Antitrust or Antitrade? Self-Assessment of Market Share Chills the Incentive to License Nanotechnology Patents in the European Union

Robert C. O'Loughlin*

[M]any legitimate market arrangements diminish the number of competitors. It would be odd if they did not, as the nature of competition is to make winners and losers.[1]

I. INTRODUCTION

As the new technological era has ushered in the dawn of a "world market," the ability to compete and thrive in that market has become increasingly important. Technological development is the key to success in the world market.[2] New technologies are being brought to market every day, and with them, the demand for older technologies gives way to the demand for the newest and most advanced technological development. For a business to compete in today's market, it must offer technologies on the forefront of advancement.[3] Likewise, for the United States and the European Union (EU) to maintain dominant positions in the world market, their industries must invest in the development of the latest technologies.[4]

The future of technological development will be shaped by nanotechnology.[5] Although nanotechnology is not new,[6] some of the

* B.S., Physics and Mathematics, Washburn University, 2004; J.D. candidate 2007, Washburn University School of Law. I would like to thank Bob Reader, Vice President of the National Institute for Strategic Technology Acquisition and Commercialization (N.I.S.T.A.C.), Professor Mary Ramirez, Associate Professor of Law, Washburn University School of Law, and Peter Pauzauskie, Ph.D candidate, University of California at Berkeley for their invaluable guidance and indispensable expertise in these areas. I also thank my editors for keeping me "in the margins," and my wife for all of her love, support, and tolerance. A special thanks to my son, Garrett, for putting up with my "computer problem."

1. United States v. Syufy Enters., 903 F.2d 659, 664 (9th Cir. 1990).

2. Dr. Dirk Schuessler-Langeheine, Licensing in the European Union 2 (2006) (unpublished manuscript, on file with author).

3. *See generally Commission Report on the Functioning of Community Product and Capital Markets*, COM (2000) 881. "New technologies are a new high octane fuel available for developed economies . . . ." *Id.*

4. *See* U.S. DEP'T OF JUSTICE, PROGRESS REPORT OF THE DEPARTMENT OF JUSTICE'S TASK FORCE ON INTELLECTUAL PROPERTY, at iii (2006), http://www.usdoj.gov/opa/documents/ipreport61906.pdf.

5. *See* Nicholas M. Zovko, *Nanotechnology and the Experimental Use Defense to Patent Infringement*, 37 MCGEORGE L. REV. 129, 130 (2006).

6. *See, e.g.*, *id.* at 132-35. There has been significant research and development of nanostructures for the last 20 years. *Id.*

field's most important developments have occurred within the last few years.[7] These developments are the precursors to a technology that may have the promise of revolutionizing the world as we know it.[8] To ensure that the nanotechnology market flourishes, both United States and EU companies will need to cooperate within the EU market.[9]

Unfortunately, the EU recently has passed competition[10] legislation that may deter patent licensing by United States and EU companies in the EU market. The new EU legislation includes a Technology Transfer Block Exemption Regulation (TTBER), which exempts certain types of technology transfer agreements from antitrust scrutiny.[11] The TTBER requires parties to the agreement to calculate their combined market share before execution.[12] Parties with combined market shares below certain threshold levels may be exempt from antitrust scrutiny.[13]

While calculating a market share already is a difficult endeavor, the market implications of nanotechnology will significantly complicate the matter. Moreover, if the technology transfer agreement becomes the subject of litigation, a court will be charged with determining the market shares of the parties.[14] If the court's determination differs from that of the parties, the agreement may be declared void. The resulting legal uncertainty is likely to deter companies from licensing nanotechnology in the EU, which would have a negative impact on innovation in the field. Therefore, the EU should abolish the self-assessment requirement

7. *See, e.g.*, Bing Zhou, Ray Balee & Rebecca Groenendaal, *Nanoparticle and Nanostructure Catalysts: Technologies and Markets*, 2 NANOTECH. L. & BUS. 222, 224-29 (2005).

8. *Research: The Enormous Challenge of the Infinitely Small*, TECH EUR., Mar. 14, 2003, at 202, *available at* 2003 WLNR 6451499. The United States National Science and Technology Council (NSTC) reported in 2000 that nanotechnology research and development across the world was reaching "phenomenal levels." Paul C. Lin-Easton, *It's Time for Environmentalists to Think Small – Real Small: A Call for the Involvement of Environmental Lawyers in Developing Precautionary Policies For Molecular Nanotechnology*, 14 GEO. INT'L ENVTL. L. REV. 107, 109 (2001). Representatives of both government and industry have expressed enthusiasm for nanotechnology research. In fact, nanotechnology was one of the Clinton Administration's top priorities. *Id.* at 110. Moreover, as of 2001, the Bush Administration had requested $518.9 million to fund nanotechnology research. *Id.* The Bush Administration requested $1.05 billion in funding for nanotechnology in 2006 after noting government nanotechnology spending of almost $1.1 billion during 2005. NAT'L SCI. & TECH. COUNCIL, THE NATIONAL NANOTECHNOLOGY INITIATIVE, SUPPLEMENT TO THE PRESIDENT'S 2006 BUDGET, at i (2005), *available at* http://www.nano.gov/NNI_06Budget.pdf. For 2007, the budget request is $1.3 billion. NAT'L SCI. & TECH. COUNCIL, THE NATIONAL NANOTECHNOLOGY INITIATIVE, SUPPLEMENT TO THE PRESIDENT'S 2007 BUDGET, at i (2006), *available at* http://www.nano.gov/NNI_07Budget.pdf. This represents a twenty-one percent increase over the 2006 budget request. *Id.*

9. *See* Lin-Easton, *supra* note 8, at 109.

10. The European Commission refers to the laws that regulate competition as "competition law," whereas the United States uses the term "antitrust law." I will use the terms interchangeably throughout this note.

11. Commission Regulation 772/2004, Application of Article 81(3) of the Treaty to Categories of Technology Transfer Agreements, 2004 O.J. (L 123) 11 [hereinafter TTBER].

12. *See* Schuessler-Langeheine, *supra* note 2, at 37-39.

13. TTBER, *supra* note 11, at art. 3.

14. *See* Pat Treacy & Thomas Heide, *The New EC Technology Transfer Block Exemption*, EUR. INTELLECTUAL PROP. REV. 26(9), 414, 419 (2004).

of the TTBER and implement a safe harbor that is similar to that of the United States antitrust laws.

II. BACKGROUND

A. Nanotechnology and Molecular Manufacturing

Nanotechnology refers to the manipulation of matter on the nanoscale, which is defined as the range between 0.1 and 100 nanometers.[15] A nanometer is one billionth of a meter. Nanotechnology research is characterized by several specific endeavors. One of these endeavors is the creation and manipulation of nanostructures.[16] The most well-known nanostructures are named for their geometric structure,[17] and include nanotubes,[18] nanowires,[19] and nanoparticles.[20] These structures have a multitude of applications.[21] The novelty and usefulness of nanostructures are products of their unique characteristics.[22] When matter is reduced to the nanoscale, the characteristics of the particular substance are often vastly different from the characteristics of the same substance at larger scales.[23] For example, carbon nanotubes exhibit unprece-

15. Jennifer Kahn, *Nano's Big Future*, NAT'L GEOGRAPHIC, June 2006, at 100. "Nano, a prefix that means 'dwarf' in Greek, is shorthand for nanometer, . . . a distance so minute that comparing it to anything in the regular world is a bit of a joke." *Id.* "This comma, for instance, spans about half a million nanometers. To put it another way, a nanometer is the amount a man's beard grows in the time it takes him to lift a razor to his face." *Id.* "[N]anotechnology involves imaging, measuring, modeling, and manipulating matter at this length scale." COMM. ON TECH., EXECUTIVE OFFICE OF THE PRESIDENT, NATIONAL NANOTECHNOLOGY INITIATIVE: STRATEGIC PLAN, at iii (2004).

16. Zhou, *supra* note 7, at 222. This is the oldest area of nanotechnology research and has experienced decades of development. *Id.*

17. E-mail from Peter Pauzauskie, Ph.D candidate, Univ. of Cal. at Berkeley, Dept. of Chemistry, to author (Dec. 25, 2006) (on file with author).

18. Carbon nanotubes are "nanometer-scale cylindrical graphitic structures that exhibit extraordinary physical properties as determined by their structure." Diego A. Rey, Carl A. Batt & John C. Miller, *Carbon Nanotubes in Biomedical Applications*, 3 NANOTECH. L. & BUS. 263, 263 (2006).

19. Nanowires are solid wires with nano-scale diameters. John Miller, K.J. Cho & Michael D. McGehee, *A Realistic Assessment of the Commercialization of Nanotechnology: A Primer for Lawyers and Investors*, 1 NANOTECH. L. & BUS. 10, 13 (2004). They generally are made of metals, silicon, or zinc oxide. *Id.*

20. The term nanoparticle includes various structures with a 0-dimensional geometry, such as quantum dots. E-mail from Peter Pauzauskie, *supra* note 17. Quantum dots are semiconducting nanocrystals that have useful electrical and optical properties. Miller, Cho & McGehee, *supra* note 19, at 14.

21. *See, e.g.*, Susan Curtis, *Nanosolar to Build World's Largest Solar Cell Factory*, NANOTECHWEB.ORG, June 21, 2006, http://nanotechweb.org/articles/news/5/6/10/1; Stefan Frank et al., *Carbon Nanotube Quantum Resistors*, SCIENCE, June 12, 1998, at 1744; Dumas Garrett, *Break-Out in Nanotech – The Next Potential Wave of IPOs*, 2 NANOTECH. L. & BUS. 274, 274 (2005); Liz Kalaugher, *Carbon Dots Light Up for Optical Tagging*, NANOTECHWEB.ORG, June 7, 2006, http://nanotechweb.org/articles/news/5/6/1/1 (recognizing applications in "medical imaging, biological sensing and light-emitting diodes"); Zovko, *supra* note 5, at 136 (indicating that nanotechnology will have applications in "consumer products, manufacturing and the environment, energy, the military, medicine, computer hardware, and space travel").

22. J. Peter Paredes, *Written Description Requirement in Nanotechnology: Clearing a Patent Thicket?*, 88 J. PAT. & TRADEMARK OFF. SOC'Y 489, 489-90 (2006).

23. *Id.*

dented characteristics of strength.[24] Other unique characteristics of carbon nanotubes include varying degrees of conductivity,[25] optical absorption and emission,[26] chemical reactivity,[27] various useful mechanical properties,[28] thermal conductivity,[29] flexibility,[30] and thermal durability.[31]

Characteristics such as these will allow nanostructures of various types to find their way into a multitude of familiar products, elevating their performance and durability to a level never before thought possible.[32] In fact, this transition already has begun. For example, nanostructures are currently utilized in the textile industry,[33] enabling manufacturers to create clothing that resists wrinkles and stains.[34] Similarly, at least one company is developing nanofilms that will be used to coat the insides of houses.[35] These nanofilms will be dirt resistant and even self-cleaning,[36] and may eventually allow the house to "maintain its own energy needs."[37]

While nanostructures enable the improvement of many familiar products such as tennis rackets, golf clubs, paints, and cosmetics,[38] the true romance of nanotechnology lies in the current development of molecular manufacturing.[39] Molecular manufacturing is the construction of structures by manipulating individual atoms or molecules, thereby build-

24. Rey, Batt & Miller, *supra* note 18, at 273 (explaining that carbon nanotubes "have the highest tensile yield strength of existing materials"). *See also* Kahn, *supra* note 15, at 106.

> Because of their light, stiff composition, merely sprinkling carbon nanotubes into epoxy strengthens the glue by more than 30 percent. The tubes have also begun turning up in high-end sporting equipment. They strengthen tennis rackets, mountain-bike handlebars, frames for racing bikes, and golf-club shafts. Carbon nanotubes also show promise for use in transparent conductive films for displays on computers, cell phones, PDAs, and automatic teller machines.

Id.

25. Rey, Batt & Miller, *supra* note 18, at 269. For example, metallic carbon nanotubes are able to carry 1000 times more current than copper. *Id.*

26. *Id.*

27. *Id.* at 272.

28. *Id.* at 273.

29. *Id.*

30. *Id.*

31. *Id.* Carbon nanotubes can survive temperatures as high as 2800 degrees Celsius (5072 degrees Fahrenheit). *Id.* Conventional metal wires begin to melt at temperatures between 600 and 1000 degrees Celsius (1112 and 1832 degrees Fahrenheit). *Id.*

32. *See generally* Kahn, *supra* note 15, at 106.

