyzing intellectual property licensing arrangements and patent monopolization.[86] The last and most important step toward technology market analysis is drawn from the *International Guidelines*: a definition of markets for intellectual property rights that can be analytically distinguished from related markets for goods or services.

III. ECONOMICS OF TECHNOLOGY MARKET ANALYSIS

The next step toward an understanding of technology market analysis is an exploration of its economic foundations. The starting point in economics, as in law, is the market definition inquiry that has

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84. IP GUIDELINES, *supra* note 1, § 3.2.2 n.20.

85. HORIZONTAL MERGER GUIDELINES, *supra* note 31, § 1.32.

86. *E.g.*, IP GUIDELINES, *supra* note 1, § 5.5 (citing United States v. New Wrinkle, Inc., 342 U.S. 371 (1952) (finding that a patent pooling arrangement constituted price-fixing in violation of Section 1 of the Sherman Act)); *id.* § 6.0 (citing Walker Process Equipment, Inc. v. Food Machinery & Chemical Corp., 382 U.S. 172 (1965) (holding that a patent procured by fraud and in bad faith monopolized commerce in violation of section 2 of the Sherman Act)).

traditionally been applied to markets for goods.[87] In modern antitrust analysis, market definition asks whether a hypothetical monopolist of the proposed relevant market could profit by setting price above competitive levels by a small but significant amount for a nontransitory period of time. If such supra-competitive pricing could be profitable, the market could be subject to anticompetitive harm and could therefore be an appropriate area for antitrust inquiry. The proposed market is not a relevant antitrust market if such pricing would not profit a hypothetical monopolist because of customer substitution to other items (or decreased use). Substitution to other items and decreased use are summarized in the price-sensitivity of demand for the item of concern: in economic terms, market definition is concerned with the demand elasticity that a hypothetical monopolist would face in the supply of a particular good in a given area.[88]

As noted earlier, technology market analysis is, first and foremost, a traditional product (goods) market analysis applied to intellectual property transactions. More specifically, the paradigmatic technology market is an *input* market, not unlike the goods market for soft drink concentrate used to produce soft drinks.[89] This is because technology licenses are typically demanded in order to provide legal access to inputs into further economic activity.[90] As with other inputs like steel or glass, the demand for licenses is based on the demand for these other activities or goods. Viewed at the time of the licensing transaction, such economic activities may be: (a) related to the provision of current or prospective goods or services, or (b) transactions in technologies as such, whereby patent portfolios or other intellectual property rights are acquired in anticipation of future gain. Ultimately, such demands are

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87. *Cf.* IP GUIDELINES, *supra* note 1, § 2.1 ("The Agencies apply the same general antitrust principles to conduct involving intellectual property that they apply to conduct involving any other form of tangible or intangible property.").

88. *See generally* Gregory J. Werden, *Demand Elasticities in Antitrust Analysis*, 66 ANTITRUST L.J. 363 (1998).

89. *See* Final Order, Coca-Cola Co., 117 F.T.C. 795, 803 (1994) ("There is no use for concentrate other than in the production of carbonated soft drinks, and the demand for concentrate is therefore derived from the demand for carbonated soft drinks."); *see also* Weyerhaeuser Co., 106 F.T.C. 172, 193–205 (1985) (finding that an input — "corrugating medium" — for which there were no close substitutes constituted a relevant product market, separate and distinct from the end product — "corrugated sheet and boxes" — in which the input was integrated in the manufacture of the end product); FTC v. Weyerhaeuser Co., No. 80–3175, 1981 U.S. Dist. LEXIS 12029, at *8 (D.D.C. 1981) (finding the same), *aff'd*, 665 F.2d 1072 (D.C. Cir. 1981).

90. *See generally* Jack A. Nickerson, *Strategic Objectives Supported by Licensing*, *in* TECHNOLOGY LICENSING: CORPORATE STRATEGIES FOR MAXIMIZING VALUE 63 (Russell L. Parr & Patrick H. Sullivan eds., 1996) (setting forth a taxonomy of strategic objectives that technology licenses can serve).

based on the potential productivity or competitive advantages the technologies may provide in some future goods.[91] Transactions in such technologies are hence conceptually analogous to those in stocks;[92] in both cases, prices are based on expectations of future profitability.[93]

In standard economic language, the demand for technology licenses is a "derived demand" for inputs.[94] A technology or group of technologies is more likely a relevant market when its derived demand is relatively inelastic, that is, insensitive to price. With relatively inelastic demand, an increase in the royalties charged by the hypothetical monopolist above the competitive level would result in a smaller decrease in the number of licensees or in the use of technology than if the demand were elastic.

Where the demand for intellectual property licenses is based on present goods (e.g., specialty steel producers licensing smelting technologies for current production), we can call the relevant markets for such technologies "*current-goods* technology markets." In contrast, where licensees' demand derives from the technology's potential to develop future goods (e.g., pharmaceutical companies licensing technology to develop new drugs), we can call the relevant markets for such technologies "*future-goods* technology markets."

Distinctions between current-goods and future-goods technology markets, however, are not always sharp, and technology market analysis may involve current-goods, potential future-goods, and the related technologies. For example, a foundation (parent) seed line owned by an agribusiness company may be licensed to produce seeds (current-goods) used by others to develop new seed varieties (future-goods) and for research that may not have commercial results for years.

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91. *See id.*

92. *See* STEPHEN A. ROSS ET AL., CORPORATE FINANCE 117 (5th ed. 1999) (noting that the price-earnings ratio of stock reflects a multiple of anticipated future earnings).

93. *See id.*

94. The term's originator, Alfred Marshall, described this derivative relationship: "The demand for raw materials and other means of production is *indirect* and is *derived* from the direct demand of those directly serviceable products which they help to produce." ALFRED MARSHALL, PRINCIPLES OF ECONOMICS 381 (9th ed. 1961). Both the term and analysis have long been standard in economics; antitrust cases have also used derived demand analysis. *See, e.g.*, Illinois v. Panhandle Eastern Pipe Line Co., 730 F. Supp. 826, 866 (C.D. Ill. 1990) ("The LDC's [local distribution companies] demand is a derived demand, reflecting the demand characteristics of final consumers of natural gas.").

A. Criteria for Defining Technology Markets

Properly applied, technology market analysis may help courts and enforcement officials avoid certain kinds of false positives (concluding that there is an antitrust problem when there is not) and false negatives (concluding that there is no antitrust problem where one actually exists) that may arise in the application of traditional goods market definition. An example of such error is the assumption that downstream competition and substitutability in goods markets constrains potential upstream market power. In some cases, significant anticompetitive effects in technology markets will not be evident in the related goods markets. Economic analysis also offers potentially provable criteria that indicate when a technology will likely be a relevant market due to inelastic derived demand.[95] The application of these criteria to technology market analysis can be illustrated by looking at the facts of the Cracking Patents case, *Standard Oil (Indiana) v. United States*.[96] In that case the Supreme Court, by confining its analysis to the market for goods, missed potential anticompetitive effects and probable market power based on licensed technology.

B. Applying the Criteria to the Cracking Patents Case

Standard Oil concerned the pooling of patents on processes for "cracking" petroleum to increase gasoline yields. Cracking was the major early twentieth century innovation in refining technology.[97] With the application of cracking technology to petroleum refining, yields rose from 2.48 gallons per forty-two gallon barrel of oil in 1904 (when

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95. These are the standard "laws" of derived demand. Such "laws" need not always hold true, but they are useful analytical criteria by which one may gauge whether a technology is a likely relevant market because its royalty could profitably be held at monopoly levels, in part because of the exclusion of competition. For the original statement of these laws, see MARSHALL, *supra* note 94, at 385–86. *See also* J.K. WHITAKER, *Derived Demand*, *in* 1 THE NEW PALGRAVE: A DICTIONARY OF ECONOMICS 813–14 (John Eatwell et al. eds., 1987) (providing a more technical and modern statement).

96. 283 U.S. 163 (1931).

97. Estimates of the increased yield of gasoline due to cracking technology vary widely, in part because of different baselines and in part because the different cracking technologies were not equally efficient. At a minimum, however, cracking technology nearly doubled the amount of gasoline that could be refined from a barrel of crude oil in the first ten years following the introduction of the first cracking technology in 1913. *See* JOHN LAWRENCE ENOS, PETROLEUM PROGRESS AND PROFITS 299 tbl.8a (1962). This made it possible to meet the enormous increase in the demand for gasoline that arose from the automobile revolution of the early twentieth century. *See* John S. McGee, *Patent Exploitation: Some Economic and Legal Problems*, 9 J.L. & ECON. 135, 150 (1966).

cracking barely existed) to 14.63 gallons in 1925,[98] by which time cracked gasoline accounted for over twenty-six percent of U.S. gasoline production.[99] Although the DOJ claimed that the defendants' cross-licensing arrangements amounted to a price-fixing cartel, the Supreme Court found that the pooling of the cracking technology patents could not have had an anticompetitive effect because increased royalties could not raise gasoline prices.[100] The defendants' combined share of gasoline production was insufficient, according to the Court's analysis, to confer dominance in gasoline supply. [101]

This conclusion is superficially attractive, but incomplete. Applying the economic principles of derived demand to the stylized facts of this case, it becomes clear that cracking technology (or subsets thereof) almost certainly was a relevant market (or markets) because a hypothetical monopolist controlling such technology would not have lost significant licensing revenue by setting royalties above the competitive level.

Economic analysis suggests that a relevant market for technology is likely to exist where four criteria are met: (1) demand for products using the technology is relatively inelastic; (2) the royalty for licensing the technology is a small portion of the total cost or price of the product in which the technology is used; (3) substitute technologies are either unavailable or not as efficient as the technology comprising the candidate relevant market; (4) the cost of switching to alternative technologies is high because significant inputs are specialized to the use

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98. *See* United States v. Standard Oil Co. (Indiana), 33 F.2d 617, 619 (N.D. Ill. 1929).

99. Cracked gasoline production figures (68,583,000 barrels) are from ENOS, *supra* note 97, at 285 tbl.1a. Total gasoline production figures (259,601,000 barrels) are from U.S. DEP'T OF COMM., BUREAU OF THE CENSUS, HISTORICAL STATISTICS OF THE UNITED STATES 596 ser. M 162–77 (1975).

100. *See* 283 U.S. at 179.

101. *See id.* In addition to the pool members' relatively low share of the "all gasoline" market, the Court found other factors significant. These additional factors included the absence of restraints on licensees' gasoline prices or output, the number of licensees, and pool members' rights to license their own patents to third parties. *See id.* at 170. The Court found that the pooled cracking technologies were licensed for only about fifty-five percent of gasoline cracking capacity and that cracked gasoline was only twenty-six percent of U.S. gasoline production. For these figures, the Court apparently relied on outdated and probably inaccurate data. Subsequent reanalysis of contemporary industry data has suggested that the pool members' share of the technology market — measured in terms of gasoline refined under their patented processes — may have been over ninety percent. *See* George L. Priest, *Cartels and Patent License Arrangements*, 20 J.L. & ECON. 309, 369 (1977) (reviewing various analyses of cracking patents market data).

of the technology.[102] The *Standard Oil* case illustrates the application of these criteria to the technology market definition inquiry.