33. *Id.* at 103.

34. *Id.* One scientist, who purchased a pair of pants from the Gap that incorporate nanotechnology, says, "I spilled coffee on them this morning, and it rolled right off." *Id.* (quoting Paul Alivisatos, Associate Director of Physical Sciences at Lawrence Berkeley National Laboratory).

35. Mark Henricks, *The Wave of Next-Generation Innovators*, ENTREPRENEUR, Sept. 2006, at 76, 78, *available at* http://www.entrepreneur.com/article/printthis/165720.html.

36. *Id.*

37. *Id.*

38. These are examples of some products that are currently available with nanoparticle enhancements. Future products may include anything imaginable, from plastic bags to sunglasses.

39. *See generally* K. ERIC DREXLER, ENGINES OF CREATION: THE COMING ERA OF NANOTECHNOLOGY (1996).

ing the desired structure from the bottom up.[40] Currently, most conventional manufacturing is done by a top-down approach.[41] Final products are created from raw materials such as trees, coal, crude oil, and minerals.[42] The raw materials are cut, chopped, filtered, and manipulated to produce materials suited for building the desired product.[43] Most of this processing has the goal of removing matter that is not useful in creating the final product.[44]

In contrast to conventional manufacturing, molecular manufacturing involves building final products one molecule, or atom, at a time by carefully placing them in the exact desired location.[45] The growth of living organisms provides the model for this new technology.[46] Living organisms grow by the replication and meticulous placement of one cell at a time. The nanotechnology community has been studying this process to replicate it as precisely as possible. Researchers suggest that virtually every product currently on the market eventually will be produced in this manner.[47]

Molecular manufacturing, enabled by so-called nanofactories, will redefine industrial efficiency. Nanofactories will contain large numbers of assemblers, nano-scale devices that work together to construct the desired product.[48] Each assembler will be capable of "manipulating individual molecules very rapidly and precisely."[49] The result is a product that is precisely constructed and ready for sale in a fraction of the time that a conventionally manufactured product would be today.[50]

Working in harmony, the developments of nanostructures and molecular manufacturing will enable cross-disciplinary technological advances of almost unimaginable consequence.[51] For example, biotechno-

40. Glenn Harlan Reynolds, *Nanotechnology and Regulatory Policy: Three Futures*, 17 HARV. J.L. & TECH. 179, 181 (2003).

41. Frederick A. Fiedler & Glenn H. Reynolds, *Legal Problems of Nanotechnology: An Overview*, 3 S. CAL. INTERDISC. L.J. 593, 596 (1994).

42. *Id.*

43. *Id.*

44. *Id.*

45. *Id.* at 597. "Full-fledged nanotechnology promises nothing less than complete control over the physical structure of matter – the same kind of control over the molecular and structural makeup of physical objects that a word processor provides over the form and content of a document." *Id.* at 599. "Bottom-up constructions . . . are where the real power of nano lies." Kahn, *supra* note 15, at 108.

46. Fiedler & Reynolds, *supra* note 41, at 597.

47. Briefing Document, Ctr. for Responsible Nanotech., Five-Minute Molecular Manufacturing (Mar. 29, 2006), http://www.crnano.org/BD-5MinMM.htm.

48. Fiedler & Reynolds, *supra* note 41, at 599.

49. *Id.*

50. "A nanofactory, containing vast numbers of nanoscale fabricators working in parallel under computer control, would be able to build a supercomputer in an hour." Ctr. for Responsible Nanotech., *supra* note 47.

51. *Id.*

> As a general-purpose manufacturing technology, molecular manufacturing will be able to build highly advanced products useful in almost every field of endeavor, including medicine, environmental remediation, daily life, housing, humanitarian relief, entertainment,

logical developments enabled by nanotechnology will lead to revolutionary medical applications such as biosensors,[52] drug delivery systems,[53] and tissue generation systems.[54] One primary goal of this development is to improve the treatment of cancer.[55] A myriad of other diseases also will be targeted by this technology.[56] Eventually, "[h]ealth care providers will be able to use devices that both diagnose and precisely treat disease."[57]

Nanotechnology also will enable the enhancement of information technology, a field that already is developing by leaps and bounds.[58] For example, quantum computing may result in processors that are thousands of times smaller than the smallest processors currently on the market.[59] In fact, D-Wave, a Canadian computer company, predicts that by next year, it will be able to build computer chips no bigger than a thumbnail that will be able to simulate the behavior of nanoscale systems "with more computing power than the aggregate total of all computers on the planet today and ever built in history."[60]

Due to the extraordinary capabilities of nanotechnology, the United States military also has a great interest in its development.[61] In

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> computation, transportation, infrastructure, and war. The ability of a personal nanofactory to build another nanofactory in an hour means that manufacturing capacity will not be scarce; because the manufacturing process will be automated and self-contained, the products will be inexpensive to make.

Id.

52. Rey, Batt & Miller, *supra* note 18, at 285.

> The development of new, minute and ultra-sensitive biosensors could lead to personalized diagnostic kits that allow patients to determine their state of health from the comfort of their own homes. By placing a drop of bodily fluid on a small, disposable chip, patients may be able to identify the early onset of disease. The market potential for health care devices with these characteristics is undoubtedly tremendous.

Id.

53. Michael Moradi, *Global Developments in Nano-Enabled Drug Delivery Markets*, 2 NANOTECH. L. & BUS. 139, 140 (2005). "It is estimated that the global market share for nanoparticle-based therapeutics is expected to grow . . . from 0.9% to 5.2% by 2012, comprising a $4.8 billion industry. Carbon nanotubes are among the promising new nanoparticles that can be used for drug and gene delivery." Rey, Batt & Miller, *supra* note 18, at 282.

54. Rey, Batt & Miller, *supra* note 18, at 288. "The engineered generation of functional tissue as such requires scaffolds, and carbon nanotubes are emerging as promising materials in this regard." *Id.* Nano-scaffolds have been used to promote generation of smooth muscle cells, and recently, the regeneration of visual tissue. *See generally* Rutledge G. Ellis-Behnke et al., *Nano Neuro Knitting: Peptide Nanofiber Scaffold for Brain Repair and Axon Regeneration with Functional Return of Vision*, 103 PROC. OF THE NAT'L ACAD. OF SCIS. 5054 (Mar. 20, 2006), *available at* http://www.pnas.org/cgi/reprint/103/13/5054.pdf.

55. Jie Chen & Stephen T.C. Wong, *Nanotechnology in Oncology*, 3 NANOTECH. L. & BUS. 293, 293-94 (2006). "The National Cancer Institute (NCI) of the United States has set a challenge goal to eliminate suffering and death due to cancer by 2015, and nanotechnology plays an important role in achieving this ambition." *Id.*

56. *See id.* at 294.

57. *Id.*

58. Steve Jurvetson, *Transcending Moore's Law with Molecular Electronics and Nanotechnology*, 1 NANOTECH. L. & BUS. 70, 90 (2004).

59. *Id.* at 87-88.

60. *Id.* at 88. "Professor David Deutsch of Oxford summarized: 'Quantum computers have the potential to solve problems that would take a classical computer longer than the age of the universe.'" *Id.*

61. Robert D. Pinson, *Is Nanotechnology Prohibited by the Biological and Chemical Weapons*

fact, the military already is investing substantially in nanotechnology research.[62] The military's continued interest in nanotechnology's application will motivate rapid innovation in the field. Whether developed for the military or the consumer, these innovations will soon permeate the international market, with far-reaching economic implications.

B. The New Market of Nanotechnology

As nanotechnology matures and is incorporated into our everyday products,[63] it will undoubtedly have significant effects on the international market. In fact, Lux Research predicts that fifteen percent of total worldwide manufacturing will be devoted to nanotechnology products by the year 2014.[64] The nanotechnology-enabled market is expected to surpass $2.6 trillion by that time.[65] Although much of nanotechnology involves relatively new scientific research and development, characterizing it as an independent industry is difficult.[66] Instead, nanotechnology will be fully integrated into the existing market

Conventions?, 22 BERKELEY J. INT'L L. 279, 281 (2004).

> A nanotech weapon can be more powerful than any known chemical, biological, or nuclear agent because of the incredibly small size of nanoparticles and their ability to penetrate any material or substance. It can be developed and programmed to attack machines. Nanotechnology can even be used to refine existing chemical or biological weapons to make them more potent, less detectable, and easier to produce. Additionally, because of nanotechnology's small size, it can easily be dispersed in the air or through food or water.

Id.

62. *See, e.g.*, Air Force Research Laboratory, http://www.afosr.af.mil/ResearchAreas/special_durint.htm (last visited Jan. 17, 2007) (Army funded research center); Center for NanoEnergetics Research, http://www.me.umn.edu/~mrz/CNER.htm (last visited Jan. 17, 2007) (Army funded research center); Edgewood Chemical Biological Center, http://www.edgewood.army.mil/ (last visited Jan. 17, 2007) (United States Army RDECOM laboratory); MIT Institute for Soldier Nanotechnologies, http://web.mit.edu/ISN/ (last visited Jan. 17, 2007); U.S. Naval Research Lab - Nanoscience and Technology, http://www.nanosra.nrl.navy.mil/ (last visited Jan. 17, 2007).

63. Many consumer products currently on the shelves contain manufactured nanoparticles. George A. Kimbrell, *Nanomaterial Consumer Products and FDA Regulation: Regulatory Challenges and Necessary Amendments*, 3 NANOTECH. L. & BUS. 329, 329 (2006). Recent research has shown that there are approximately 116 cosmetics, sunscreens, and other personal care products incorporating nanoparticles. *Id.* at 331-32; Alessandro Zago, *Nanomaterials: Disrupting the Thermal Management and Textiles Industries*, 2 NANOTECH. L. & BUS. 23, 23 (2005). Other currently available products containing nanotechnology include step assists on vans, car bumpers, protective coatings for eyeglasses, metal-cutting tools, cosmetics, tennis balls, mattresses, wound dressings, ink, and automobile catalytic converters. National Nanotechnology Initiative, Applications/Products, http://www.nano.gov/html/facts/appsprod.html (last visited Jan. 17, 2007). In fact, in 2005, consumers bought $32 billion worth of products that incorporate nanotechnology, "ranging from GM vehicles containing polymer-nanoclay composites, to antimicrobial bandages made using nanosilver particles from Nucryst, to hearing aids that incorporate sensors based on nanostructured magnetic layers." Matthew M. Nordan, *Nanotechnology's Impact Today – And How to Make Sense of It*, 3 NANOTECH. L. & BUS. 252, 252 (2006).

64. Kimbrell, *supra* note 63, at 331.

65. Nordan, *supra* note 63, at 253. Currently, nanotechnology research and development spending is estimated at $9.6 billion. *Id.* at 252.

66. *Id.* at 252-53. "[O]bservers often refer to the 'nanotechnology market,' or 'nanotech industry.' But in reality, there is no such thing: Nanotech is broad enabling technology that affects many different industries and markets in different ways." *Id.* at 252. "Nanomaterials—basic nanoscale building blocks like carbon nanotubes or dendrimers—are incorporated into intermediate products like coatings, memory chips, or diagnostic reagents to impart new properties. These intermediate products are then used in a wide array of finished goods." *Id.* at 253.

structures because it will enable the exponential improvement of almost every product currently on the market.[67] Because of its potential for rapid, low-cost innovation,[68] nanotech is the ultimate example of the "new economy industries."[69]

Companies continuously will need to develop and expand their capabilities, inventing new methods and materials to facilitate the incorporation of nanotechnology into their business. This constant innovation[70] will be essential in taking advantage of the new markets and benefits. Additionally, the development of nanotechnology will enable the creation of "new products and even new kind[s] of industries, not yet in sight."[71] These new products will create new markets, the contours of which cannot possibly be comprehended today.

C. Innovation and Patents

Given the incredible rate of advancement in the field of nanotechnology, patent rights are vitally important to the process of innovation.[72] Innovation is the key to the technological development of nanotechnology.[73] "Technological progress articulates itself in innovation . . . ."[74] Innovation is encouraged by patent protection and fluidity.[75] Patent rights are the cornerstone of the protection of innovation, and they pro-

67. Kahn, *supra* note 15, at 103. "'Nano's going to be like the invention of plastic,' says Paul Alivisatos, associate director of physical sciences at Lawrence Berkeley National Laboratory's new nanofabrication center. 'It'll be everywhere: in the scalpels doctors use for surgery and in the fabrics we wear.'" *Id.*; *see also* Zovko, *supra* note 5, at 136.