1. Inelastic Demand for Products Using the Technology

Low demand elasticity for gasoline contributes to the viability of a cracking technology market. With price-insensitive (inelastic) demand, even high royalties will not depress gasoline production significantly (other things being equal) and both total refinery operations and licensing revenues can be maintained. This implies less pressure on refiners to consider switching technologies (assuming such technologies are available). It is likely that gasoline demand was relatively inelastic because fuel accounts for a relatively small proportion of the total cost of automobile transportation, from which the demand for gasoline derived. Even if passed through into gasoline prices, a significant royalty overcharge by a hypothetical monopolist of all cracking technologies would have had a relatively small effect on the production of gasoline overall.

2. The Royalty is a Small Proportion of the Total Cost or Price of the Good or Activity

Technology royalties were a small proportion of the price or the cost of producing cracked gasoline. Even if passed through in prices, a higher royalty would have less than a proportionate effect on the unit cost of cracked gasoline and would therefore potentially depress cracked gasoline production only slightly below what it would otherwise be. This could keep royalty income up.

In 1917, the royalty for the then predominant cracking technology — Standard Oil of Indiana's "Burton" process — was about 1.41 cents per gallon of gasoline,[103] or 6.75 percent of the wholesale (dealers' net) gasoline price at the time.[104] A ten percent increase in this royalty fee would have been only 0.141 cents per gallon, or 0.0675 percent of the wholesale price of gasoline. It is unlikely that such an increase would have induced much shifting away from cracked gasoline or cracking technologies. Given this fact, producers of uncracked

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102. The four laws of derived demand set forth in the accompanying text are adapted from MARSHALL, *supra* note 94, at 385–86 and WHITAKER, *supra* note 95, at 813–14.

103. *See* ENOS, *supra* note 97, at 309 tbl.14.

104. *See id.* at 288 tbl.2b. The royalty would constitute an even lower proportion of the retail price, which under normal conditions is higher than the wholesale price upon which the calculation is based.

gasoline would have had less incentive to increase their production, thus further weakening the constraints on the hypothetical cracking technology monopolist. The loss in royalty income would likely be relatively small, and the defendants (acting in concert as a monopolist) would have been more likely to profit by keeping price above the competitive level.

3. No Cost-Effective Substitutes for the Technology

Substitute (non-cracking) technologies were not cost-effective.[105] Cracking provided much higher gasoline yields than the older technologies it displaced. High royalty rates charged by a hypothetical cracking monopolist would not have induced much shift in demand away from cracking technologies generally. Therefore such shifts would not have prevented high royalties.

4. High Licensee Switching Costs

Each refining facility was specialized to particular cracking technologies. At least for the life of the facilities, royalties somewhat above competitive levels probably would not reduce licensing, but could reduce the licensees' profits. In other words, some or all of the hypothetical monopolist's higher royalties would be borne by the refiners, in the form of lower returns. So long as the refiners lacked economically viable alternatives, supra-competitive cracking technology royalties would not be defeated by shifts of production away from cracked gasoline.

Since important complementary inputs were specialized to specific cracking technologies, many refiners of cracked gasoline would have reacted to higher royalties by accepting lower returns: they had no alternative, and they would have been slow to abandon specialized plants and equipment. Even when potentially cost-effective substitutes became available, the refiner licensees would have to make substantial investments in plant re-design or construction before they could switch.

Over time, there was considerable substitution from the initial market leader in favor of other cracking processes. Between 1919 and 1929 the Burton technology's share of cracked gasoline production fell from 100 percent to 9.4 percent.[106] It is likely that this substitution is

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105. As noted earlier, cracking technology was roughly twice as efficient as straight-run gasoline refining. *See id.* at 1.

106. *See id.* at app.285, tbl.1a; U.S. DEP'T OF COMM., BUREAU OF THE CENSUS, HISTORICAL STATISTICS OF THE UNITED STATES 596 ser. M 167 (1975).

indicative of competing technologies within a technology market and/or successive technology markets over time. Overall, then, the relevant market for the *Standard Oil* case should have been cracking patents *technology*, the demand for which was derived from the demand for cracked gasoline. [107]

IV. CLASSIFYING TECHNOLOGY MARKETS

While the more recent technology market cases have not generally produced the kind of detailed public record and analysis generated by *Standard Oil*, there is nevertheless much to be learned from the experience with technology market definition so far.[108] It is instructive to consider, for example, the specific types of relevant markets that have been alleged in recent technology market cases and the application of technology market analysis in those disputes. The following section reviews recent technology market cases and applies a basic system of classification with two purposes in mind. The first is to develop a better understanding of technology market analysis by looking critically at the specific types of technology markets that have been alleged. The second is to suggest a series of analytical questions that might be asked by the courts and the antitrust enforcement agencies in the process of defining and evaluating relevant product markets for technology. To that end, the discussion below classifies and assesses technology markets alleged in recent cases in relation to: (1) downstream goods markets; and (2) other potentially substitutable technologies.

A. Technology Markets Classified in Relation to Goods Markets

Recent technology market cases may be classified in relation to markets for goods as follows: (1) current-goods technology market

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107. *See* JOHN S. MCGEE, INDUSTRIAL ORGANIZATION 174 (1988). *See generally* McGee, *supra* note 97.

108. The *Microsoft* case is perhaps the exception that proves the rule. Whereas most technology market cases have been resolved by consent decrees without generating a litigation record, *Microsoft* has already produced a circuit court opinion, an extensive trial record, voluminous findings of fact, and mountains of commentary. *See, e.g.*, United States v. Microsoft Corp., 84 F. Supp. 2d 1 (D.D.C. 1999); United States v. Microsoft Corp., 147 F.3d 935 (D.C. Cir. 1998); MICHAEL A. CUSUMANO & DAVID B. YOFFIE, COMPETING ON INTERNET TIME: LESSONS FROM NETSCAPE AND ITS BATTLE WITH MICROSOFT (1998); STAN J. LIEBOWITZ & STEPHEN E. MARGOLIS, WINNERS, LOSERS AND MICROSOFT: COMPETITION AND ANTITRUST IN HIGH TECHNOLOGY (1999); Steven C. Salop & R. Craig Romaine, *Preserving Monopoly: Economic Analysis, Legal Standards, and Microsoft*, 7 GEO. MASON L. REV. 617 (1999).

cases;[109] (2) future-goods technology market cases;[110] and (3) cases in which both types of technology markets are alleged.

1. Current-Goods Technology Markets

A straightforward current-goods technology market was alleged by the Antitrust Division of the DOJ in its case against American National Can Co. ("ANC") and KMK Maschinen AG ("KMK"), involving laminated tubes used for packaging toothpaste and pharmaceuticals.[111] The DOJ complaint challenged as anticompetitive a series of licensing and purchase agreements pursuant to which KMK left the U.S. market, selling its vertically-integrated U.S. tube-making equipment business and exclusively licensing its tube-making technology to ANC.[112] The relevant markets alleged were: (1) laminated *tubes* (the downstream goods market);[113] (2) laminated tube-making *equipment* (an upstream input goods market);[114] and (3) "laminated tube-making *technology*."[115] The complaint goes on to allege that "[t]he use of patented and unpatented tube-making technology is essential to the profitable manufacture of laminated tubes and laminated tube-making equipment" and that ANC, by virtue of the KMK license, held the rights to three of the four leading tube-making technologies in the world.[116]

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109. *See generally supra* Part II.
110. *See generally supra* Part II.
111. *See* Complaint, United States v. American Nat'l Can Co., No. 96-1458 (D.D.C. 1996), *available at* http://www.usdoj.gov/atr/cases/f0700/0728.htm. Before entering into the agreements challenged by the DOJ, "both ANC and KMK were vertically integrated companies that owned rights to tube-making technology, manufactured laminated tube-making equipment for use in the United States, and manufactured and sold laminated tubes in the United States." Competitive Impact Statement, United States v. American Nat'l Can Co., No. 96-1458, 1996-2 TRADE CAS. (CCH) ¶71,641; 78,508 (D.D.C. 1996).
112. *See generally* Complaint, United States v. American Nat'l Can Co., No. 96-1458 (D.D.C. 1996).
113. *See id.* ¶¶ 12–16. The complaint further alleged that the laminated tube market was "highly concentrated," with three firms accounting for 95% of all such tubes manufactured and sold in the U.S. *Id.* ¶ 14.
114. *See id.* ¶¶ 17–21. The complaint further alleged that the market for laminated tube-making *equipment* was "highly concentrated," consisting of just three firms worldwide. *Id.* ¶ 18.
115. *Id.* ¶¶ 22–23 (emphasis added). *See also* Final Judgment, United States v. American Nat'l Can Co., No. 96-1458, 1996 WL 760292 (D.D.C. 1996) ("'[L]aminated tube-making technology' means any form of intellectual property relating to (i) the design, development, construction, or operation of laminated tube-making equipment or any component, feature or use thereof.").
116. Complaint ¶22, United States v. American Nat'l Can Co., No. 96-1458 (D.D.C. 1996).

Since the case was settled with a consent decree, the Antitrust Division's allegations have never been tested in litigation.[117] But if the picture painted in the complaint and the competitive impact statement is substantially true, the use of technology market analysis seems appropriate. Here the tube-making technology is an essential input for the manufacture of two current goods: laminated tube-making equipment and laminated tubes.[118] Rights to the technology are bought and sold in regular licensing transactions, but the market for such rights is highly concentrated. No close substitutes exist for this specific type of intellectual property.[119] Under these circumstances, a distinct market for licensed technology emerges, in which a hypothetical monopolist could profit by raising prices above competitive levels.

The FTC's case for challenging the proposed merger of two large petrochemical firms, Montedison, S.p.A. and Shell Oil, is another example of a current-goods technology market. In this case, the Commission alleged that the market for the licensing of polypropylene technology was very highly concentrated.[120] In addition to the market for polypropylene technology, the FTC further alleged two current-goods markets consisting of two types of polypropylene resin manufactured with polypropylene technology.[121] The Commission also concluded that "polypropylene technology" was an "essential input" for the production of polypropylene resin.[122]

In consideration of the facts presented in the materials accompanying the consent decree, the use of technology market analysis in *Shell/Montedison* seems well founded. Montedison was the leader in

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117. *See* Final Judgment, United States v. American Nat'l Can Co., No. 96-1458 (D.D.C. 1996).