68. Kahn, *supra* note 15, at 104.

69. *See* WILLIAM M. LANDES & RICHARD A. POSNER, THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW 390 (2003).

> The new-economy industries tend to be characterized . . . by falling average costs (on a product, not firm, basis) over a broad range of output, modest capital requirements relative to what at least until recently was available for new enterprises in the global capital market, very high rates of innovation, quick and frequent entry and exit, "instant scalability" (the ability of a firm to multiply the output of a product very rapidly with no increase in marginal cost), and economies of scale in consumption ("network externalities," as they are more commonly called), the realization of which may require either monopoly or interfirm cooperation in standards setting.

Id.

70. Innovation is essentially the development of improvements upon existing technology. Invention is the creation of new technology. Both will be vital for the development of nanotechnology, and because the patent laws protect both, I will use the two words interchangeably.

71. Zago, *supra* note 63, at 23.

72. Michael A. Van Lente, Note, *Building the New World of Nanotechnology*, 38 CASE W. RES. J. INT'L L. 173, 185 (2006).

73. Commission Report, *supra* note 3. "More innovation . . . yields the highest return in terms of competitiveness, employment and growth." *Id.* "'Every world leader nowadays has an innovation plan' . . . [and] IP protection is on President Bush's agenda for every state visit at the White House." *Director Dudas Says PTO Has Made No Final Decisions on Rules Changes*, 75 U.S.L.W. (BNA) No. 10, at 2157 (Sept. 19, 2006).

74. Schuessler-Langeheine, *supra* note 2, at 2.

75. Amy L. Landers, *Liquid Patents*, 84 DENV. U. L. REV. 199, 204 (2006). Patent fluidity is the concept of the ease of transfer of patents and patent rights. This can include licensing, assignment, and even patent auctions. *Id.*

vide the necessary incentive to innovate.[76] In fact, "intellectual property is one of the most valuable forms of property that exists."[77]

Patents drive the development of nanotechnology by providing important protection against free-riding and a means of recouping research and development costs.[78] Indeed, the importance of patents has led many companies to see them as more than mere protection of development. Patents are now viewed as vital assets and may even be the focus of a company's central operations.[79] For many companies, intellectual property itself represents the face of the technology arena.[80] Companies carve out their stake in the intellectual property (IP) landscape by acquiring patents and patent rights. The race to claim pieces of the patent "landscape" will drive innovation and ultimately foster competition.[81]

Modern United States patent rights are authorized in the United States Constitution.[82] The Constitution grants Congress the power "[t]o promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective

76. Schuessler-Langeheine, *supra* note 2, at 2. "[I]nnovation is protected by intellectual property rights. The creation and exploitation of intellectual property is thus a decisive element of innovation, technical progress and economic welfare . . . ." *Id.*

77. U.S. DEP'T OF JUSTICE, *supra* note 4, at 13.

78. *See* Francisco Castro, *Legal and Regulatory Concerns Facing Nanotechnology*, 4 CHI.-KENT J. INTELL. PROP. 140, 144 (2004). "Thousands of nanotechnology patents have been issued and thousands more have entered the application process." Terry K. Tullis, *Application of the Government License Defense to Federally Funded Nanotechnology Research: The Case for a Limited Patent Compulsory Licensing Regime*, 53 UCLA L. REV. 279, 298 (2005).

79. Large corporations often invest a great deal in developing intellectual property portfolios, often containing hundreds of patents, many of which may be unrelated to each other. *See, e.g.*, Gideon Parchomovsky & R. Polk Wagner, *Patent Portfolios*, 154 U. PA. L. REV. 1, 46-47 (2005) (observing that "[s]ince 1994, IBM has amassed over 25,000 U.S. patents . . . [and that] Canon Kabushiki Kaisha, received [more than 15,000] patents during the same period"). "Gemstar still maintains a portfolio of over 260 patents on listing and interactive technologies, and numerous analysts believe the size of this portfolio . . . leaves the company poised for a long-term dominant role in the [on-screen guide and interactive program listing] industry." *Id.* at 51. Moreover, some companies do nothing but buy and sell patents, while others focus on assisting inventors with readying their inventions for marketable patents**.** Amy Feldman, *Reinventing Inventing*, POPULAR SCI., Oct. 2006, at 44. Myhrvold Intellectual Ventures works with inventors in brainstorming sessions to develop the inventions and draft patent applications. "Nathan Myhrvold, former chief technology officer for Microsoft, . . . has been snapping up thousands of patents from inventors who don't have the resources to bring their innovations to market." *Id.* "His monthly brainstorming sessions have already produced some 500 patent applications for Myhrvold's Intellectual Ventures. Though not as prolific as, say, IBM, Myhrvold is already a major force in the field of invention. And he's only just begun." *Id.*

80. Van Lente, *supra* note 72, at 187. "Rather than viewing patents as a way to protect business activity, young companies may view their research and business activities as mere facets of their primary identities as intellectual property dealers and rulers of particular pieces of the intellectual property landscape." *Id.*

81. *See* Amy L. Landers, *Let the Games Begin: Incentives to Innovation in the New Economy of Intellectual Property Law*, 46 SANTA CLARA L. REV. 307, 307 (2006); Thomas O. Barnett, Assistant Attorney General, Interoperability Between Antitrust and Intellectual Property, Presentation to the George Mason University School of Law Symposium: Managing Antitrust Issues in a Global Marketplace (Sept. 13, 2006), *available at* http://www.usdoj.gov/atr/public/speeches/218316.pdf.

82. *See* U.S. CONST. art. I, § 8, cl. 8. The concept of granting patents, however, dates back to times long before the ratification of the Constitution. *See* ROBERT P. MERGES, PETER S. MENELL & MARK A. LEMLEY, INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE 105-08 (3d ed. 2003).

Writings and Discoveries."[83] The patent laws that Congress passed under that authority[84] reward the inventor with significant market advantage for his creative endeavor by granting him the right to "exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States."[85] Many other nations, including most of those in Europe, have similar patent laws.[86]

Patent law is often characterized as providing a limited monopoly as an incentive to maximize innovation.[87] The inventor is able to market his invention without the threat of being undersold by a competitor who is marketing the same invention,[88] or an invention that is substantially similar.[89] Patent rights allow the inventor to recover research and development costs.[90] Additionally, the temporary ability to charge monopoly prices is incentive to obtain a patent.[91] However, because the time period of the patent protection is generally limited to twenty years,[92] this monopoly is temporary.[93]

The exclusive rights granted by the patent monopoly can provide the necessary framework in which businesses may exhibit true economic monopoly behavior. Monopolies generally are in a position to be anticompetitive.[94] As such, they are often unfavorable in the competitive

83. U.S. CONST. art. I, § 8, cl. 8.

84. *See, e.g.*, Patents (Title 35) 66 Stat. 792 (1952) (codified at 35 U.S.C. § 1 et seq.); Patent Law Amendments Act of 1984, Pub. L. No. 98-622, 98 Stat. 3383 (codified at 35 U.S.C. § 157 (2000)).

85. 35 U.S.C. § 154(a)(1) (2000). Additionally, "if the invention is a process, [the patent includes a grant] of the right to exclude others from using, offering for sale or selling throughout the United States, or importing into the United States, products made by that process." *Id.*

86. *See* MARTIN J. ADELMAN ET AL., CASES & MATERIALS ON PATENT LAW 17-18 (2d ed. 2003).

87. Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 535 U.S. 722, 730 (2002). It is important to note, however, that the patent monopoly is to be distinguished from "monopolies that have economic consequences grave enough to warrant the invocation of antitrust prohibitions." LANDES & POSNER, *supra* note 69, at 374. The patent confers a property right, which is not something that by itself has antitrust significance. *Id.* Nonetheless, it is conventional to characterize patents as granting limited monopolies, namely because of their exclusive nature. *Id.*

88. 35 U.S.C. § 271 (2000).

89. *See* Warner-Jenkinson Co. v. Hilton Davis Chem. Co., 520 U.S. 17, 24-30 (1997) (discussing the modern doctrine of equivalents); Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 339 U.S. 605, 608-10 (1950) (delineating the contours of the doctrine of equivalents).

90. Robert C. Lind & Paul Muysert, *The European Commission's Draft Technology Transfer Block Exemption Regulation and Guidelines: A Significant Departure from Accepted Competition Policy Principles*, EUR. COMPETITION L. REV. 25(4), 161, 163 (2004). Without the guarantees and protections of such a monopoly, other firms could free-ride off the inventor's efforts, and undersell the inventor because they would not have the R&D overhead to restrain them. David A. Balto & Andrew M. Wolman, *Intellectual Property and Antitrust: General Principles*, 867 PLI/Pat 9, 25 (2006).

91. *See* LANDES & POSNER, *supra* note 69, at 294.

92. 35 U.S.C. § 154(a)(2) (2000).

93. Indeed, "[f]rom a societal perspective, the goal is that the short-term 'monopoly' prices will be more than offset over time by the increased rate of innovation, which in turn yields better products at lower cost than would have been available without the innovations." Landers, *supra* note 81, at 312 (quoting Edward F. Sherry & David J. Teece, *Some Economic Aspects of Intellectual Property Damages*, 573 PLI/Pat 399, 403 (1999)).

94. MERGES, MENELL & LEMLEY, *supra* note 82, at 990.

United States economy.[95] Thomas Jefferson recognized the tension between the granting of the "embarrassment of an exclusive patent" and the capitalist structure, which is built upon competition.[96] This tension has become a prominent issue in the interplay between patent law and antitrust law.

D. Patent Licensing and Antitrust

"The conflict between antitrust law and patent law plays out quite dramatically in the context of patent licensing."[97] Licensing patents is a common practice through which companies commercialize their patented technologies.[98] Patent commercialization plays an important role in national economic growth.[99] As a result, nanotechnology developers often rely on patent licenses to commercialize their innovations.[100] While patent licenses may have procompetitive effects, companies must be careful that their licenses do not offend antitrust laws by being anticompetitive.

A patent license makes the licensee immune from a patent infringement suit that might otherwise be brought by the licensor.[101] In other words, the licensee is free to use technology that it would otherwise be prevented from using by the rights of the patent owner.[102] This freedom may help parties compete in the market by resulting in efficiency, increased supplies, and more useful technology.[103] The benefits resulting from this enhanced competition are transferred to consumers in the form of lower prices and more valuable output.[104]

Additionally, when a patent owner licenses his patent, he is able to streamline the process of bringing his invention to market, increasing his potential for financial gain. Patent owners often lack the capability of efficiently bringing the subject matter of their patent to market.[105]

95. *See* Sherman Act, 15 U.S.C. § 2 (2000).

96. Graham v. John Deere Co., 383 U.S. 1, 10-11 (1966) (quoting Letter from Thomas Jefferson to Isaac McPherson (Aug. 13, 1813), *in* VI WRITINGS OF THOMAS JEFFERSON, at 180-81 (Washington ed.)).

97. Nhat D. Phan, Note and Comment, *Leveling the Playing Field: Harmonization of Antitrust Guidelines for International Patent Licensing Agreements in the United States, Japan, and the European Union*, 10 AM. U. J. INT'L L. & POL'Y 447, 449 (1994).

98. The right to license patents is conferred by the patent laws. 35 U.S.C. § 261 (2000).

99. U.S. DEP'T OF JUSTICE, *supra* note 4, at iii.

100. Tullis, *supra* note 78, at 294. Patent licenses are especially important in the field of nanotechnology because there has been no significant infringement litigation in the field. *Id.* at 299-300. In the absence of such litigation, the contours of the validity of nanotechnology patents are unclear. *Id.* Thus, licensing nanotechnology patents is arguably "safer" than contesting or defending their validity. *Id.*

101. Balto & Wolman, *supra* note 90, at 50.

102. Alan J. Weinschel, *Antitrust Issues in Licensing Intellectual Property*, 867 PLI/Pat 275, 300 (2006).

103. Balto & Wolman, *supra* note 90, at 50.

104. *Id.*

105. Gerald F. Masoudi, Deputy Assistant Attorney General, Intellectual Property and Competition: Four Principles for Encouraging Innovation, Address at the Digital Americas 2006 Meeting:

Other times, they simply are not able to commercialize the patent in certain industries.[106] To remedy this situation, the patent owner can license the patent to a company with those capabilities that will commercialize the patented technology.[107] Without the burden of readying the technology for market, the patent owner can focus its efforts on the improvement of the product or the development of beneficial innovations thereon.[108] Thus, the license allows for the inventors and innovators to more effectively compete in the market as well.