118. The DOJ found that there were "no viable economic substitutes for laminated tubes" used for packaging toothpaste and pharmaceuticals. Competitive Impact Statement, United States v. American Nat'l Can Co., No. 96-1458 (D.D.C. 1996), *available in* 1996-2 Trade Cas. (CCH) ¶ 71,641, 78,507; *see also supra* Part II.B.3. (suggesting that the lack of cost-effective substitute for technology means relevant technology market is more likely). The DOJ also noted that laminated tube-making equipment could not "efficiently be used for any other purpose." Competitive Impact Statement at 78,508 (suggesting the existence of important inputs specialized to the use of laminated tube-making technology); *see also supra* Part II.B.4. (high licensee switching costs and specialized assets suggest that a relevant technology market is more likely).

119. *See* Competitive Impact Statement, United States v. American Nat'l Can Co., No. 96-1458, 1996 WL 760292, at *5 (D.D.C. 1996); *see also supra* Part II.B.3.

120. *See* Complaint, Montedison, S.p.A., 119 F.T.C. 676, 681 (1995). The complaint also alleges a technology market for polypropylene catalyst technology, defined as "technology, plant design, and polypropylene catalyst technology, whether licensed to others or consumed internally." *Id.* at 678.

121. *See id.* at 678–79.

122. *See id.*

licensing polypropylene technology for use in the construction and operation of plants that manufactured polypropylene resin. In the four years preceding the Commission's complaint, Montedison, with its co-licensor Mitsui, accounted for roughly half of the polypropylene manufacturing capacity built or projected to be built under technology licenses.[123] Shell together with its co-licensor Union Carbide constituted the second leading licensor of polypropylene technology, accounting for over 30 percent of the polypropylene manufacturing capacity built or projected to be built under technology licenses during the same period.[124] Even though the goods market for manufactured polypropylene in North America was only moderately concentrated at the time of the proposed merger, the market for polypropylene *technology* was highly concentrated and would have become considerably more so had the merger proceeded without modification.[125] The facts therefore suggest a distinct pattern of licensing transactions in polypropylene *technology*, a close connection between the technology and an existing goods market, and the possibility that market power could be exercised by raising the price or restricting the output of essential technology licenses.[126]

The DOJ's prosecution in *United States v. Microsoft Corp.*[127] also generally fits the current-goods technology market model. In that particular case, the U.S. District Court found two relevant markets: one for "the licensing of all Intel-compatible PC [personal computers] operating systems world-wide"[128] and another "for Web browsing functionality."[129] The government's core contentions were that

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123. *See* 119 F.T.C. 676, 680.

124. *See id.* at 681.

125. Under the terms of the consent decree that settled the matter, Shell agreed to divest its polypropylene technology licensing business. The divested assets would continue to compete with Montedison and the other firms in the polypropylene technology licensing market. *See id.* at 694.

126. *See, e.g.*, PETER H. SPITZ, PETROCHEMICALS: THE RISE OF AN INDUSTRY 546–50 (1988); Peter C. Grindley & Jack A. Nickerson, *Licensing and Business Strategy in the Chemicals Industry, in* TECHNOLOGY LICENSING: CORPORATE STRATEGIES FOR MAXIMIZING VALUE 97–120 (Russell L. Parr & Patrick H. Sullivan eds., 1996); Ashish Arora, *Patents, Licensing, and Market Structure in the Chemical Industry*, 26 RES. POL'Y 391 (1997); John Kenly Smith, Jr., *Patents, Public Policy, and Petrochemical Processes in the post-World War II Era*, 27 BUS. & ECON. HIST. 413–19 (1998).

127. 65 F. Supp. 2d 1, 5 (D.D.C. 1999) (findings of fact), *subsequently reissued in* 84 F. Supp. 2d 9, 13 (D.D.C 1999).

128. United States v. Microsoft Corp., 65 F. Supp. 2d 1, 5 (D.D.C. 1999) (findings of fact), *subsequently reissued in* 84 F. Supp. 2d 9, 13 (D.D.C 1999).

129. 65 F. Supp. 2d 1, 154 (D.D.C. 1999) (findings of fact), *subsequently reissued in* 84 F. Supp. 2d 9, 13 (D.D.C 1999). In its findings, the district court essentially adopted the two relevant markets proposed in the DOJ's complaint: (1) personal computer

Microsoft used its monopoly power in the personal computer ("PC") operating systems ("OS") market to maintain its monopoly in the OS market and to monopolize the Internet browser market.[130] Although neither the court nor the Antitrust Division identifies the OS or browser functionality markets as "technology markets"; both markets consist of licensed intellectual property and its substitutes thus falling squarely within the *IP Guidelines* definition.[131] Both PC operating systems and Internet browsers, moreover, are essential inputs for current goods, i.e., personal computers.[132] Demand for operating systems and Internet browsers are therefore derived from the demand for PCs.[133]

Significantly, if we credit the district court's interpretation of the facts in *Microsoft*, the PC operating system and Web browser current-goods technology markets generally fit the four "laws of derived demand" identified earlier as the criteria to be used in determining whether a separate relevant market for a technology exists.[134] First, the court suggests that demand for the products using the technology (PCs) is relatively inelastic.[135] Second, the royalty for licensing the technology is a small portion of the total cost or price of the product in which the technology is used.[136] Third, the court is persuaded that substitute

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operating systems, and (2) Internet browsers. *See* Plaintiff's Complaint ¶ 53, United States v. Microsoft Corp. (D.D.C. 1998) (No. 98-1232), *available at* http://www.usdoj.gov/atr/cases/f1700/1763html.

130. *See* Plaintiff's Complaint ¶¶ 69–123, United States v. Microsoft Corp., No. 98-1232 (D.D.C. 1999).

131. *See* IP GUIDELINES, *supra* note 1, § 3.2.2 ("Technology markets consist of the intellectual property that is licensed . . . and it close substitutes."). Indeed, computer software is perhaps the quintessential example of a *technology* market and a crucial factor accounting for the growth of the technology markets in recent years. Software is an exceptionally efficient means of carving out a firm's specialized processes and making them readily transferable for use by a potentially limitless number of other firms. *See generally* ASHISH ARORA ET AL., MARKETS FOR TECHNOLOGY (WHY DO WE SEE THEM, WHY DON'T WE SEE MORE OF THEM AND WHY WE SHOULD CARE) §§ 3–4, 7 (H. John Heinz III Sch. of Pub. Policy and Management, Carnegie Mellon Univ., Working Paper, No. 1999-6, 1999), *available at* http://www.heinz.cmu.edu/heinz/papers/active/wp000194.html.

132. A PC operating system adapted to the Intel x86/Pentium class of microprocessors is essential to the operation of most personal computers. An Internet browser program is essential to the large subset of PC users who wish to use their PCs "to locate, access, display, and manipulate content and applications located on the [world-wide] web." Plaintiff's Complaint ¶ 56, United States v. Microsoft Corp., No. 98-1232 (D.D.C. 1999).

133. *See supra* Part II.A.

134. *See supra* Part II.B.

135. This may be inferred from the court's finding that there are no close substitutes for the PC. *See* United States v. Microsoft Corp., 65 F. Supp. 2d 1, 5–9 (D.D.C 1999), *subsequently reissued in* 84 F. Supp. 2d 9 (D.D.C. 1999).

136. *See, e.g.*, Mark Boslet, *Microsoft's Windows Bucks the Pricing Trend*, WALL ST. J., Mar. 23, 1998, at B9 (reporting that the OEM price for *Windows 95* was approximately

technologies are either unavailable or not as efficient as the technology comprising the candidate relevant market.[137] And fourth, the cost of switching to alternative technologies is high.[138] It follows that while Microsoft's allegedly anticompetitive conduct may significantly affect the market for PCs, *goods* market analysis alone will not adequately assess the alleged anticompetitive effects of such conduct.[139] Rather, the facts of the *Microsoft* case as presented in the court's findings suggest the need for an evaluation of competition in separate — i.e., separate from the PC goods market and separate from each other — relevant markets that include, respectively, Internet browser software on the one hand, and PC operating system software on the other.

2. Future-Goods Technology Markets

As noted above, future-goods technology markets are those in which the demand for licensed technology is derived from the anticipated demand for *future* goods, rather than the existing demand for current goods.[140]

In challenging the proposed merger of Ciba-Geigy Ltd. and Sandoz Ltd. in 1997, the FTC alleged that the market for "gene therapy technology," as well as several other new innovation markets, would have been adversely affected by the transaction.[141] The proposed merger combined two formidable patent portfolios covering significant areas of gene therapy technology then in the research and clinical trial stages of development.[142] Because no gene therapy product was approved by the

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$45 in 1998); John R. Wilke & Keith Perine, *Microsoft Trial Judge Questions Claim Competition Restrains Company's Prices*, WALL ST. J., Jan. 22, 1999, at B3 (noting Microsoft's practice of charging original equipment manufacturers ("OEMs") approximately $50 per-copy of *Windows*); Press Release, Microsoft Corp., Why Does Microsoft Charge So Little for Windows? (October 9, 1999) (stating that Microsoft charged OEMs a licensing fee of about $50, or 2.4 percent of the average price of a computer, in 1997 per copy of *Windows* installed), *at* http://www.microsoft.com/presspass/doj/econ/10-16econ-b.asp.

137. *See Microsoft*, 65 F. Supp. 2d at 5–9.

138. *See id.*

139. Significantly, the government's complaint does not allege that there is an anticompetitive product market for PCs. In fact, the market for PCs is highly competitive. Based on recent sales figures, the Herfindahl-Hirschman Index ("HHI") for the U.S. PC market is less than 800. *See* David P. Hamilton, *PC-Sales Growth Slowed in Fourth Period*, WALL ST. J., Jan. 24, 2000, at B8 (reporting fourth quarter 1999 PC sales and shipments).

140. *See supra* Part II.

141. Complaint ¶ 9, Ciba-Geigy Ltd., No. C-3725 (F.T.C. 1997), *available at* http://www.ftc.gov/os/1997/9704/c3725cmp.htm.

142. *See* Ciba-Geigy Ltd., 62 Fed. Reg. 409 (F.T.C. 1997) (analysis to aid public

Food and Drug Administration ("FDA") for commercial sale at the time of the merger, the "gene therapy technology" market in 1997 could be classified as a future-goods technology market. Although the first commercial gene therapies were not expected to obtain FDA approval until the year 2000, the FTC concluded that the combined gene therapy technology embodied in the patent portfolios of the two firms could be used to exclude competitors from developing future gene therapy products, thereby stifling innovation in an emerging industry. Specifically, the Commission alleged that "Ciba/Chiron and Sandoz control crucial *inputs* into the development of gene therapy products, and the merger creates an unmatchable portfolio of intellectual property assets that are necessary to commercialize gene therapy products."[143]

The gene therapy technology market alleged by the Commission in the Ciba-Geigy/Sandoz merger case consists of intellectual property, the demand for which is derived from anticipated demand for future gene therapy products yet to be commercialized. The facts, as presented in the FTC's complaint and analysis to aid public comment, suggest that the use of technology market analysis in *Ciba-Geigy* is appropriate. The gene therapy technology was an essential input for future gene therapy treatments (i.e., future goods). There was a distinct demand (among gene therapy technology firms that could not develop their products without licenses to patents that would be controlled by the merged firm) for licensing the relevant gene therapy patent rights separately, in the respective portfolios of Ciba-Geigy and Sandoz. Further, there was a possibility that the merged firm could exercise market power by virtue of its control over the combined gene therapy technology portfolios of its two constituent firms.

3. Current- and Future-Goods Markets Alleged

In its case against Summit Technology and VISX, Inc., the FTC challenged a patent pooling arrangement through which Summit and VISX had allegedly monopolized a market for licensing technology related to photorefractive keratectomy ("PRK"), a new type of laser vision correction procedure.[144] Significantly, the anticompetitive

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comment).

143. *Id.* at 410 (emphasis added).

144. The FTC enforcement action against Summit and VISX began in 1998 with the filing of a three-count complaint. *See* Admin. Complaint, Summit Tech., Inc. and VISX, Inc., No. 9286, 1998 FTC LEXIS 29 (F.T.C. 1998). The complaint charged that (1) the patent pooling arrangement between Summit and VISX — by which the firms agreed, *inter alia*, to cross-license several PRK-related patents — was an agreement in restraint of trade; (2) the agreement and related conduct constituted a conspiracy to monopolize

conduct challenged in the Commission's complaint began in 1992 when the patent pool was formed.[145] Although there were extensive clinical trials, no commercial PRK procedures were performed in the United States until the FDA approved the procedure and permitted Summit to market lasers for PRK in 1995.[146] Thus, for the period from 1992 to 1995, the market for the licensing of technology related to PRK was a future-goods technology market. With FDA approval of PRK in 1995, the same market became a current-goods technology market.[147]

4. The *Intel* Case and the Problems of Classification

The broadly framed relevant market language in the FTC's complaint against *Intel* that alludes to possible current or future technology markets can be understood as an example of the problems of categorization that arise in defining markets in high-technology industries.[148] As noted above, distinctions between current and future-goods technology markets are not always sharp, and technology market analysis may involve current goods, potential future goods, and related technologies.[149]

In the *Intel* case, the FTC alleged that the company withheld essential technical information from three customers in order to force the customers to license certain microprocessor-related patents to Intel on a royalty free basis.[150] According to the Commission, Intel engaged in this

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markets for the sale of PRK equipment and the licensing of PRK technology; and (3) VISX had fraudulently procured a key PRK industry patent by withholding relevant information from the Patent and Trademark Office. *Id.* ¶¶ 25–30. Summit and VISX entered into consent agreements with the FTC settling the first two counts of the administrative complaint, covering the issues involving the patent pooling arrangement between Summit and VISX. *See* Decision and Order, Summit Technology, Inc. and VISX, Inc., No. 9286, 1999 FTC LEXIS 23 (F.T.C. 1999). Administrative proceedings against VISX continued pursuant to the third count of the complaint, and an administrative law judge dismissed the remaining count after an administrative trial. *See* Initial Decision, VISX, Inc., No. 9286 (F.T.C. 1999), *available at* http://www.ftc.gov/os/1999/9906/index.htm.

145. *See* Admin. Complaint ¶ 8, Summit Tech., Inc. and VISX, Inc., No. 9286, 1998 FTC LEXIS 29, at *2 (F.T.C. 1998).

146. *See generally* Initial Decision, VISX, Inc., No. 9286, ¶¶ 430–434 (F.T.C. 1999).

147. *See id.* ¶ 434.

148. *See* Complaint, Intel Corp., No. 9288, 1999 FTC LEXIS 38 (F.T.C. 1999).

149. *See supra* Part II.

150. The customers were Digital Equipment Corporation, Intergraph Corporation, and Compaq Computer Corporation. *See* Complaint at n.5, Intel Corp., No. 9288, 1999 FTC LEXIS 38, at *33 (F.T.C. 1999). The dispute with Intergraph also generated significant private litigation. *See* Intergraph Corp. v. Intel Corp., 3 F. Supp. 2d 1255 (N.D. Ala. 1998), *vacated by* 195 F. 3d 1346 (Fed. Cir. 1999). *See also* William J. Baer & David A. Balto, *Antitrust Enforcement and High-Technology Markets*, 5 MICH. TELECOMM.

conduct to (1) maintain its monopoly in "general purpose microprocessors" by disadvantaging potential competitors; and (2) "monopolize both [the] current generation and future generations of general-purpose microprocessors, and [the] narrower market contained therein."[151] The complaint describes the FTC's alleged relevant markets as follows:

> One line of commerce relevant to Intel's conduct is the manufacture and sale of all general purpose microprocessors, including current-generation microprocessors. The relevant market also *includes* future-generation microprocessors *and technologies* for current-generation and future-generation microprocessors. In addition, narrower markets may be contained within the market for general purpose microprocessors.[152]

The first and third quoted sentences appear to be describing goods markets for "general purpose microprocessors," while suggesting that "narrower markets may be contained within" this category.[153] The second sentence states that the relevant market *includes* technologies for current-goods (microprocessors), future-goods, and *technologies* for current and future-goods. However, it is not clear whether the existence of a separate microprocessor *technology market* is being alleged. The complaint, moreover, refrains from specifying the type or types of microprocessor technologies that might constitute relevant product markets.[154] The Commission may have viewed "*technologies* for

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TECH. L. REV. 73 (1998–99) (explaining the rationale for action against Intel from the perspective of two high-ranking FTC officials); Stephen Labaton, *Failed Partnership Is A Lens For Viewing U.S.-Intel Suit*, N.Y. TIMES, Mar. 8, 1999, at C1 (describing dispute between Intergraph and Intel as it relates to the FTC's case against Intel).

151. Complaint ¶ 41, Intel Corp., No. 9288, 1999 FTC LEXIS 38, at *20 (F.T.C. 1999). The Commission's action against Intel was resolved by a consent decree before going to trial. *See* Decision and Order, Intel Corp., No. 9288, 1999 FTC LEXIS 145 (F.T.C. 1999). Under the terms of the consent, Intel agreed that it would no longer respond to patent infringement suits brought by customers by withholding the technical information it routinely gives such customers, so long as those customers do not seek injunctive relief to stop the manufacture, use, sale, offer to sell, or importation of Intel microprocessors. *Id.* at *10.

152. Complaint ¶ 4, Intel Corp., No. 9288 (emphasis added), 1999 FTC LEXIS 38 (F.T.C. 1999).

153. Although the Commission does not use the term, the phrase "narrower market contained within" evokes the concept of submarkets discussed earlier. *See supra* Part I.A.

154. The Commission's pre-trial brief in the *Intel* matter defines the relevant product

current-generation and future-generation microprocessors" solely as goods embodying technology, for which there is no separate technology market in which a hypothetical technology monopolist could exercise market power.[155] This might explain why the complaint does not specifically allege a separate technology market. Alternatively, the Commission may have intended its relevant market description to allege both separate microprocessor goods markets as well as current and future-goods *technology* markets for microprocessor-related intellectual property, the control of which would permit a hypothetical monopolist to charge supra-competitive prices to licensees. The relevant market language of the complaint can be read to support either interpretation.

The closely related private litigation between Intergraph and Intel,[156] based on the same conduct at issue in the FTC case, suggests that there is room for good faith disagreement regarding the composition of the relevant markets at issue in this dispute. Prior to the FTC consent decree, Intergraph, a manufacturer of workstation computers designed to use Intel microprocessors and the Windows NT operating system, had sued Intel for infringement of patents covering its "Clipper" microprocessor technology and for violations of sections 1 and 2 of the Sherman Act.[157] After unsuccessfully attempting to license the Clipper patents from Intergraph, Intel had retaliated against Intergraph's infringement lawsuit by withholding technical information and other resources upon which Intergraph was dependent as an OEM, having designed its product around an Intel microprocessor.[158] In the private action against Intel, the District Court held that (1) Intel had monopoly power in relevant markets for "high performance microprocessors"[159] and "Intel CPUs";[160] (2) Intergraph competed in "the high-end graphics

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market more specifically as "general purpose microprocessors *used as central processing units ('CPUs') in reprogrammable digital computers.*" Complaint at 8, Intel Corp., No. 9288 (F.T.C. 1999) (emphasis added), *available at* http://www.ftc.gov/alj/D9288/index.html.

155. *Cf.* IP GUIDELINES, *supra* note 1, § 3.2.2, n.19 (stating that "there is no need for a separate analysis of technology markets to capture relevant competitive effects" where intellectual property is "licensed, sold, or transferred as an *integral part of a marketed good*") (emphasis added).

156. *See* Intergraph Corp. v. Intel Corp., 3 F. Supp. 2d 1255 (N.D. Ala. 1998), *vacated by* 1999 U.S. App. LEXIS 29199 (Fed. Cir. 1999).

157. *Intergraph*, 3 F. Supp. 2d at 1268 n.36.

158. *Id.* at 1269; *see also Intergraph*, 1999 U.S. App. LEXIS 29199, at *2 ("Intergraph owns the Clipper technology and patents thereon.").

159. *Intergraph*, 3 F. Supp. 2d at 1275.

160. The District Court used the terms "microprocessor," "central processing unit," and "CPU" interchangeably to describe the high-performance microprocessors that function as the "brains" of personal computers. *Id.* at 1259 n.5.

workstation market;"[161] and (3) Intel had leveraged its microprocessor monopoly power in an attempt to monopolize "markets for graphic subsystems and workstations in which Intergraph competes."[162] Reversing the District Court's grant of an injunction to Intergraph, Judge Newman, writing for a Federal Circuit panel, noted that Intergraph did not compete with Intel in the general purpose microprocessor market or in any market for Clipper microprocessors,[163] and that the record did not support Intergraph's monopoly leveraging theory.[164]

While neither the district court nor the appellate panel expressly delineated technology markets, the distinction between markets for technology and markets for goods is perhaps implicit in the Federal Circuit's analysis of the economic relationship between Intel and Intergraph with regard to Intergraph's Clipper microprocessor technology. As the Clipper patentee, Intergraph was a would-be "seller" or licensor of Clipper technology, but not of any goods made with

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161. *Id.* at 1276.

162. *Id.* at 1278. The district court made no attempt to define separate technology markets as they might have been defined under the analysis set forth in the *IP Guidelines* § 3.2.2.