Patent licenses can achieve these goals most effectively if they contain some restrictive provisions.[109] Companies interested in commercializing nanotechnology consider the freedom to execute restrictive license terms to be vitally important.[110] Restrictive licensing terms are often preferred by parties to patent licenses.[111] For example, exclusive licenses[112] restrict other competitors' access to the licensed technology.[113] Consequently, exclusive licenses can be tremendously profitable.[114] Indeed, exclusive licensing arrangements can be "one of the more solid

Intellectual Property and Innovation in the Digital World (Apr. 11, 2006), *available at* http://www.usdoj.gov/atr/public/speeches/215645.pdf (noting that "[t]he best innovators are not necessarily the best manufacturers, marketers, or retailers"). For example, "[p]rofessors . . . don't know how to turn their ideas into products." David Whelan, *$100 Million, Anyone?*, FORBES, Oct. 9, 2006, at 64. Licensing allows inventions from universities to enjoy commercial success. "[A] product prototype leaving a [licensing] institute will be more valuable than just a patent and . . . it won't be diluted by rounds of venture capital funding, so inventors should fare better." *Id.* at 66.

106. Balto & Wolman, *supra* note 90, at 50.

107. *Id.* "Such exploitation in turn increases the perceived value of patents and hence increases the incentives to invest in the development of new technologies." *Id.*

108. This is especially important in the case of the research professor at a university. Generally, the researcher will not have any means available to make the invention/innovation market-ready. Whelan, *supra* note 105, at 64. To promote the commercialization of university research, Congress passed the Bayh-Dole Act. Bayh-Dole Act, Pub. L. No. 96-517, 94 Stat. 3015 (1980) (codified at 35 U.S.C. §§ 200-211 (2000)). Under the Bayh-Dole Act, the researcher can create a patentable invention; the university can patent it and license the patent to an entity in the private sector who can commercialize it. *See* 35 U.S.C. § 202 (2000). The researcher is then free to move on to his next project, and the university will be able to recoup research investment from the license, which can be funneled into the next project.

109. Restrictive licensing provisions are simply provisions in the license agreement that restrict the rights of one of the parties in some way.

110. *See* Robert P. Taylor, *Antitrust Issues in Licensing Intellectual Property Rights*, 1526 PLI/Corp 365, 378 (2006).

111. *See* U.S. DEP'T OF JUSTICE & FED. TRADE COMM'N, ANTITRUST GUIDELINES FOR THE LICENSING OF INTELLECTUAL PROPERTY § 2.3 (1995) [hereinafter IP GUIDELINES].

112. In this context, an exclusive license is one in which the licensor agrees to license patent rights only to the licensee.

113. IP GUIDELINES, *supra* note 111. *See also* Tullis, *supra* note 78, at 294.

> In 2003, twelve of fifteen publicly announced nanotechnology intellectual property license agreements were exclusive, with such universities as MIT and NYU selling exclusive commercialization rights to individual companies. Among publicly announced nanotechnology deals between January and December 2004, seventeen disclosed that the terms were exclusive while only three were clearly nonexclusive licenses. The exclusivity trend continued between December 2004 and May 2005 with eight exclusive nanotechnology licensing deals and three nonexclusive licensing deals. Every publicly announced nanotechnology licensing deal involving a university between January 2003 and May 2005 was exclusive in nature.

Id. at 294-95.

114. Tullis, *supra* note 78, at 296.

foundations a company can start with."[115] Other restrictions, such as grant-back clauses,[116] may prevent licensees from free-riding on the licensed technology by making improvements on the licensed technology and unfairly competing with the licensor's technology.[117]

Although patent licenses are encouraged for their procompetitive effects, they may also provide an ideal forum for anticompetitive practices.[118] Restrictive clauses in the agreement may have the effect of preventing the licensee from competing at all in the market or may limit other firms' entry into the market.[119] Additionally, license agreements simply may not be the least restrictive means available to produce a given social benefit.[120] Antitrust law plays a vital role in regulating licenses by prohibiting agreements that have anticompetitive effects that are not outweighed by procompetitive effects.

1. Application of United States Antitrust Law to Patent License Agreements

In the United States, antitrust agencies and courts have rejected the notion that patent licenses should receive broad immunity from antitrust inquiry.[121] Put simply, "[i]ntellectual property rights do not confer a privilege to violate antitrust laws."[122] Therefore, parties to patent license agreements should be prepared to defend their agreements against antitrust scrutiny. However, analyzing patent license agreements in the antitrust framework can be complicated.[123]

To clarify the application of United States antitrust law to intellectual property licensing, the Department of Justice and the Federal Trade Commission issued the Licensing Guidelines in 1995.[124] There are three general principles that lie at the heart of the Licensing Guidelines:

> [1] for the purpose of antitrust analysis . . . intellectual property [is] essentially comparable to any other form of property; [2] the Agencies do not presume that intellectual property creates market power in the antitrust

115. Mark Henricks, *The One and Only*, ENTREPRENEUR, Oct. 2006, at 128. The co-founders of Pacarc, exclusive distributor for the Jet Towel hand dryer in the United States, built their success upon an exclusive distributorship. *Id.*

116. A grant-back clause provides that the licensor will obtain intellectual property rights in any improvements or modifications that the licensee performs upon the licensed subject matter.

117. IP GUIDELINES, *supra* note 111, § 2.3.

118. *Id.* § 3.1.

119. *See id.*

120. *Id.* § 3.4.

121. *See* United States v. Microsoft Corp., 253 F.3d 34, 63 (D.C. Cir. 2001). Rejecting Microsoft's argument that the exercise of intellectual property rights should not "give rise to antitrust liability" because the rights are legally acquired, the court stated that Microsoft's assertion "is no more correct than the proposition that use of one's personal property, such as a baseball bat, cannot give rise to tort liability." *Id.*

122. *In re* Indep. Serv. Orgs. Antitrust Litig., 203 F.3d 1322, 1325 (Fed. Cir. 2000).

123. *See* IP GUIDELINES, *supra* note 111, § 2.1.

124. *See* IP GUIDELINES, *supra* note 111.

> context; and [3] the Agencies recognize that intellectual property licensing allows firms to combine complementary factors of production and is generally procompetitive.[125]

Because of the importance of intellectual property, "even if an intellectual property right does give rise to market power, such power does not by itself offend the antitrust laws."[126] To implicate antitrust law, the restrictions in a licensing agreement must be capable of harming competition.[127]

In assessing whether a particular agreement has this anticompetitive effect, the antitrust agencies generally begin by determining whether the parties to the agreement are engaged in a vertical or horizontal relationship.[128] A vertical relationship is characterized by a complementary relationship between the parties.[129] For example, an automobile manufacturer has a vertical relationship with the automobile dealership that sells the vehicles it manufactures. An anticompetitive restraint in a vertical relationship "forecloses access to, or increases competitors' costs of obtaining, important inputs, or facilitates coordination to raise price or restrict output."[130]

Conversely, a horizontal relationship is one between companies that are, or could be, competitors in the same market.[131] In other words, the firms are situated at the same level of production. For example, a relationship between two car dealerships would be a horizontal relationship. An anticompetitive restraint in a horizontal relationship "increase[s] the risk of coordinated pricing, output restrictions, or the acquisition or maintenance of market power."[132]

After evaluating the nature of the existing relationship, antitrust agencies will consider whether the parties were competitors or potential competitors prior to the execution of the license agreement. Agreements between competitors or potential competitors will receive stricter scrutiny than those between non-competitors.[133] Antitrust violations commonly found in agreements between competitors include price-fixing, territorial allocation, and concerted refusals to deal.[134] However,

125. IP GUIDELINES, *supra* note 111, § 2.0.
126. Weinschel, *supra* note 102, at 300.
127. *See, e.g.*, 15 U.S.C. §§ 1-2, 13-14 (2000).
128. IP GUIDELINES, *supra* note 111, § 3.3.
129. *Id.*
130. *Id.* § 4.1.1.
131. *Id.* § 3.3.
132. *Id.* § 4.1.1
133. Balto & Wolman, *supra* note 90, at 52. This is motivated by the desire to limit the ability of competitors to form cartels. *Id.* "A firm will be treated as a likely potential competitor if there is evidence that entry by that firm is reasonably probable in the absence of the licensing arrangement." IP GUIDELINES, *supra* note 111, § 3.1 n.14.
134. *See, e.g.*, Nw. Wholesale Stationers, Inc. v. Pac. Stationery & Printing Co., 472 U.S. 284, 295-98 (1985) (recognizing that concerted refusals to deal may warrant per se or rule of reason treatment depending upon the circumstances); United States v. Topco Assocs., Inc., 405 U.S. 596, 607-09 (1972) (recognizing that horizontal agreements between competitors to allocate territories in order to

license agreements between non-competitors may violate antitrust laws as well. Generally, such an agreement will be characterized by provisions that unreasonably inhibit a party's ability to compete, without offering "benefits to consumers that would outweigh the . . . anticompetitive effects."[135] Suspect agreements between both competitors and non-competitors will be scrutinized in a similar manner.

Under the Licensing Guidelines, anticompetitive restraints generally will be evaluated using the "rule of reason."[136] Under this rule, a court will examine and weigh the restraint's procompetitive and anticompetitive effects.[137] The restraint may be illegal if its anticompetitive effects outweigh its procomptetitive effects. A central inquiry to that analysis is whether "the parties could have achieved similar efficiencies by means that are significantly less restrictive."[138] To examine the anticompetitive effects of a restrictive provision in a license agreement, the court must consider the market power that each party holds.[139] Market share is often used as a proxy to estimate market power.[140] To assess market share, the court must first delineate the relevant market.

a. Relevant Markets and Market Share in the United States

Three types of relevant markets are contemplated by the Licensing Guidelines.[141] They are goods (product) markets, technology markets, and innovation markets.[142] All three markets are implicated by the development and commercialization of nanotechnology. The most common type of relevant market that appears in antitrust litigation is the product market.

The IP Guidelines provide that the relevant product market for an antitrust inquiry regarding a patent license is to be defined in accordance with Section 1 of the Horizontal Merger Guidelines.[143] Under the Merger Guidelines, market definition is approached by focusing on po-

minimize competition are per se illegal under the Sherman Act); United States v. Socony-Vacuum Oil Co., 310 U.S. 150, 218 (1940) (holding that price-fixing is per se illegal under the Sherman Act).

135. Balto & Wolman, *supra* note 90, at 52.

136. IP GUIDELINES, *supra* note 111, § 3.4. However, a licensing restraint will generally be deemed per se illegal, without resorting to a rule of reason analysis, if its "nature and necessary effect are so plainly anticompetitive" to warrant such treatment. *Id.* (quoting FTC v. Superior Court Trial Lawyers Ass'n, 493 U.S. 411, 433 (1990)). For example, courts have held restraints such as price-fixing to be per se illegal. *See* FTC v. Superior Court Trial Lawyers Ass'n, 493 U.S. 411, 432-35 (1990). To determine which treatment to apply to a license agreement, the court must assess "whether the restraint . . . can be expected to contribute to an efficiency-enhancing integration of economic activity." IP GUIDELINES, *supra* note 111, § 3.4.

137. *See* FTC v. Ind. Fed'n of Dentists, 476 U.S. 447, 458-59 (1986).

138. IP GUIDELINES, *supra* note 111, § 4.2.

139. *See id.* § 2.2. Market power is defined as "the ability profitably to maintain prices above, or output below, competitive levels for a significant period of time." *Id.*

140. United States v. Phila. Nat'l Bank, 374 U.S. 321, 362-63 (1963).

141. IP GUIDELINES, *supra* note 111, § 3.2.

142. *Id.*

143. *Id.* § 3.2.1.

tential consumer responses to "small but significant and nontransitory" increases in the price (SSNIP) of the product.[144] The relevant product market is defined by the SSNIP test as

> a product or group of products and a geographic area in which it is produced or sold such that a hypothetical profit-maximizing firm, not subject to price regulation, that was the only present and future producer or seller of those products in that area likely would impose at least a "small but significant and nontransitory" increase in price [SSNIP], assuming the terms of sale of all other products are held constant.[145]

After the relevant product market is defined, the market power of a participant in that market can sometimes be roughly estimated by calculating that participant's market share. This calculation requires consideration of all of the market participants and their shares of the market.[146] A market participant's market share usually is calculated using data reflecting the participant's current total sales on the relevant market and the supply elasticity of the participant in that market.[147] Although goods markets will be implicated by the final products of nanotechnology development, technology markets and innovation markets are of special relevance in the context of licensing nanotechnology patents.

Many nanotechnology patents are, and will continue to be, licensed separately from the products that they describe. In such a situation, the technology markets are useful for analyzing competitive effects.[148] To define a relevant technology market, agencies will generally apply the SSNIP test to the technologies that enable certain goods.[149] If the license is not easily quantifiable in terms of money, the technology market will be delineated by "identifying other technologies and goods which buyers would substitute at a cost comparable to that of using the licensed technology."[150]

There are some situations in which the analysis of a licensing

144. U.S. DEP'T OF JUSTICE & FED. TRADE COMM'N, HORIZONTAL MERGER GUIDELINES, § 1.11 (1997) [hereinafter MERGER GUIDELINES].

145. *Id.* § 1.0. "A relevant market is a group of products and a geographic area that is no bigger than necessary to satisfy this test." *Id.*

146. *Id.*

> Participants include firms currently producing or selling the market's products in the market's geographic area. In addition, participants may include other firms depending on their likely supply responses to a "small but significant and nontransitory" price increase. A firm is viewed as a participant if, in response to a "small but significant and nontransitory" price increase, it likely would enter rapidly into production or sale of a market product in the market's area, without incurring significant sunk costs of entry and exit.

Id.

147. *Id.* § 1.41. "Market shares can be expressed either in dollar terms through measurement of sales, shipments, or production, or in physical terms through measurement of sales, shipments, production, capacity, or reserves." *Id.* The Merger Guidelines recommend calculating the market shares in a manner that best reflects the firm's "future competitive significance." *Id.*

148. IP GUIDELINES, *supra* note 111, § 3.2.2.

149. *Id.* § 3.2.2. n.20; MERGER GUIDELINES, *supra* note 144, § 1.11.

150. IP GUIDELINES, *supra* note 111, § 3.2.2.

agreement may not be practical in either a goods or a technology market.[151] Many of the patents relating to nanotech cover technology that will be used in future products. The IP Guidelines suggest that innovation markets should be used to analyze the competitive effects of agreements to license those technologies.[152]

Innovation markets are defined according to the research and development in which the business engages as it attempts to create new products.[153] The close substitutes for that research and development are included in the innovation market definition.[154] The market shares of competitors in such markets are calculated by examining their "shares of identifiable assets or characteristics upon which innovation depends, . . . shares of research and development expenditures, or . . . shares of a related product."[155] These markets will only be used when it is possible to associate a business's ability to perform the research and development with "specialized assets or characteristics" of the business.[156]

b. United States Safety Zone for Patent License Agreements

The IP Guidelines provide for a "safety zone" for certain types of licensing arrangements.[157] The purpose of this provision is to "provide some degree of [legal] certainty" to encourage licensing arrangements that "promote innovation and enhance competition."[158] Generally, only analysis of goods markets will determine whether the safety zone will apply to a particular restraint.[159] Under that analysis, the safety zone will apply where the restraint does not appear to be anticompetitive on its face, and the combined market share of the two parties to the license is no greater than twenty percent.[160]

If technology or innovation markets are implicated and "market share data are unavailable or do not accurately represent competitive significance," the Guidelines provide for modified "safety zones."[161]

151. *Id.* § 3.2.3.

152. *Id.* Innovation markets are also useful for analyzing the competitive effects of licenses that "affect the development of new or improved goods or processes in geographic markets where there is no actual or likely potential competition in the relevant goods." *Id.*

153. *Id.*

154. *Id.* "The close substitutes are research and development efforts, technologies, and goods that significantly constrain the exercise of market power with respect to the relevant research and development, for example by limiting the ability and incentive of a hypothetical monopolist to retard the pace of research and development." *Id.*

155. *Id.* Businesses that have similar capability and incentive to innovate in the relevant innovation market may be assigned equal market shares. *Id.*

156. *Id.*

157. *Id.* § 4.3.

158. *Id.*

159. *Id.*

160. *Id.* "'Facially anticompetitive' refers to restraints that normally warrant per se treatment, as well as other restraints of a kind that would always or almost always tend to reduce output or increase prices." *Id.* § 4.3 n.30.

161. *Id.* § 4.3. In the case of technology markets, the modified safety zone will apply if the re-

However, parties should bear in mind that changes in the market over time may affect whether their agreement is protected by the safety zone.[162] These analyses will only become necessary in the context of litigation. Conversely, parties that execute license agreements affecting EU markets must conduct similar analyses before the agreement is executed, regardless of the potential for litigation.

2. Application of EU Competition Law to Patent License Agreements

The EU competition laws regulate patent licenses in part through Article 81 of Title VI of the European Commission Treaty (Article 81).[163] Article 81(1) prohibits agreements that "have as their object or effect the prevention, restriction or distortion of competition within the common market."[164] Agreements of the type captured by Article 81(1) are void,[165] "at least in respect of the prohibited clauses."[166] This article applies to agreements that may affect trade between EU Member States.[167] EU courts have interpreted this language broadly to include "[a]ny practice which [may affect] market conditions or structure."[168]

Until recently, the European Commission (EC) viewed all license agreements that were not non-exclusive agreements "for the whole common market" as suspect, and therefore potentially prohibited by Article 81(1).[169] At that time, the EC analyzed every license agreement about which it was notified to determine whether it was acceptable under Article 81.[170] Over time, the EC realized that this "required a cumbersome and time-consuming proceeding which imposed heavy burdens

straint is not anticompetitive on its face and if there are no fewer than four "independently controlled technologies in addition to the [licensed technology] that may be substitutable for the licensed technology at a comparable cost to the user." *Id.* The safety zone will be applicable to agreements that implicate innovation markets under similar circumstances. *Id.* The only difference is that instead of no less than four "independently controlled technologies," there must be no less than four "independently controlled entities in addition to the parties to the [license agreement that] possess the required specialized assets or characteristics and the incentive to engage in [closely substitutable] research and development." *Id.*

162. *Id.*

163. Marleen van Kerckhove, Alan Bryson & David Perkins, *Licensing Issues in the European Union – The Review of the Technology Transfer Block Exemption*, 717 PLI/Pat 123, 125 (2002).

164. Treaty Establishing the European Community, Nov. 10, 1997, 1997 O.J. (C 340) 3, art. 81 [hereinafter EC Treaty].

165. EC Treaty art. 81(2).

166. Schuessler-Langeheine, *supra* note 2, at 18.

167. The European Union contains Belgium, France, Italy, Luxembourg, Netherlands, Germany, Denmark, Ireland, United Kingdom, Greece, Portugal, Spain, Austria, Finland, Sweden, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia, Bulgaria, and Romania. Wikipedia, List of European Union Member States by Accession, http://en.wikipedia.org/w/index.php?title=List_of_European_Union_member_states_by_accession&oldid=101125691 (last visited Jan. 17, 2007). Croatia and Turkey are currently involved in accession negotiations. *Id.* The Republic of Macedonia and Albania are candidate countries. *Id.* Bosnia, Herzegovina, Montenegro, and Serbia are potential candidate countries. *Id.*

168. Hedvig K.S. Schmidt, *Article 82's 'Exceptional Circumstances' that Restrict Intellectual Property Rights*, EUR. COMPETITION L. REV. 23(5), 210, 211 (2002).

169. Schuessler-Langeheine, *supra* note 2, at 19.

170. *Id.*

on the limited personnel of the Commission."[171] In response, the EC began condensing the process through new legislation, enacted between 1984 and 2004.[172]

As part of the new legislation, the EC created the TTBER.[173] This regulation provides that certain agreements may be exempt from the prohibitions of Article 81. The exemptions therein are applicable to "patent licensing agreement[s], . . . copyright licensing agreement[s] . . . , [and] knowhow . . . licensing agreement[s]" between two parties that permit "the production of contract products."[174] If an agreement is not covered by the TTBER, the parties must conduct an economic analysis, similar to the "rule of reason," to determine whether the agreement will satisfy the exemptions in Article 81(3).[175]

a. Self-Assessment of Market Share Under TTBER

Parties must conduct a self-assessment before executing a licensing agreement that may affect trade between Member States of the EU. This assessment is characterized by two steps: (1) an assessment of "whether the license agreement has an anti-competitive object or actual or potential anti-competitive effects,"[176] and (2) "[i]f the agreement is found to restrict competition[,] . . . whether the pro-competitive benefits produced by that agreement outweigh the anti-competitive effects."[177] For a party to a license agreement to take advantage of the TTBER, its self-assessment must "convincingly demonstrate that [the] license agreement . . . results in efficiency gains, brings a fair share for consumers, contains only indispensable restrictions of competition, and does not eliminate competition in respect of the products concerned."[178]

The parties begin this assessment by determining whether they are competitors.[179] The next step in the assessment requires each party to identify its market share in the relevant market.[180] The parties then determine whether their agreement contains any provisions designated by the EC as "hardcore restrictions."[181] The TTBER will exempt the

171. *Id.* at 20.
172. *See id.* at 20-23.
173. TTBER, *supra* note 11.
174. TTBER, *supra* note 11, at art. 1(1)(b). These are products that are produced using the technology that has been licensed. It may apply to agreements containing language relating to the sale and purchase of products, but only if the sale and purchase of products is not "the primary object of the agreement." *Id.*
175. Simon Chalkley, *International Licensing Within the European Economic Area*, 858 PLI/Pat 425, 432 (2006).
176. Schuessler-Langeheine, *supra* note 2, at 35.
177. *Id.* "This balancing of anti-competitive and pro-competitive effects is conducted in the framework of the criteria laid down in Article 81(3)." *Id.*
178. *Id.*
179. *Id.* at 36.
180. *Id.*
181. *Id.* Those are restrictions that the EC has determined to be so facially anticompetitive as to

agreement if it does not contain hardcore restrictions and the combined market share of the parties does not exceed the established market share threshold.[182]

The market share thresholds are different for competitors and non-competitors. If the parties are competitors, the exemption applies if the combined market share of the two parties is no greater than twenty percent of the relevant market.[183] If the two parties are not competitors, the exemption applies if the combined market share is no greater than thirty percent of the relevant market.[184] If the applicable threshold is met, the parties then assess the procompetitive and anticompetitive effects of the agreement.

Parties to patent license agreements should make written records of the self-assessment because they may be required to present their results in court (or to the competition authorities) to justify the validity of the agreement.[185] The self-assessment must be repeated periodically to determine whether the TTBER continues to apply to their agreement.[186] The TTBER exemptions cease to apply if the combined market share of the parties to the agreement ever exceeds the market share thresholds.[187] Thus, even though an agreement may fall within the TTBER exemption at the time of its execution, it may later fall outside of the TTBER.[188] Such an occurrence would put the parties at risk of having an unenforceable agreement that they must renegotiate.[189] To mitigate this risk, it is important for parties to be able to accurately define the relevant market relating to the agreement and their market shares within that market.

never warrant exemption from antitrust scrutiny. *See* TTBER, *supra* note 11, at art. 4. These "hardcore restrictions" include restrictions on the price that a licensee will charge to third parties to sell the product, restrictions on output, and market allocations. *Id.* These restrictions are more severe for parties that are competitors. *Id.* This distinction is not clear, however, as competitors are defined as parties that license competing technologies "without infringing each others' intellectual property rights." *Id.* art. 1(j)(i). Whether one party infringes another's intellectual property rights is a question that often is not answered until the close of extensive litigation, which may take years to conclude. George Metaxas, *Licensing in the European Union*, 877 PLI/Pat 297, 305 (2006).

182. TTBER, *supra* note 11, at art. 4.

183. *Id.* art. 3(1).

184. *Id.* art. 3(2).

185. Schuessler-Langeheine, *supra* note 2, at 36. "While the Guidelines set out the Commission's current views on what may be exempted by self assessment, the boundaries of what is lawful are likely to be worked out in future cases as the assessments carried out by licensing parties are tested in enforcement actions or in court." *Id.* This, of course, adds to the uncertainty of the whole process and may ultimately diminish the attractiveness of executing license agreements that may affect trade between countries that are members of the EU.