163. *Intergraph*, 1999 U.S. App. LEXIS 29199 at *21. Intergraph abandoned the commercial use of its Clipper microprocessor technology in favor of Intel's microprocessor in 1993. *Id.* Intel, for its part, may not have sought a license to the Clipper patents in order to enter a "market" for Clipper workstation microprocessor technology, but rather to assure "design freedom" for its other technologies that might arguably infringe one or more of the Clipper patent claims. *See* Brief for Intel Corp., *In re* Intel Corp., FTC Dkt. No. 9288, at 41–42 (arguing that Intel's conduct was a legitimate response to the "minefield of microprocessor patents" that could potentially "hold up" Intel with "extortionate licensing demands"), *available at* http://www.ftc.gov/alj/D9288/intelbrief.pdf; *see also* Peter C. Grindley and David J. Teece, *Managing Intellectual Capital: Licensing and Cross-Licensing in Semiconductors and Electronics*, 39 CAL. MGMT. REV. 8 (1997) (because there are thousands of overlapping semiconductor patents, firms typically enter into wholesale cross-licensing agreements in order to assure design freedom to develop products without fear of infringement); Jack A. Nickerson, *Strategic Objectives Supported by Licensing*, in TECHNOLOGY LICENSING: CORPORATE STRATEGIES FOR MAXIMIZING VALUE 71 ("Design freedom is a term applied to the practice of cross-licensing intellectual property portfolios to expand design options, avoid costly design-around efforts, and avoid patent infringement-related monitoring and litigation"); Alex Grove, *Developing A Complex: The Intricate Maze of Intellectual Property On Today's Chips Is Driving VCs Nuts*, RED HERRING, Apr. 1998, at 53 (explaining that increasing complexity of semiconductor technology makes it "less likely that either a manufacturer or a designer will own all of the intellectual property needed to fashion today's more advanced chips").

164. *Intergraph*, 1999 U.S. App. LEXIS 29199, at *38. Intergraph's monopoly leveraging theory was based on evidence that Intel planned to enter or otherwise exert control over "the graphics subsystem and workstation markets." *Id.* at *34. The Federal Circuit found that the record did not support Intergraph's contention that Intel was leveraging its market power in the microprocessor market in an attempt to monopolize other markets in which Intergraph competes. *Id.* at *38–40.

Clipper technology. As a would-be "buyer" or licensee of the Clipper technology, Intel was in a vertical relationship to Intergraph. Thus Intel did not compete with Intergraph in either the Clipper *technology* market, nor in the market for *goods* embodying Clipper technology.[165]

B. Technology Markets Classified in Relation to Other Technologies

As noted earlier, technology markets consist of intellectual property and its close substitutes, including alternative technologies to which buyers could turn in response to the exercise of market power.[166] Thus an important issue in technology market definition is the economic relationship between the primary technology at issue and other technologies that may or may not be properly included in the relevant market. A market in which there are no close substitutes for the primary technology can be classified as an *intra-modal* technology market (all competition occurring among holders of *substantially similar technology*), while a market in which there are close substitute technologies for the primary technology can be classified as an *inter-modal* technology market (competition among *different technologies* that perform a similar function or task).[167]

1. Intra-Modal Versus Inter-Modal Technology Competition

The *American National Can* case offers an example of an intra-modal technology market. As noted earlier, in that case the DOJ concluded that there were no other technologies that could be counted as reasonably interchangeable substitutes for laminated tubes as methods

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165. *Cf.* IP GUIDELINES, *supra* note 1, § 3.3 (licensing complementary intellectual property establishes vertical relationship when licensor and licensee would not have been competitors but for the license).

166. *See id.* § 3.2.2.

167. Consider as a semi-hypothetical example the provision of transportation between New York and Washington, D.C. If the route were served by passenger trains and no other forms of transportation, the relevant market for travel between New York and Washington would be *intra-modal*. If, alternatively, the same route were served by the same passenger trains as well as by airlines carrying passengers at prices comparable (on a quality-adjusted basis) to those charged for train service, the competition would be *inter-modal*, i.e., between the train and plane modes. *See generally* KENNETH D. BOYER, PRINCIPLES OF TRANSPORTATION ECONOMICS 86–89 (1997) (analyzing demand for intercity passenger transportation among competing modes). Another example of inter-modal competition is analyzed in Raymond Hartman et al., *Assessing Market Power in Regimes of Rapid Technological Change*, 2 INDUS. & CORP. CHANGE 317, 325–33 (1993) (describing competition among medical diagnostic technologies).

of packaging toothpaste and certain pharmaceuticals.[168] Thus there was no inter-modal competition in the laminated tube-making technology market. Rather, whatever competition existed in the technology market was intra-modal competition among a few substantially similar alternative technologies for producing laminated tubes.[169]

In contrast, a recent enforcement action involving direct broadcast satellite technology ("DBS") offers an example of an inter-modal technology market. In *United States v. Primestar Inc.*, [170] the DOJ Antitrust Division challenged the proposed acquisition of DBS capacity by Primestar, an entity controlled by five large cable television companies.[171] The DOJ explained in its complaint: "The relevant product market affected by this transaction is the delivery of multiple channels of video programming directly to the home. *The programming can be delivered via a number of distinct methods, including cable, satellite or wireless technologies*."[172] Under the DOJ's theory of harm to competition, the transaction would have been anticompetitive because cable and DBS technologies compete in the relevant market for the provision of multi-channel video programming ("MCVP") distribution.[173]

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168. *See supra* Part III.A.1.

169. *See id.*

170. No.1:98CV01193 (D.D.C. filed May 12, 1998). To be sure, the *American National Can* technology market is a purer example of the type of technology market contemplated in the *IP Guidelines* than is the *Primestar* technology market. The *American National Can* technology market is an input market composed exclusively of patented technology and unpatented know-how. The cable, satellite, and wireless video programming delivery "technologies" referred to in the *Primestar* complaint are technical methods combining unpatented know-how, patented technology, and goods embodying patented technology. Thus cable video programming delivery and DBS video programming delivery are competing, proprietary "technologies" in the sense that the term "technology" is used in everyday discourse. But neither technology is solely or principally "licensed intellectual property and its close substitutes." IP GUIDELINES § 3.2.2. While the differences are significant, *Primestar* may be properly included in this discussion of inter-model technology competition for several reasons. First, the DOJ complaint expressly frames the antitrust issue as one of competition among different technologies performing the same function. Second, high-technology processes tend to have a significant intellectual property component, even where the intellectual property is primarily embodied in technical equipment. Third, the primary concern in the *Primestar* case, as in a pure *IP Guidelines* technology market case such as *American National Can*, is with competition among technical methods in an input market.

171. The transaction was challenged both under section 7 of the Clayton Act as an unlawful merger, and under section 2 of the Sherman Act as monopolization.

172. *Id.* ¶ 62 (emphasis added).

173. *See id.* ¶¶ 76–78, 83. The DOJ argued that if Primestar acquired DBS capacity, the firm would favor the interests of cable television — the MCVP technology of its principal owners — rather than using its DBS capacity to compete aggressively to take MCVP business away from the cable interests. *Id.* ¶ 86. The parties abandoned the

2. Intra-Modal Versus Inter-Model Competition in the *Microsoft* case

The DOJ's prosecution of Microsoft[174] is a prominent example of a technology market case in which the existence and nature of inter-modal competition is vigorously contested. As noted earlier, the district court in that case found two relevant markets: (1) "the licensing of all Intel-compatible PC operating systems world-wide"[175] and (2) "Web browsing functionality."[176]

According to the district court, the OS market is effectively limited to the Microsoft *Windows* operating system because of high switching costs or "lock-in" and the unique functional characteristics of the personal computer.[177] Specifically, the court found that consumers will not readily switch from Intel-based PCs to non-Intel-based computers because of the high cost of purchasing and learning to use new non-Intel-based computers.[178] Consumers will not switch from the *Windows* Intel-compatible OS to non-Intel-compatible OSs because of the dearth of application software written (or likely to be written) for alternative operating systems.[179] The court concludes, moreover, that "information appliances" — hand-held computers, "smart" telephones, television set-top boxes, and computer game consoles — do not compete with Intel-compatible PCs and are not likely to do so "for the foreseeable future."[180] Microsoft counters that the *Windows* OS competes with the

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transaction five months after the filing of the DOJ complaint. *See* Press Release, Department of Justice, Joel Klein Statement Regarding Primestar Abandoning Deal to Acquire News Corp./MCI's Direct Broadcast Satellite Assets (Oct. 14, 1998), *available at* http://www.usdoj.gov/atr/public/press_releases/1998/1988.htm. For a pre-*IP Guidelines* example of a similar technology market, see U.S. v. FCC, 652 F.2d 72, 81 (D.C. Cir. 1980) (affirming the Federal Communications Commission's determination that the relevant "market includes both satellite and terrestrial specialized communication services").

174. Complaint, United States v. Microsoft *Corp.*, No. 98–1232 (D.D.C. filed May 18, 1998).

175. *Microsoft*, 65 F. Supp. 2d 1, 5 (D.D.C. 1999) (findings of fact).

176. *Id.* at 49. In its findings, the district court essentially adopted the two relevant markets proposed by the DOJ in its complaint: (1) "personal computer operating systems" and (2) "Internet browsers." *United States v. Microsoft Corp.*, No. 98–1232 (D.D.C. filed May 18, 1998).

177. *Microsoft*, 65 F. Supp. 2d at 16 (consumers cannot abandon Microsoft *Windows* "without incurring substantial costs").

178. *Id.* at 5. Switching costs would also include the replacement of application software and the purchase of new peripheral devices.

179. *See id.* at 9–10. The court calls this the "applications barrier to entry." Consumers will not switch to a new OS unless there is an adequate selection of application software available to run with the new OS, and application software developers are hesitant to develop software for an OS that has few users.

180. *Id.* at 7.

Apple Macintosh, workstations "running some variant of the UNIX operating system," and "middleware such as Netscape's Web browsing software and Sun's Java," among other products.[181] The company also contests the court's finding with regard to information appliances:

> Within the next few years, if not already, consumers who use their computers primarily 'for storing addresses and schedules, for sending and receiving E-mail, for browsing the Web, and for playing video games' also will be able to choose an 'information appliance' such as a handheld personal computer, a 'smart' wireless telephone or a television set-top box.[182]

Applying analysis that is consistent with both traditional and *IP Guidelines* market definitions, the court bases its relevant market determination principally on its assessment of the likelihood, in the short term, of significant demand-side substitution in response to a supra-competitive price increase.[183] Significantly (for purposes of examining the issue of inter-modal technology competition), Judge Jackson excludes from the relevant markets the alternative technologies offered by information appliances because: (a) he is not persuaded that information appliances are reasonably interchangeable substitutes for personal computers, and (b) he believes that if such appliances will ever *become* reasonably interchangeable substitutes for Intel-compatible PCs or web browsers, it will not be within the short-term time horizon — "the next few years"[184] — to which his relevant market analysis, like that of traditional and *IP Guidelines* relevant market analyses, is limited.

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181. Defendant Microsoft Corporation's Proposed Conclusions of Law, United States v. Microsoft Corp., 97 F. Supp. 2d 59 (D.D.C. 2000) (arguing that Microsoft "competes on both product development and pricing to prevent itself from being displaced by rival platform vendors"), *at* http://www.microsoft.com/presspass/trial/p-col/col.asp. Variants of the UNIX operating system would presumably include the LINUX operating system, an open-source OS based on UNIX. *See, e.g.*, Stephen Shankland, *Dell Sells Laptops with Linux*, CNET NEWS.COM (Feb. 1, 2000), *at* http://www.canada.cnet.com/news/0-1003-200-1538576.html.

182. Defendant Microsoft Corporation's Proposed Conclusions of Law, *supra* note 181.

183. *See Microsoft*, 65 F. Supp. 2d at 5–6 ("[I]f one firm controlled the licensing of all Intel-compatible PC operating systems world-wide, it could set the price of a license substantially above that which would be charged in a competitive market and leave the price there for a significant period of time without losing so many customers as to make the action unprofitable.").

184. *Id.* at 7.

The court's exclusion of information appliances from the relevant markets is substantially based on its finding that "no single type of information appliance, nor even all types in the aggregate, provides all of the features that most consumers have come to rely on in their PC systems and in the applications that run on them."[185] This assessment raises questions that are relevant to the issue of inter-modal competition in technology market definition. The first is a question of fact: is the court correct in asserting that "*most consumers* have come to rely on" a certain constellation of PC features that no single type or combination of appliances can provide? This point, like most of the *Microsoft* findings of fact, is presented without citation to the trial record or any documentary evidence, and is open to good-faith debate.[186] The second question raised by Judge Jackson's exclusion of information appliances is whether, for purposes of technology market definition, a number of *parts* can compete with a *whole*.[187] That is to say, if we accept the proposition that the PC represents a desirable combination of features for

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185. *Id.*

186. The information appliance industry is premised, at least in part, on the business judgment that Judge Jackson is wrong. *See, e.g.*, Robert A. Guth, *Inside Sony's Trojan Horse*, WALL ST. J., Feb. 25, 2000, at B1 (manufacturer of video game console seeks "to dominate a new wave of Internet gadgets and services, just as U.S. PC companies have ruled the first wave"); Walter S. Mossberg, *A Simple New Gadget Lets You Go Online Without Using a PC*, WALL ST. J., Jan. 27, 2000, at B1 (product review of Netpliance "I-Opener" internet access information appliance concluding that the product is "a good option for both novice Internet users who disdain a PC and veteran PC owners who want a cheap second Internet access device); Andy Reinhardt et al., *The Soul of a New Refrigerator*, BUS. WEEK, Jan. 17, 2000, at 42 (PC industry technology leaders are reacting to "slowing growth and plunging prices" in the conventional PC business by offering Internet appliances); Molly Williams, *Facing Computer Slowdown, Intel Boosts Focus on Consumer Devices*, WALL ST. J., Jan. 2, 2001, at A9 (in response to lower demand for PCs and understanding that "[n]ew computers pack more power than most users need," a leading PC microprocessor manufacturer is introducing internet appliance products). The Japanese preference for accessing the Internet via mobile phones rather than PCs is also worthy of note. *See* Clay Chandler, *In Japan, the Internet Without the PC*, WASH. POST, Feb. 8, 2000, at E1 ("While nearly everyone in the United States logs on over a computer, nearly 6 million of Japan's 17.5 million Internet users — fully 34 percent — gain access through mobile phones."); *see also* William Echikson & Andy Reinhardt, *Suddenly, PCs Are Falling Flat*, BUSINESS WEEK, Dec. 11, 2000 (noting declining demand for PCs and increasing demand for non-PC internet access devices among European consumers).

187. The court's characterization of the PC market is reminiscent of the "cluster" markets that have been found in some antitrust cases. *See, e.g.*, United States v. Connecticut Nat'l Bank, 418 U.S. 656, 664–66 (1974) (relevant market is cluster of commercial banking services including credit, checking and trust administration); JBL Enters. v. Jhirmack Enters., 698 F.2d 1011, 1016–17 (9th Cir. 1983) (relevant market consists of complete lines of shampoos sold to wholesalers because wholesalers did not usually purchase individual shampoo products).

some consumers, could technologies offering a more limited set of features nevertheless constrain the ability of a PC operating systems monopolist to charge supra-competitive prices?[188]

Today, consumers considering a PC purchase have a choice between buying a now-familiar product — the PC — at a low retail price, on the one hand, or experimenting with a relatively new information appliance that can only deliver some of the features offered by a PC. If Judge Jackson's assessment of the market is correct, we should not expect significant substitution away from PCs in the next few years, and information appliances will not constrain the pricing of PC input monopolists. If, on the other hand, a significant number of consumers welcome the opportunity to purchase information appliance technologies that allow them to pay a fraction of the PC's price in exchange for the specific *subset* of PC functions that is of use to them, such technologies might constrain the pricing of a PC input monopolist.[189] In that case, information appliances would be properly included in the market, even though they offer only a subset of the functions offered by the PC.

V. OBJECTIONS TO TECHNOLOGY MARKET ANALYSIS

This Section considers three arguments against technology market analysis. The first argument, extrapolated from the policy debate over innovation market analysis, questions the viability and wisdom of defining relevant markets for research and development ("R&D") efforts in advance of the commercial distribution of goods embodying that R&D as an input. The second argument questions the application of relevant product market analysis, whether in its traditional or *IP Guidelines* form, to high-technology industries. The third argument maintains that technology market analysis is impractical because of the difficulties in assessing the competitive significance of intellectual property.

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188. *Cf.* James A. Keyte, *Market Definition and Differentiated Products: The Need for a Workable Standard*, 63 ANTITRUST L.J. 697, 702 (1995) (noting "cross-elasticity of demand analysis between two products does not take into account the potentially constraining effect of *multiple imperfect substitutes*") (emphasis added).

189. There are some indications that the PC industry may already perceive information appliances as a potential competitive threat. *See, e.g.*, Walter S. Mossberg, *Compaq's New Series Has a Quaint Old Look and Slick New Features*, WALL ST. J., Jan. 6, 2000, at B1 (reporting that a new line of personal computers is designed to compete with "the impending wave of Internet appliances").

A. When Technology Markets Are Like Innovation Markets

As noted earlier, the three types of relevant markets identified in the *IP Guidelines* — goods, technology, and innovation — substantially overlap.[190] The distinction between a future-goods *technology* market — a market for intellectual property to be used in goods that do not yet exist — and an *innovation* market "consisting of research and development directed toward new or improved goods or processes," is at least somewhat unclear.[191] Since an innovation market consists of "*research and development* directed toward new or improved goods or processes,"[192] it would be tempting to conclude that such research and development is in all cases distinguishable from technology markets for "licensed [intellectual property] and its close substitutes."[193] However, a "research and development" effort may include a substantial intellectual property component.[194] =If there are current market transactions in intellectual property used in R&D efforts, those current transactions may justify defining a technology market as well as, or instead of, an innovation market.[195]

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190. *See supra* Part I.D.

191. One critic of innovation market analysis has argued that, in practice, the "innovation markets" defined by the FTC and the DOJ in enforcement actions have actually been markets for "future goods." *See* Lawrence B. Landman, *Did Congress Actually Create Innovation Markets?*, 13 BERKELEY TECH. L.J. 721 (1998); Lawrence B. Landman, *Competitiveness, Innovation Policy, and the Innovation Market Myth: A Reply to Tom and Newberg on Innovation Markets as the "Centerpiece" of "New Thinking" on Innovation*, 13 ST. JOHN'S J. LEGAL. COMMENT. 223 (1998). This author's principal concern seems to be that it may be misleading to "managers and lawyers" for the antitrust enforcement agencies to characterize "future-goods" markets as markets for "innovation." *Id.* at 235. *But see* IP GUIDELINES, *supra* note 1, § 3.2.3 ("An innovation market consists of the research and development *directed to particular new or improved goods* or processes, and the close substitutes for that research and development.") (emphasis added); *see also* FEDERAL TRADE COMMISSION STAFF, ANTICIPATING THE 21ST CENTURY: COMPETITION POLICY IN THE NEW HIGH-TECH, GLOBAL MARKETPLACE, ch. 7, at 12 (1996) (interpreting the *IP Guidelines* "innovation market" definition to mean that "[t]he R&D at issue [when the staff applies innovation market analysis] must be 'directed to particular new or improved *goods* or processes'") (emphasis added).

192. IP GUIDELINES, *supra* note 1, § 3.2.3 (emphasis added).

193. *Id.* at § 3.2.2.

194. The complaint in the FTC's case against the *Ciba-Geigy/Sandoz* merger, discussed above in Section III.A.2, illustrates the overlap between the innovation and future-goods technology market concepts. The complaint's relevant market section begins by alleging that: "One relevant line of commerce in which to analyze the effects of the proposed merger is gene therapy *technology* and *research and development* of gene therapies . . . ." Complaint, *In re* Ciba-Geigy Ltd., 123 F.T.C. 842 (1997) (emphasis added).

195. *Id.*

Given the overlap between the innovation market and future-goods technology market concepts, it is worth considering whether the latter may be vulnerable to the vigorous critique that has been directed at innovation market analysis. That critique rejects innovation market definition as unworkable and fraught with unacceptable risk.[196] Critics of innovation market analysis maintain that it is beyond the capacity of courts or the agencies to identify and assess accurately the competitive significance of R&D efforts.[197] Since innovation competition cannot be reliably identified and assessed, the exercise of defining innovation markets and using them as a basis for antitrust enforcement decisions serves only to increase the likelihood of false-positive enforcement determinations — finding violations where there are none — which may have the perverse effect of stifling innovation before it has begun.[198]

To what extent does the innovation market critique apply to future-goods technology market analysis? Perhaps the best answer is that although one important element of the critique may apply in some cases, the differences between the inquiries exempt future-goods technology market analysis from the brunt of the anti-innovation-market critique.

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196. The critics of innovation market analysis include: George A. Hay, *Innovations in Antitrust Enforcement*, 64 ANTITRUST L.J. 7, 16 (1995) ("There is absolutely no basis for believing that the structure of the [Merger] Guidelines specifically associating given market share thresholds with a high likelihood of reduced competition and higher prices for a given product, can be carried over to an analysis of market shares of R&D inputs in an innovation market."); Robert J. Hoerner, *Innovation Markets: New Wine in Old Bottles?*, 64 ANTITRUST L.J. 49 (1995); Lawrence B. Landman, *Did Congress Actually Create Innovation Markets?*, 13 BERKELEY TECH. L.J. 721 (1998); Richard T. Rapp, *The Misapplication of the Innovation Market Approach to Merger Analysis*, 64 ANTITRUST L.J. 19, 20 (1995) ("The innovation market approach represents a leap into the unknown, with a potential for harm to economic welfare as great as any potential benefit."); Aziz, *supra* note 3, at 513 ("By defining innovation markets, the IP Guidelines only serve to decrease the predictability of antitrust enforcement in mergers and acquisitions."); Nicholas A. Widnell, Comment, *The Crystal Ball of Innovation Market Analysis in Merger Review: An Appropriate Means of Predicting the Future?*, 4 GEO. MASON L. REV. 369 (1996).