186. *Id.* at 38. "[C]ompanies will have to rely increasingly on sophisticated legal analysis and self-review. For this purpose outside legal and economic advice may have to be sought." *Id.* at 39.

187. *See* TTBER, *supra* note 11, at art. 2. However, there is a two year grace period. *Id.* art. 8.

188. Schuessler-Langeheine, *supra* note 2, at 38.

189. *Id.*

b. Relevant Markets and Market Share in the EU

Like the United States, the EU recognizes three types of relevant markets: product markets, technology markets, and innovation markets. The EC defines a product market as comprising "all those products and/or services which are regarded as interchangeable or substitutable by the consumer, by reason of the products' characteristics, their prices and their intended use."[190] The EC defines the geographic market as one that

> comprises the area in which the undertakings concerned are involved in the supply and demand of products or services, in which the conditions of competition are sufficiently homogeneous and which can be distinguished from neighbouring areas because the conditions of competition are appreciably different in those areas.[191]

Generally, where data regarding market sales value is available, it is used to calculate market share.[192] If that data is not available, the parties should use available market information such as market sales volumes to make estimates of market share.[193] If the relevant market is a product market, a licensee's market share is calculated by considering the licensee's sales of products that incorporate the licensed technology and those products' substitutes.[194] Additionally, if the licensor supplies products on that market, his share of the market must also be considered.[195]

According to the EU guidelines, technology markets are defined by the technology being licensed and its substitutes, which are technologies that the licensee considers to be "substitutable for the licensed technology" because of similar characteristics, royalties, and uses.[196] The primary method for delineating a technology market under EU doctrine is similar to the method for delineating product markets.[197] The market includes the technology that is the subject matter of the proposed license agreement and any other technology that satisfies a SSNIP test.[198] An alternative to this method contemplated by the guidelines is to con-

190. Commission Notice on the Definition of Relevant Market for the Purposes of Community Competition Law, 1997 O.J. (C 372) 5, ¶ 7, *available at* WESTLAW, EU-ALL.

191. *Id.* ¶ 8. "According to Steve Anderman, when dealing with IPRs the geographic market is often shaped to fit the area of the intellectual property protection without any further analysis of the interpenetration of trade. This is usually confined to one Member State or two . . . ." Schmidt, *supra* note 168, at 212.

192. TTBER, *supra* note 11, at art. 8(1).

193. *Id.* "For the purpose of this calculation, the licensor's market share includes the market shares of his existing licensees." Schuessler-Langeheine, *supra* note 2, at 29.

194. Commission Notice – Guidelines on the Application of Article 81 of the EC Treaty to Technology Transfer Agreements, 2004 O.J. (C 101) 2, 13 [hereinafter TTBER GUIDELINES].

195. *Id.* "In the calculation of market shares for product markets, however, sales made by other licensees are not taken into account when calculating the licensee's and/or licensor's market share." *Id.*

196. *Id.* at 5.

197. *Id.*

198. *Id.*

sider the "market for products incorporating the licensed technology."[199]

If the relevant market is a technology market, there are at least two alternative approaches to calculating market share. The parties may calculate their market shares as their share of the "total licensing income from royalties."[200] Alternatively, the parties may calculate their share of the "sales of products incorporating the licensed technology on downstream product markets."[201] This approach requires consideration of all sales on the relevant market, even those that do not incorporate a licensed technology.[202] The licensor should calculate his market share "on the basis of the sales of the licensor and all his licensees of products incorporating the licensed technology."[203] If the market concerns technology that has not yet been incorporated in marketed products, the licensor's market share is zero.[204] However, once that technology generates sales, the licensor acquires a market share based on those sales.[205]

A license agreement may concern innovation markets. In such a case, the parties generally should examine the competitive effect of the patent license agreement on the existing product and technology markets.[206] However, in some cases such an analysis may not be sufficient, and it may be necessary to conduct an analysis of relevant innovation markets.[207] If the relevant market is an innovation market, the EC will not calculate a market share. Instead, the central inquiry is whether there will be a "sufficient number" of businesses competing in that particular type of research and development "for effective competition in innovation to be maintained."[208]

The applicable market analysis will be used by the parties to a patent license agreement to determine whether their agreement falls within the market share thresholds. If it does, it may be able to take advantage of the antitrust exemptions of the TTBER. Unfortunately, this determination will cause more problems than it was meant to address.

199. *Id.*
200. *Id.* "However, this may often be a mere theoretical and not a practical way to proceed because of lack of clear information on royalties etc." *Id.*
201. *Id.*
202. *Id.*
203. *Id.* at 13.
204. *Id.*
205. *Id.*
206. TTBER GUIDELINES, *supra* note 194, at 6. "In such cases innovation is a source of potential competition which must be taken into account when assessing the impact of the agreement on product markets and technology markets." *Id.*
207. *Id.* "This is particularly the case where the agreement affects innovation aiming at creating new products and where it is possible at an early stage to identify research and development poles." *Id.*
208. *Id.*

III. ARGUMENT

The self-assessment required by the TTBER is sure to raise transaction costs and hinder the development of nanotechnology.[209] Effective nanotech innovation is dependent upon efficient multi-national cooperation, which requires that patents be as fluid as possible.[210] The ability to license freely in the international sphere is the key to patent fluidity.[211] Because the EU and United States are major world market players that need to work together to develop nanotechnology, the antitrust laws of both will be implicated in many patent licensing situations.[212] While the United States antitrust laws likely will not impede nanotechnology patent licensing, the EU TTBER is likely to cause transaction costs, delays in license negotiations, and legal uncertainty for companies in both regions. Consequently, nanotech companies likely will avoid licensing patents in the EU, which will hinder global innovation in nanotechnology.

A. Licensing Difficulties Under the TTBER

Although the EU's approach to anticompetitive behavior is now more liberal than before the TTBER was enacted, the process of entering into a licensing agreement in the EU has been complicated.[213] One of the primary implications that the TTBER has upon companies attempting to enter license agreements in the EU is that "the burden for compliance" is now upon the parties to the agreement.[214] Companies will prefer license agreements for the production of goods and services[215] that are exempted by the TTBER because such agreements are presumptively compliant with competition laws.[216] Thus, both EU and United States companies that wish to license nanotechnology patents in the EU will be required to conduct the problematic self-assessment.

1. Relevant Market Determination Under the TTBER Self-Assessment

Defining the relevant nanotechnology market is critical to deter-

209. *See* Chalkley, *supra* note 175, at 437.

210. *See* Patrick Mendis, *Science, Technology, and Intellectual Property Rights in American Foreign Policy*, 9 J. TECH. L. & POL'Y 17, 17 (2004).

211. *See* Ted Sabety, *Nanotechnology Innovation and the Patent Thicket: Which IP Policies Promote Growth?*, 15 ALB. L.J. SCI. & TECH. 477, 508 (2005).

212. *See* EC Treaty art. 81(1); IP GUIDELINES, *supra* note 111, § 2.1.

213. Marc Hansen & Omar Shah, *The New EU Technology Transfer Regime – Out of the Straightjacket into the Safe Harbour*, EUR. COMPETITION L. REV. 25(8) 465, 467 (2004).

214. Chalkley, *supra* note 175, at 431.

215. *Id.* at 433. "Licenses for pure research and development are . . . excluded" from the TTBER exemptions. *Id.* There is considerable reasoning to support the argument that the exclusion of such licenses is unwarranted, but that is beyond the scope of this discussion.

216. *See* TTBER, *supra* note 11, at art. 2.

mining market share and, therefore, is an important step in the self-assessment.[217] Unfortunately, defining relevant markets can be difficult and often is a subjective determination.[218] There is a danger that parties will define their market shares differently than a court would. This risk is compounded by the fact that "[t]he Commission tends to define markets very narrowly; sometimes too narrowly."[219]

Relevant nanotechnology markets currently may be difficult to define because most of the technology is in the research and development stage.[220] The accurate definition of a relevant market depends upon the substitutability of the product or technology.[221] Nanotechnology that will be incorporated into existing technologies may not result in products that will be substitutes for existing products that are not enhanced by nanotechnology. It is not clear if consumers will initially be willing to pay a higher price for a product that takes advantage of the unique properties of nanotechnology.[222] If they are willing to pay the higher price, the relevant market may be defined to include the new product as well as the older technology that does not take advantage of nanotechnology. In such a case, the firm producing the nano-enabled product is unlikely to have a very large share of the market at the outset.[223]

As demand for the new product increases and manufacturing costs drop, the firm may quickly expand its share of the market. On the other hand, if the cost of manufacturing (and thus, the price of the product) does not reach competitive levels quickly, it is possible that the nano-enabled product will occupy a niche in a different market: the market for nano-enabled technologies of that particular type.[224] Consequently, when two parties execute a license agreement for the production of nanotechnology, the extent of the commercial reality of the license

217. *See* Image Technical Servs., Inc. v. Eastman Kodak Co., 125 F.3d 1195, 1203 (9th Cir. 1997). The risks of costly litigation over differing determinations of the relevant market for the purposes of complying with Article 81 will likely reduce parties' incentive to license nanotechnology patents in the EU. "Such an effect on patent . . . holders is contrary to the fundamental and complementary purposes of both the intellectual property and antitrust laws, which aim to 'encourag[e] innovation, industry and competition.'" *Id.* at 1218 (quoting Atari Games Corp. v. Nintendo of Am., Inc., 897 F.2d 1572, 1576 (Fed. Cir. 1990)).

218. *See* United States v. Waste Mgmt., Inc., 743 F.2d 976, 978 (2d Cir. 1984) ("The parties strenuously disagree over the proper definition of the relevant product and geographic markets.").

219. Schmidt, *supra* note 168, at 211.

220. *See* Robert Pitofsky, *New Definitions of Relevant Market and the Assault on Antitrust*, 90 COLUM. L. REV. 1805, 1807 (1990). Of course, defining the relevant market correctly to begin with is important. *See, e.g.*, Eastman Kodak Co. v. Image Technical Servs., Inc., 504 U.S. 451, 493-95 (1992) (Scalia, J., dissenting) (explaining that the Court's choice of market definition allowed it to "invoke the per se rule . . . [where] [t]he existence of even vibrant interbrand competition [was] no defense").

221. *See supra* notes 145-156 and accompanying text.

222. *See* R. Hewitt Pate, Assistant Attorney General, Competition and the End of Geography, Address to the Progress & Freedom Foundation (Aug. 23, 2004), *available at* http://www.usdoj.gov/atr/public/speeches/205153.pdf.

223. This is because a company will have zero market share before it introduces its product to the market, and any subsequent market share will increase slowly at first as consumers become aware of the product.

224. *See* Pate, *supra* note 222.

likely will be difficult to estimate. This uncertainty will significantly complicate an accurate determination of relevant markets.[225]

Molecular manufacturing also will have applications that impact various industries.[226] The licensing of patents related to this technology usually will implicate technology markets.[227] The extent of the commercial reality of those technologies initially will be difficult to ascertain. As molecular manufacturing develops, its applications probably will be widespread and difficult to predict.[228] Broad patent rights in this field will require patent owners to extensively license the technology to commercialize its benefits.[229]

Additionally, many products, such as carbon nanotubes, may be classified both as a starting point for valuable research and as an end-product.[230] These developments are likely to blur the lines between products markets, technology markets, and innovation markets.[231] Thus, the goal of self-assessment under the TTBER is jeopardized and its usefulness questionable. The complications involved in defining the relevant market will be amplified when the parties attempt to calculate market shares.

2. The Problem with Market Shares

The self-assessment of a nanotechnology company's share of the relevant market may prove to be a prohibitive task.[232] The lack of useful data will significantly complicate the calculation of an emerging nanotechnology business's market share.[233] This is especially true when the relevant market for the antitrust inquiry is a technology market.[234] In the case of new developments, there will be no historical sales data to analyze. While it may be tempting to analyze the market data relating to the existing product that the new technology is meant to replace, such

225. *See* Pitofsky, *supra* note 220, at 1807.

226. *See* Miller, Cho, & McGehee, *supra* note 19, at 21-22.

227. *See supra* notes 146-148 and accompanying text.

228. Michael Vassar, *Corporate Cornucopia*, 2 NANOTECH. PERCEPTIONS: A REV. OF ULTRAPRECISION ENGINEERING AND NANOTECH. No. 1b (2006), *available at* http://www.kurzweilai.net/articles/art0675.html.