197. *See, e.g.*, Rapp *supra* note 196, at 45 ("The problem, simply put, is that R&D competition is more complicated than price competition, and the incentives, path of progress, and outcomes are much harder to predict."); Widnell, *supra* note 196, at 391 ("The [antitrust] enforcement agencies do not have the fact-finding ability to effectively determine the impact of mergers on innovation markets.").

198. *See, e.g.*, Richard T. Rapp, Should Antitrust Enforcers Rely on Potential Competition Analysis or the Concept of Innovation Markets?, Written Testimony Before the Federal Trade Commission Hearings on Global and Innovation-Based Competition (Oct. 25, 1995) (arguing that the speculative nature of innovation market analysis increases risks of challenging transactions that have no anticompetitive effects), *available at* http://www.ftc.gov/opp/hearings.htm; Widnell, *supra* note 196, at 391 ("The probability and social cost of 'false positives' [through the application of innovation market analysis] is substantial.").

For while it is true that licensed intellectual property can be part of a research and development effort, technology market definition is not concerned with the identification and assessment of *R&D competition.* It is only concerned with delineating markets for technology and determining what close substitutes to include therein.[199] Thus the principal element of the innovation market critique relating to R&D competition — i.e., that antitrust decision-makers cannot reliably assess the competitive significance of R&D efforts — is inapposite to technology market definition. However, the part of the innovation market critique that cautions against defining markets that bear too little connection to markets for goods is another matter. In some cases, the connection between a future-goods intellectual property transaction and any actual or potential goods market may be so attenuated that its competitive significance cannot be meaningfully assessed. When intellectual property is so far removed from actual or potential goods that it is not possible to assess its value, relationship to potential competitors, or power to exclude, future-goods technology market definition has no place.

There are, however, some future-goods markets for intellectual property, such as the ones alleged by the FTC in the *VISX* and *Ciba-Geigy* cases, that can be appropriately analyzed as antitrust technology markets. In both of those cases, markets for patent rights — with sophisticated buyers, sellers, and transactions — came into existence years before the emergence of markets for goods.[200] Where there are technology transactions based on informed business judgments of how intellectual property is likely to be used in the creation of future goods, the enforcement agencies and the courts may find a factual basis upon which to assess whether a given transaction could permit a hypothetical intellectual property monopolist to exercise market power in markets for the technology and/or for future goods for which the technology may constitute an essential input. In the absence of such market indicia, decision-makers should refrain from defining technology markets.

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199. *See* IP GUIDELINES, *supra* note 1, § 3.2.2; *see also supra* Part I.D.

200. *See* VISX, Inc, 1999 FTC LEXIS 23 (F.T.C. 1999) (initial decision) (describing a transaction in the technology market that predated commercial provision of PRK laser surgery by several years), *at* http://www.ftc.gov/os/1999/9906/index.htm; *Ciba-Geigy*, 62 Fed. Reg. 409 (1997) (analysis to aid public comment) (noting that while no commercial gene therapy products existed at the time of the proposed merger, gene therapy treatments were in clinical trials progressing toward FDA approval).

B. Market Definition for High-Technology Industries

The second argument against technology market analysis questions whether the traditional tools of antitrust relevant market analysis should be applied to so-called high-technology industries. Over the past several years, questions concerning the application of antitrust analysis to high-technology industries have sparked considerable debate.[201] In this debate, some argue that competition in high-technology industries is fundamentally different from competition in other industries, and that antitrust policy must change in order to take account of the differences.[202] The other side of the debate typically acknowledges the

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201. *See, e.g.*, Jorde & Teece, *supra* note 3; FEDERAL TRADE COMMISSION STAFF, ANTICIPATING THE 21ST CENTURY: COMPETITION POLICY IN THE NEW HIGH-TECH, GLOBAL MARKETPLACE (1996) [hereinafter FTC STAFF REPORT]; DWIGHT R. LEE & RICHARD B. MCKENZIE, TECHNOLOGY, MARKET CHANGES, AND ANTITRUST ENFORCEMENT (2000); CARL SHAPIRO & HAL R. VARIAN, INFORMATION RULES: A STRATEGIC GUIDE TO THE NETWORK ECONOMY (1999); William J. Baer & David A. Balto, *Antitrust Enforcement and High-Technology Markets*, 5 MICH. TELECOMM. TECH. L. REV. 73 (1998–1999); Raymond Hartman et al., *Assessing Market Power in Regimes of Rapid Technological Change*, 2 INDUS. & CORP. CHANGE 317 (1993); Andrew C. Hruska, *A Broad Market Approach to Antitrust Product Market Definition in Innovative Industries*, 102 YALE L.J. 305 (1992); Joseph Kattan, *Antitrust Analysis of Technology Joint Ventures: Allocative Efficiency and the Rewards of Innovation*, 61 ANTITRUST L.J. 937 (1993); Janusz A. Ordover & William Baumol, *Antitrust Policy and High-Technology Industries,* 4 OXFORD REV. ECON. POL'Y 13 (1988); Janusz A. Ordover & Robert D. Willig, *Antitrust and High-Technology Industries: Assessing Research Joint Ventures and Mergers*, 28 J.L. & ECON. 311 (1985); Joel I. Klein, The Importance of Antitrust Enforcement in the New Economy, Address Before the New York State Bar Association Antitrust Law Section Program (Jan. 29, 1998) (remarks by the Assistant Attorney General for Antitrust), *available at* http://www.usdoj.gov/atr/public/speeches/1338.htm; Robert Pitofsky, Antitrust Analysis in High-Tech Industries: A 19th Century Discipline Addresses 21st Century Problems, Remarks Before the American Bar Association Section of Antitrust Law's Antitrust Issues in High-Tech Industries Workshop (Feb. 25, 1999) (remarks by the Chairman of the FTC), *available at* http://www.ftc.gov/speeches/pitofsky/hitch.htm. Constance K. Robinson, Leap-Frog and Other Forms of Innovation: Protecting the Future for High-Tech and Emerging Industries Through Merger Enforcement, Address Before the Practicing Law Institute (Mar. 20, 1999) (remarks by the Director of Operations and Merger Enforcement of the DOJ Antitrust Division), *available at* http://www.usdoj.gov/atr/cases/f2400/2482.htm.

202. *See, e.g.*, LEE & MCKENZIE, *supra* note 201, at 17 (arguing that antitrust enforcement against high-tech firms represents the interests of those firms that have lost the competition for leadership in the marketplace and thereby impedes technological progress); Hruska, *supra* note 201, at 311 (proposing a "broad market" test that would define relevant product markets for high-tech industries to include many more actual and potential competitors than under traditional relevant market analysis); David J. Teece & Mary Coleman, *The Meaning of Monopoly: Antitrust Analysis in High-Technology Industries*, 43 ANTITRUST BULL. 801, 803 (1998) (arguing that limitations of existing analytical tools make it much more likely that antitrust enforcement in high-tech industries will harm competition).

advent of new high-technology industries, but argues that established antitrust policy can be applied to such industries as appropriately as it is applied to any others.[203]

Although there is no standard definition of a new high-technology industry, the commonly cited characteristics of such industries are as follows: (1) high-technology firms derive much of their value and competitive significance from their capacity to establish and maintain technological leadership;[204] (2) high-technology industries are often characterized by "network effects" which offer enormous competitive advantages to the firm that is able to establish a network around its proprietary technology;[205] (3) a firm that wins an innovation "race" in a high-technology industry may be able to dominate that industry for a substantial period of time;[206] (4) competition in such industries may not fit the traditional economic model in which several current producers of substantially similar goods compete on the basis of price;[207] (5) instead, competition in high-technology industries is often characterized by periods of dominance by a leading firm, followed by "leap-frog" technological innovation which allows another firm to displace the existing technology, not with a cheaper version of the existing technology, but with a substantially new technology that redefines the industry and establishes a new dominant firm.[208] Significantly, Judge

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203. *See, e.g.*, Pitofsky, *supra* note 201 (acknowledging that high-tech industries are different, but arguing that "antitrust should — indeed must — continue to apply"); *see also* Baer & Balto, *supra* note 201, at 73; Klein, *supra* note 201.

204. *See, e.g.*, Teece & Coleman, *supra* note 202, at 804–08 (describing high-tech industries as characterized by fierce technological competition); Pitofsky, *supra* note 201, at 2 (noting technological complexity of high-tech industries).

205. *See, e.g.*, FTC STAFF REPORT, *supra* note 201, ch. 9, at 1 ("With the rise of communications and computer industries, to name two obvious examples, the importance of standards and networks to our modern economy generally, and to certain industries in particular, has increased dramatically."); SHAPIRO & VARIAN, *supra* note 201, at 173 ("the new information economy is driven by the *economics of networks*") (emphasis in the original); Teece & Coleman, *supra* note 201, at 814 (network effects are characteristic of high-technology industries); Pitofsky, *supra* note 201, at 3 (noting network effects in high-tech industries).

206. *See, e.g.*, Hartman et al., *supra* note 201, at 319 (arguing that temporary period of monopoly is characteristic of innovation competition and offers the reward that makes such competition economically viable); Michael Katz & Carl Shapiro, *Network Externalities, Competition, and Compatibility*, 75 AM. ECON. REV. 424, 437 (1985) (describing winner-take-all competition in high-tech industries with network externalities); *see also* FTC STAFF REPORT, *supra* note 201, ch. 1 at 24 (noting costs and rewards of being first to market with product innovation, as opposed to product imitation).

207. *See generally* Teece & Coleman, *supra* note 201, at 826–28.

208. *See generally* Hartman et al., *supra* note 201, at 319–21; Teece & Coleman, *supra* note 33, at 804–10; *see also* JAMES M. UTTERBACK, MASTERING THE DYNAMICS

Jackson describes this type of competition in the *Microsoft* findings of fact:

> The software industry in general is characterized by dynamic, vigorous competition. In many cases, one of the early entrants into a new software category quickly captures a lion's share of the sales, while other products in the category are either driven out altogether or relegated to niche positions. *What eventually displaces the leader is often not competition from another product within the same software category, but rather a technological advance that renders the boundaries defining the category obsolete.* These events, in which categories are redefined and leaders are superseded in the process, are spoken of as 'inflection points.'[209]

To apply standard, static relevant market analysis (including, by implication, both the traditional and *IP Guidelines* technology market forms) to such high-technology markets is, it is argued, inappropriate and likely to lead to erroneous determinations.[210] High market shares may only reflect first-mover advantages or the fruits of winning a hard-fought competition to become the industry standard. Moreover, the traditional static inquiry into likely demand-side substitution in response to a small but significant and nontransitory price ("SSNP") increase may tell antitrust decision-makers very little about the nature of competition in such industries.[211] Even if there are no current substitutes and no firms on the demand side that could be identified as capable of entering the existing market within two years in response to a SSNP increase, the market may still be extremely competitive. That competition would flow not from current producers of similar goods, but from the specter of

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OF INNOVATION (1996) (describing case studies of the disruptive effects of technological innovation).