229. *See* John M. Garvey & Andrew S. Baluch, *Creating Nanotechnology Intellectual Property Assets: Driving Revenue and Deal Flow Through an Intelligent Intellectual Property Strategy*, 3 NANOTECH. L. & BUS. 72, 75 (2006).

230. *See* Miller, Cho, & McGehee, *supra* note 19, at 13-14.

231. This of course would complicate the determination of the relevant market.

232. *See* Schuessler-Langeheine, *supra* note 2, at 28. "The exact determination of market shares at any given point in time is one of the most difficult tasks facing business under the new TTBER." *Id.* at 29.

233. Treacy & Heide, *supra* note 14, at 419. "Reliable market share information is often difficult to come by. Even where it is obtainable, it is unlikely to give more than a general estimate of a party's market share. This problem is exacerbated in dynamic industries [such as nanotechnology] where market shares can change very quickly." *Id.*

234. *Commission Evaluation Report on the Transfer of Technology Block Exemption Regulation No 240/96 – Technology Transfer Agreements under Article 81*, COM (2001) 786 final (Dec. 20, 2001), *available at* WESTLAW, EU-ALL.

an analysis could be quite misleading.[235] Thus, parties will be unable to calculate market share with any legal certainty.[236]

Reliance on an uncertain self-assessment of market share can be risky because a court later may assess a party's market share quite differently.[237] Even if one effectively can estimate a market share in this context, the rapidly changing technology may render such a determination obsolete almost immediately.[238] While the parties might, in theory, be able to determine the appropriate relevant market and the respective market shares within that market, those efforts may be nullified by a court that finds otherwise.[239] Thus, the TTBER will often be useless to parties that intend to license nanotechnology in the EU.

3. Market Share Thresholds Are Futile

In addition to the difficulty of determining relevant markets and calculating market shares, reliance on the market share thresholds may frustrate the purpose of the TTBER. The EC enacted the TTBER to exempt from antitrust scrutiny those businesses that would be unlikely to reduce consumer welfare by wielding market power in the relevant market.[240] A business has market power when it can "force a purchaser to do something that he would not do in a competitive market."[241] In other words, market power is "the ability of a single seller to raise price and restrict output."[242] Generally, market share is used to give a rough assessment of market power.[243] However, market share does not always

235. *See* Schuessler-Langeheine, *supra* note 2, at 28.

> As long as a new technology is not distributed, the relevant market share remains at 0%. At the start of distribution the market share will increase and in the case of a great innovation the relevant thresholds will soon be exceeded, and in some cases even a market share of 100% is conceivable. As a result, all license agreements of such a licensor would no longer be within the safe harbour of the [TTBER].

Id. at 29.

236. *See* Image Technical Servs., Inc. v. Eastman Kodak Co., 125 F.3d 1195, 1203 (9th Cir. 1997).

237. Treacy & Heide, *supra* note 14, at 419.

238. A recent market forecast predicted that one facet of the nanotechnology market, nanomaterials, will grow at an annual rate of fifty-eight percent, to almost $13 billion in 2014. Zago, *supra* note 63, at 24. The overall market for nanotechnology is expected to be trillions of dollars at that time. *See* Albert P. Halluin, *Incorporation of Parts into the Whole: Avoiding Liability When Incorporating Nanotechnology Improvements*, 3 NANOTECH. L. & BUS. 25, 26 (2006).

239. Because the EC courts tend to define markets very narrowly, the market shares determined by courts will often exceed the low market share thresholds of the TTBER. *See* Benedict Bird & Adrian Toutoungi, *The New EC Technology Transfer Regulation: One Year On*, EUR. INTELLECTUAL PROP. REV. 28(5), 292, 294 (2006). To contrast, in the United States, an *individual* market share of between thirty percent and sixty-five percent is usually required to implicate antitrust laws from a market power perspective. *Image Technical Servs.*, 125 F.3d at 1206 (observing that "[c]ourts generally require a 65% market share to establish a prima facie case of [monopoly] power" (citing Am. Tobacco Co. v. United States, 328 U.S. 781, 797 (1946))).

240. Lars Kjolbye, *The New Commission Guidelines on the Application of Article 81(3): An Economic Approach to Article 81*, EUR. COMPETITION L. REV. 25(9), 566, 567 (2004).

241. Jefferson Parish Hosp. Dist. No. 2 v. Hyde, 466 U.S. 2, 14 (1984).

242. Fortner Enters., Inc. v. U.S. Steel Corp., 394 U.S. 495, 503 (1969).

243. "[T]he measurement of market power" has been described as "the most elusive and unreliable aspect of antitrust enforcement." Robert Pitofsky, *Antitrust in the Next 100 Years*, 75 CAL. L.

accurately reflect market power, and businesses with large market shares may not threaten consumer welfare.[244]

Market share is only one of several factors that contribute to a finding of dangerous market power. An accurate assessment of dangerous market power includes consideration of demand elasticity, supply elasticity, barriers to entry, the size of the relevant market, and the cause of the company's market power.[245] Because markets are dynamic and complex, these considerations are indispensable factors in a useful market power calculation.[246]

First, a company with a large market share may not possess significant market power if demand elasticity is high.[247] Demand elasticity is a measure that reflects the change in the demand for a product in reaction to a change in the price of the product.[248] For example, a company that introduces to the market a new dress shirt that has been enhanced by the incorporation of nanotechnology may be one of very few companies selling such a product. Accordingly, that company would have a large share of the market for nanotech dress shirts. However, if that company raises the price of the shirt by a small amount, as compared to the price of conventional dress shirts, consumers may be satisfied to purchase a conventional shirt from one of the many other clothing manufacturers. In that situation, the demand elasticity is high, and the company producing the nanotech shirt does not have the ability to raise and maintain prices above a competitive level.[249] Thus, while the company may have a large market share, it does not have significant market power.[250]

Second, the supply elasticity of the relevant market may significantly affect the ability of a company with a high market share to sustain supracompetitive prices.[251] Supply elasticity measures the ability of a company to switch from producing one type of product to another in response to a change in price.[252] High supply elasticity will limit a company's market power in the relevant market.[253] Many companies will

REV. 817, 825 (1987).

244. PATRICK A. MCNUTT, LAW, ECONOMICS AND ANTITRUST 276 (2005).

245. *See* William M. Landes & Richard A. Posner, *Market Power in Antitrust Cases*, 94 HARV. L. REV. 937, 947 (1981).

246. *Id.* at 947.

247. RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW 302 n.3 (4th ed. 1992). This principle also demonstrates that monopoly power in a market is variable. *Id.*

248. *See* Landes & Posner, *supra* note 245, at 940 n.8. The demand for a particular product is elastic if "consumers have alternative uses for their money to which they will turn in great number if the relative price of the product increases." POSNER, *supra* note 247, at 302 n.3.

249. *See* POSNER, *supra* note 247, at 303. "Indeed, its monopoly price may be lower than the competitive price . . . ." *Id.*

250. This example illustrates the inescapable conclusion that the definition of the relevant market and the calculation of market share are analytically intertwined. As a consequence, they are usually delineated together.

251. Ball Mem'l Hosp., Inc. v. Mut. Hosp. Ins., Inc., 784 F.2d 1325, 1335 (7th Cir. 1986).

252. *See* POSNER, *supra* note 247, at 300.

253. *See id.*

eventually be able to switch from conventional products to nano-products. Companies devoted to the development of foundational nanotechnology will be able to modify their technologies to allow incorporation into various types of products.[254] As a result, a company's power in such a market will be constrained by the ability of other companies to switch their production to substitutes for that company's product.[255]

Third, low barriers to entry in a relevant market may constrain a company's market power. A pertinent example of this phenomenon was explored in *United States v. Calmar, Inc.*,[256] a case involving a proposed merger between two companies with relatively large market shares in the relevant market. The court in *Calmar* examined a relevant market for different types of sprayers and dispensers.[257] Although the court found that Calmar had a large market share, it concluded that "even after the proposed merger the ease of entry into the market would prevent any supplier from exercising market power."[258] The court reasoned that a significant, sustained increase in price would cause new suppliers to enter the market and would cause users to find other sources of supply or to manufacture their own devices.[259] The court illustrated its findings with empirical evidence suggesting that Calmar's significant market share had no effect on the market in the past.[260]

The nanotechnology markets may prove to be very similar in nature to the market described in *Calmar*. Of particular concern are several factors that the court illustrated as examples of the market being "fluid and volatile."[261] One of these factors is consideration of products that "are simple, inexpensive, easily duplicated and easily modified or adapted to countless uses and esthetic tastes."[262] Other factors include whether there are numerous uses for the products; many alternatives to the products; alternative sources of supply for the products; and whether many firms have the capability to manufacture the products or sufficient

254. *See supra* notes 32-44 and accompanying text.
255. *See Ball Mem'l Hosp.*, 784 F.2d at 1335.
256. 612 F. Supp. 1298 (D.N.J. 1985).
257. *Id.* at 1300.
258. *Id.* at 1306; *see also* David Whelan, *Meet Marvell*, FORBES, Aug. 14, 2006, at 58, 58-62 (describing the quick market entry and success of Marvell Technology Group). "Marvell has dominated every market it has chosen to enter . . . ." *Id.* at 58. "Marvell now supplies chips for 90% of big corporate disk drives and half the chips for mass-market PC drives." *Id.* at 60.
259. *Calmar*, 612 F. Supp. at 1306.
260. *Id.* The court summarized by saying that,

> if one were to look at the totality of this particular market, one notes that it is so fluid and volatile both from the perspective of the product user and from the perspective of the product supplier, that it is unlikely that any firm, no matter how great its market share may be at any given time, could exercise market power very long.

Id. at 1307.
261. *Id.*
262. *Id.*

substitutes.[263] These factors likely will describe many nanotechnology markets.[264] Indeed, the cost of market entry is already low in comparison to entry costs for other types of markets.[265] Thus, nanotechnology companies may find themselves subject to an erroneous presumption that their high market share indicates that they are a threat to competition and consumer welfare.[266]

Finally, even a finding of significant market power may not be sufficient to warrant the application of antitrust law. The total size of the relevant market and the reason for the market power should be considered.[267] Antitrust litigation usually is quite expensive and time-consuming.[268] Because antitrust laws are established primarily to protect consumers, antitrust litigation is not justified if the economic activity in the relevant market does not affect a significant number of consumers.[269] Additionally, "when market power does accrue, it is usually the product of consumers choosing the new solution despite the availability of the old—hardly a scenario that should automatically raise concern."[270] Therefore, a useful assessment of dangerous market power must include these considerations.

4. Competition is Not Always Necessary for the Protection of Consumers

A company with significant market power that engages in anticompetitive practices may not offend the underlying purpose of antitrust law—the protection of consumer welfare.[271] Dynamic competition is replacing the rigid competition model that historically was accepted as

263. *Id.*

264. *See supra* notes 32-44 and accompanying text.

265. Kahn, *supra* note 15, at 104.

266. "Blind reliance upon market share, divorced from commercial reality, [can] give a misleading picture of a firm's actual ability to control prices or exclude competition." United States v. Syufy Enters., 903 F.2d 659, 664 (1990) (alteration in original) (quoting Hunt-Wesson Foods, Inc. v. Ragu Foods, Inc., 627 F.2d 919, 924 (9th Cir. 1980)). The court in *Syufy* found "no structural barriers" to market entry in that case:

> Syufy does not operate a bank or similar enterprise where entry is limited by government regulation or licensing requirements. Nor is this the type of industry, like heavy manufacturing or mining, which requires onerous front-end investments that might deter competition from all but the hardiest and most financially secure investors. Nor do we have here a business dependent on a scarce commodity, control over which might give the incumbent a substantial structural advantage. Nor is there a network of exclusive contracts or distribution arrangements designed to lock out potential competitors. To the contrary, the record discloses a rough-and-tumble industry, marked by easy market access, fluid relationships with distributors, and ample and continuous supply of product, and a healthy and growing demand. It would be difficult to design a market less susceptible to monopolization.

Id. at 666-67 (citations omitted) (footnotes omitted).

267. Landes & Posner, *supra* note 245, at 953.

268. Donald I. Baker & Mark R. Stabile, *Arbitration of Antitrust Claims: Opportunities and Hazards for Corporate Counsel*, 48 BUS. LAW. 395, 396 (1993).