209. *United States v. Microsoft*, 65 F. Supp 2d 1, 16 (D.D.C. 1999) (findings of fact) (emphasis added). The term "inflection points" may have been borrowed from Andrew Grove's account of high-technology competition in ONLY THE PARANOID SURVIVE: HOW TO EXPLOIT THE CRISIS POINTS THAT CHALLENGE EVERY COMPANY AND CAREER 32–33 (1996) ("An inflection point occurs where the old strategic picture dissolves and gives way to the new.").

210. *See generally* Hartman et al., *supra* note 201, at 321–25; Teece & Coleman, *supra* note 202, at 826–28.

211. *See* HORIZONTAL MERGER GUIDELINES, *supra* note 31, § 1.11 (stating that a relevant market includes products buyers would turn to in response to a "small but significant and nontransitory price" increase by a hypothetical monopolist).

technological innovation competition that could displace the dominant high-technology firm at any moment. As long as a market is open to innovation competition, according to this argument, it is competitive in the only sense that matters for high-technology industries.[212]

What, then, are the implications of the high-technology industries argument for technology market analysis? As with the innovation market critique, the arguments over high-technology industries have some application, but do not fundamentally undermine the case for technology market analysis. By its own terms, the high-technology industries argument applies only to a small, albeit important, subset of all industries. Thus the prosaic *American National Can* market for laminated tube technology[213] may be more representative of the typical technology market case than the quintessentially high-technology *Microsoft* market for PC operating systems.[214]

There is, nevertheless, an important place for the high-technology industries critique as a source for informed advocacy that would seek to modify technology market analysis to take account of the nature of competition in specific industries. In cases that fall within the rubric of technology market analysis, firms may have opportunities to present evidence and argument tending to establish that a specific industry under review is a high technology industry.[215] It might be argued, for example, that in such an industry a dominant firm is constrained by the prospect of innovation competition, even if it appears nearly invulnerable when viewed in traditional, static terms.[216] Alternatively, the case might be

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212. *See* Teece & Coleman, *supra* note 202, at 825 (arguing that "monopoly power" exists in high-technology industries when a leading firm is "shielded from entry, i.e., insulated from competition from other innovators and imitators"); *see also* Frank H. Easterbrook, *Ignorance and Antitrust*, *in* Jorde & Teece, *supra* note 201, at 122–23. According to Easterbrook:

> An antitrust policy that reduced prices by 5 percent today at the expense of reducing by 1 percent the annual rate at which innovation lowers the costs of production would be a calamity. In the long run a continuous rate of change, compounded, swamps static losses.

Id.

213. *See supra* Part III.A.1.

214. *See supra* Parts III.A.1. & III.B.2.

215. In this regard, Microsoft's advocacy in the current case has generally been quite traditional. While pointing out, for example, that consumers will be able to choose "information appliances" as alternatives to the PC "[w]ithin the next few years, if not already," Microsoft offers no alternative theory upon which to base the inclusion of the coming wave of Internet access devices in the relevant market for the Windows operating system. Defendant Microsoft Corporation's Proposed Conclusions of Law 40, United States v. Microsoft, CA No. 98–1232 (TPJ) (Jan. 18, 2000).

216. Teece & Coleman, *supra* note 202, at 825 (noting that monopoly power is not

made that a longer time horizon for entry or a broader definition of actual and potential competition should be applied under certain circumstances.[217] While there is no broadly-accepted analytical approach to such arguments, they merit serious consideration on a case-by-case basis.[218] With time and experience, it may be possible to develop workable, transparent, and consistent analytical tools for determining whether and under what circumstances technology market analysis can be modified to take account of the nature of competition in specific high-technology industries.

C. Is Technology Amenable to Market Definition?

A third argument against technology market definition holds that licensed technology is fundamentally ill-suited to the traditional relevant product market inquiry that has been developed for the analysis of markets for goods.[219] The inquiry into the availability of substitutes for technology is, according to this argument, likely to be frustrated by the non-standard nature of patent claims[220] and the problem of predicting future goods competition.[221] The effort to ascertain prices for technology — and thereby understand the technology's price in relation to possible substitutes — also will be undermined by the non-royalty terms in technology licensing agreements.[222] More specifically, common non-royalty provisions in technology licenses — such as grantbacks, cross-licensing, and exchanges of technical assistance — make it

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defined by high market share or profits, but by insulation from "competition from other innovators and imitators").

217. *See, e.g.*, Hartman et al., *supra* note 201, at 333–44 (proposing a market definition methodology based on performance competition, rather than price competition, for a market experiencing rapid technological change); Hruska, *supra* note 201, at 311 (proposing a "broad market" test that would define relevant product markets for high-technology industries to include all products that compete with any of a firm's products).

218. While high-technology arguments are relatively new, the process of testing the law on a case-by-case basis is consistent with the common-law development of antitrust doctrine.

219. This argument is developed at length in Aziz, *supra* note 3, at 485–500.

220. *See id.* at 487–89.

221. *See id.* at 494–97; *see also* David J. Teece, *Capturing Value From Knowledge Assets: The New Economy, Markets for Know-How, and Intangible Assets*, 40 CAL. MGMT. REV. 55, 68 (1998) (contrasting relatively high "tradeability" of physical commodities with relatively low "tradeability" of know-how and intellectual property).

222. *See* Aziz, *supra* note 3, at 489–94; *see also* Christian Bessy & Eric Brousseau, *Technology Licensing Contracts: Features and Diversity*, 18 INT'L REV. L. & ECON. 451 (1998) (surveying a broad variety of price and nonprice terms in technology licensing agreements).

impossible to determine the actual price being paid for the licensed intellectual property rights.[223]

The practical objections to technology market analysis are significant and worthy of careful consideration by the courts and the antitrust enforcement agencies. There may well be cases in which the indeterminate nature of the patent claims or the uncertain valuation of non-royalty licensing terms make it impossible to assess the competitive significance of licensed technology. In such cases, technology market definition may not be appropriate. However, these practical objections make a better case for restraint in the application of technology market analysis than for abandoning the enterprise altogether.[224] The basic limitation in market definition, whether for goods or technology, is evidentiary: a relevant market is only as robust as the evidence that can be mustered in its support. If the evidence can be found for defining a technology market inductively in a given case, there seems little sense in refraining from doing so based on *a priori* notions of the nature of intellectual property.

Trends in the U.S. economy and in antitrust enforcement suggest that an increasing number of technology licensing cases will be coming before the courts and the antitrust enforcement agencies.[225] In a significant subset of these cases, it is likely that the firms participating in the relevant markets will have made sophisticated business analyses of the value of the licensed technology based on current market conditions.[226] The indeterminacy of intellectual property rights notwithstanding, technology licensors are obliged to determine a royalty

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223. *See* Aziz, *supra* note 3, at 492 ("By bundling everything together . . . it becomes impossible to isolate what value must be assigned to the technology in question."). An obvious problem with this line of reasoning is that it suggests that technology licensors and licensees do not — and, indeed, cannot — know their own business.

224. *See id.* at 499–500 (arguing that technology market analysis should be abandoned and market definition limited to markets for goods).

225. *See* sources cited *supra* note 6.

226. While there is no standard method of valuing intellectual property, there is no shortage of methods available for doing so. *See, e.g.*, Gavin Clarkson, *Avoiding Sub-Optimal Behavior in Intellectual Asset Transactions: Economic and Organizational Perspectives on the Sale of Knowledge*, 14 HARV. J.L. & TECH. (forthcoming 2001); Kevin G. Rivette & David Kline, *Discovering New Value in Intellectual Property*, 78 HARV. BUS. REV. 54, 62–63 (2000) (suggesting several methods for valuing intellectual property); PRICE WATERHOUSE COOPERS, VALUATION OF INTELLECTUAL PROPERTY ASSETS 8–22 (1999); Alexander K. Arrow, *How Do You Value a Patent — Like an Option, Of Course!* (explaining the patent valuation method used by "pl-x.com" patent trading web site), *at* http://www.pl-x.com/ipcom/arrow/ipc_arrowv1n1_con.shtml (last visited Nov. 3, 1999); ALBERT E. MUIR, THE TECHNOLOGY TRANSFER SYSTEM 91 (1997) (outlining methods for quantifying the value of inventions for purposes of technology transfer).

rate.[227] Technology licensees, for their part, must decide what they are willing to pay. Such determinations are likely to be based on firms' best judgments of (1) what the technology can be used to produce; (2) the power of the intellectual property to exclude others from certain kinds of economic activity; and (3) the availability of substitutes for the technology in question.[228] These judgments typically entail, at a minimum, an assessment of the scope and strength of the intellectual property covering the technology to be licensed. If market participants are able to make such judgments — albeit fallibly and imperfectly — antitrust decision-makers may find also an evidentiary basis for defining technology markets.

VI. CONCLUSION

This article has traced the evolution of technology market analysis — essentially the application of traditional relevant market analysis to markets for intellectual property rights — from its origins through the first few disputes that can fairly be characterized as "technology market" cases. While the concept is still very new and not without its problems, technology market definition can play an important role in antitrust analysis both as a means of identifying sources of market power and of identifying competition that might otherwise be missed were the relevant market inquiry limited to markets for goods. With time and experience, it can be expected that the courts and the antitrust enforcement agencies will develop an understanding of technology markets that will allow for a more rigorous and specialized application of the inquiry in cases involving intellectual property transactions. But whatever emerges from that developmental process, it seems clear enough that the era when relevant markets meant markets for goods alone is behind us. The volume of intellectual property transactions and the growing importance of technology mean that antitrust cannot respond to the changing economy without developing a workable approach to the assessment of competition in markets for technology.

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227. *See generally* Glenn DeSouza, *Royalty Methods for Intellectual Property*, 32 BUS. ECON. 46 (1997) (reviewing common methods for determining royalty rates for intellectual property licensing); Russell L. Parr, *Advanced Royalty Rate Determination Methods*, *in* TECHNOLOGY LICENSING: CORPORATE STRATEGIES FOR MAXIMIZING VALUE 207 (Russell L. Parr & Patrick H. Sullivan eds., 1996). Even if the negotiated license includes a royalty and a non-royalty term, such as a grantback clause, the non-royalty term has an economic value.

228. *See generally* Jack A. Nickerson, *Strategic Objectives Supported by Licensing*, *in* TECHNOLOGY LICENSING: CORPORATE STRATEGIES FOR MAXIMIZING VALUE 63 (Russell L. Parr & Patrick H. Sullivan eds., 1996).

While the trends can be overstated, ours is increasingly an "economy of ideas."[229] Some type of technology market analysis is therefore a necessary response to the changes around us.

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229. John P. Barlow, *The Economy of Ideas*, WIRED, Mar. 1994, *available at* http://www.wired.com/wired/archive/2.03/economy.ideas_pr.html.