269. Landes & Posner, *supra* note 245, at 953.

270. Masoudi, *supra* note 105.

271. TTBER GUIDELINES, *supra* note 194, at 2.

being the most consumer-beneficial system.[272] Increasingly, markets consist of smaller numbers of large companies that control the markets.[273] Because much of the world's nanotechnology development is protected by broad patent rights, nanotechnology markets are likely to follow this pattern.[274]

The nanotechnology markets may be best explained in terms of Joseph Schumpeter's "Dynamic Competition Model."[275] According to that model, such a market is characterized by a series of temporary monopolies that are periodically replaced by other temporary monopolies.[276] A tendency toward monopoly shares of a market by a nanotechnology company may be procompetitive because it may promote innovation.[277]

While a monopoly may exert temporary power over the market price, the resulting monopoly prices will attract companies that do not currently sell in the market.[278] The new companies that wish to enter the market will have incentive to innovate to compete effectively.[279] For example, if geographically removed companies have been prohibited from participating in a particular market because of high transportation costs, the monopoly prices may be high enough to cover these costs, lowering the barrier to entry for those companies.[280] Similarly, the monopoly prices may attract businesses that need the additional revenue to cover costs of obtaining manufacturing ability.[281] Thus, reliance on

272. *See* MCNUTT, *supra* note 244, at 281.
273. *Id.* at 278.
274. Vassar, *supra* note 228. This is especially true in the case of molecular manufacturing. *Id.*
275. *See* MCNUTT, *supra* note 244, at 194-95.
276. *Id.* at 195.
277. LANDES & POSNER, *supra* note 69, at 395.

> The more protection from competition a firm that succeeds in obtaining a monopoly will enjoy, the more competition there will be to become that monopolist; and provided that the only feasible or permitted means of obtaining the monopoly are socially productive, this competition may be wholly desirable rather than a form of wasteful rent seeking. A firm that will have the protection both of intellectual property law and of economies of scale in consumption if it is the first to come up with an essential component of a new-economy product or service will have a lucrative monopoly, and this prospect should accelerate the rate of innovation, just as, other things being equal, the more valuable a hoard of buried treasure is, the more rapidly it will be recovered.

Id. The benefit of this phenomenon will be more pronounced as nanotechnology matures and the cost of innovation and manufacturing (and thus, market entry) decreases significantly.

278. POSNER, *supra* note 247, at 302. "The less capital investment the creation of a substitute . . . involves, the less secure the . . . monopoly is." LANDES & POSNER, *supra* note 69, at 395. Thus, "the gale of creative destruction that [Joseph] Schumpeter described, in which a sequence of temporary monopolies operates to maximize innovation, conferring social benefits far in excess of the social costs resulting from the short-lived monopoly prices that the process entails, may be a reality." *Id.* Although Posner is talking about network monopolies (such as telephone service networks) here, the nanotech markets are analogous. This is partially because of the integration of nanotech into various existing markets. Moreover, the ease of entry to the nanotechnology markets and the sheer volume of potential applications thereof are likely to avoid the problems of too much innovation and the discouragement of further innovation by other firms, as discussed by Judge Posner. *See id.* at 396.
279. *See* MCNUTT, *supra* note 244, at 195.
280. POSNER, *supra* note 247, at 302.
281. *Id.* at 304.

market shares as reflections of dangerous market power in these situations is unwarranted.[282]

In addition to the incentive to innovate inherent in the dynamic competition model described above, these markets may increase efficiencies. "[T]he reward for successful innovation and cost minimization is often greater for the monopolist, since the competitive seller's success may be promptly duplicated by his rivals."[283] Additionally, large corporations may be better situated to further innovation because of their ability to combine vast amounts of technological and intellectual resources.[284] Large companies also are better able to undertake the risks of research and development.[285] Monopolistic businesses thus can be more efficient than competitors.[286]

B. Chills and Spills: Transaction Costs, Uncertainty and the Euro-Defense

All of these complications may lead to significant transaction costs for parties that license nanotechnology patents in the EU. The process of completing an accurate self-assessment may be hindered by the unavailability of relevant market data.[287] Moreover, potential licensors and licensees and their advisors simply do not have experience with conducting this type of assessment.[288] This lack of experience will add to training costs and will slow negotiations.[289] In fact, empirical evi-

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282. *Id.* Not only will it be difficult to predict who the likely entrants to the market are, but calculating the market shares of those firms will be difficult, as they do not yet have productive capability in the market. *Id.* The short-term threat that the current monopolist poses to these new entrants may not be serious enough in the long-term to warrant the application of antitrust law to the situation. *Id.* This is especially true in the case of nanotechnology. Moreover, public policy concerns may complicate the issue because a large amount of nanotechnology has been, and will be, publicly funded. Sabety, *supra* note 211, at 504-05. In fact, "the volume of venture capital flowing into nanotechnology is a minority slice of the entire nanotechnology R&D funding." *Id.*

> [T]he Bayh-Dole Act establishes that the IP generated by this combination of public and private funding will likely be privately owned in either case. In this manner, all of the publicly financed inventions in nanotechnology would effectively occupy the position of privately financed R&D. Thus, nanotechnology occupies a peculiar dichotomy: it is publicly funded, but the results of the R&D are privately held, as if it were privately funded . . . .

Id. at 505. It is not clear that public policy would counsel the strict application of rigid antitrust principles to markets that result from publicly funded technology.

283. POSNER, *supra* note 247, at 281.

284. *See id.*

285. *Id.* at 281.

286. *Id.* at 303.

287. "[A]dequate information is not always publicly available to allow the parties to calculate market shares or to assess whether they are competitors with any confidence." Bird, *supra* note 239, at 293.

288. *Id.*

289. *See id.*

> Intellectual property lawyers are now more likely to recommend that they check their assessment with antitrust colleagues. Parties are unlikely to want to incur the cost of working with consultant economists for any but the most important agreements. Training and education continue to be needed for the technology transfer community to acquire the necessary skills to apply the [TTBER].

Id.

dence suggests that parties have felt this effect even in the two years that the TTBER has been in force.[290]

The problem of transaction costs and delays is compounded by the requirement for constant review.[291] Ultimately, potential licensees may find it more efficient to invent around[292] or simply infringe the patents rather than license them in the EU. However, this is not the most serious danger of the new TTBER.

The self-assessment requirement is likely to lead to uncertainty surrounding licensing agreements.[293] The self-assessment will result in evidence that may be used in future antitrust actions, or indeed, actions on the license agreement itself.[294] A discrepancy between a party's self-assessment and that of a court may be fatal to a patent licensing agreement.[295] This may happen when a party files a claim to enforce a license agreement when the other party fails to comply with the terms of the agreement.

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290. *Id.* at 293-94.

291. Schuessler-Langeheine, *supra* note 2, at 37-38.

> It is possible that an agreement could be prohibited at some future point in time, in whole or in part, owing to changed circumstances. There is no ECJ case law on this exact point, but the UK Court of Appeal found that the enforceability of an agreement or a provision in that agreement may vary according to changes in market circumstances. In short, the legality and enforceability of an agreement are transient.

Treacy & Heide, *supra* note 14, at 419. Furthermore, "[g]iven the inherent nature of technology licensing, it is perhaps more likely that changes in circumstances may occur than with other types of agreements." *Id.* at 420. "[I]t is to be expected that transient voidness/legality will become a significant issue for IP agreements." *Id.*

292. Inventing around a patent consists of "achiev[ing] the technological benefits of the patent without duplicating the particular steps constituting it and thus without infringement." LANDES & POSNER, *supra* note 69, at 295.

293. Bird, *supra* note 239, at 294. "[T]he degree of legal certainty in carrying out the assessment . . . can be low . . . ." *Id.*

> [F]irms making investment decisions seek clear, predictable rules as to how the intellectual property and antitrust regimes will function together—or interoperate. If a successful firm's rivals believe that a different product would create more consumer welfare, antitrust policy should encourage them to create that product—they should not find government regulators willing to eliminate the need to design it at all.

Barnett, *supra* note 81.

294. Valentine Korah, *Draft Block Exemption for Technology Transfer*, EUR. COMPETITION L. REV. 25(5), 247, 261 (2004). "The avoidance of uncertainty is the reason that the Agencies in the United States look not so much at market shares, but rather to the other firms likely to conduct [R&D] in the market. That has the additional advantage of being forward looking." *Id.*

295. One court concluded that "[i]t was not suggested that Article 81(1) of the Treaty would invalidate only part of the Agreement. It follows that the Agreement as a whole would be invalidated and there could be nothing left to enforce." Frazer (Willow-Lane) Ltd. v. Nissan Motors (GB) Ltd., [2003] EWHC (Ch) 3157, [51] (Eng.), *available at* 2003 WL 23192244. This year, a court proclaimed that "any agreements or decisions prohibited pursuant to Article 81 EC are void." Joined Cases C-295 to C-298/04, Manfredi v. Assicurazioni, 2006 E.C.R. 00, ¶ 56. "Since the invalidity . . . is absolute, an agreement which is null and void by virtue of [Article 81] has no effect as between the contracting parties and cannot be invoked against third parties." *Id.* ¶ 57. Moreover, "that principle of invalidity can be relied on by anyone, and the courts are bound by it." *Id.* However, the Treaty's power extends even further. The invalidity is "capable of having a bearing on all the effects, either past or future, of the agreement or Decision." Case 48/72, Brasserie de Haecht v. Janssen, 1973 E.C.R. 77, ¶ 26. Thus, nullification of an agreement pursuant to Article 81 is retroactive. *Id.* ¶ 27. "It follows that any individual can claim compensation for the harm suffered where there is a causal relationship between that harm and an agreement or practice prohibited under Article 81 EC." *Manfredi*, 2006 E.C.R. ¶ 61.

The defendant may invoke the so-called "Euro-Defense" by arguing that the agreement is invalid because it violates Article 81(1). If the defendant can convince the court to calculate a market share that exceeds the threshold, the agreement will be unable to take advantage of the TTBER's protection. Thus, the agreement may be declared void, and the plaintiff will be unable to enforce the defendant's obligations under the agreement. The danger here is that the plaintiff will not know if its agreement will be valid until that issue is decided in litigation. By then, it may be too late.

Uncertainty and the Euro-Defense may therefore increase the incentive to infringe patents and, at the very least, avoid executing licensing agreements that affect the EU.[296] United States firms likely will be hesitant to execute agreements that may affect EU markets.[297] Conversely, firms based in EU member states will be enticed to filter their products and technology into the United States market to avoid the EU market.[298] The effects on both the EU and United States markets could be devastating. United States firms will find it hard to compete with their foreign counterparts at home. This may ultimately cause a disruption to the international cooperation that is vital to the efficient and safe development of nanotechnology.[299] As a result, nanotechnology innovation may be hindered.[300]

C. What Should be Done?

The EU should eliminate the self-assessment requirement of the TTBER. The TTBER should be considered only in the context of litigation. For example, in the United States, parties only address the issues of market share and market power in litigation. Thus, parties to antitrust actions in the United States do not have to worry that a court will void an agreement executed in reliance on the accuracy of self-assessments. The same should be true for licensors and licensees in the EU markets.

At the very least, market share thresholds should be abolished altogether. Instead, the inquiry should focus on whether the parties have dangerous market power. Market shares alone do not provide a sufficient proxy for market power.[301] Moreover, the risks of a firm obtaining dangerous market power through the use of restrictive licenses will likely be tempered by market forces in the case of nanotechnology.[302]

296. *See* Treacy & Heide, *supra* note 14, at 420.
297. *Id.*
298. Korah, *supra* note 294, at 261.
299. *See id.* at 261-62.
300. *Id.* at 261.
301. *See supra* Part III.A.3.
302. The market usually regulates itself anyway, and this will be especially true in the case of

While patent laws confer upon the patent owner the right to exclude others from making, using, selling, offering for sale, or importing the invention, they do not confer a right to prevent others from inventing around the patented subject matter.[303] The freedom to invent around a patent "is a limitation on the monopoly power that the patent right confers."[304] Consequently, it is a limitation of the monopoly power that a patent owner may exercise through restrictive licensing.

Additionally, the antitrust analysis involved in the TTBER should be adjusted according to whether the relationship between the parties is horizontal or vertical. The United States uses this characterization, rather than the EU's characterization of whether the parties are competitors, because it is easier to determine and allows the law to give considerably more leeway to parties in vertical relationships.[305] Vertical restrictions often increase efficiency and decrease costs for parties, which can lead to considerable amounts of innovation, making them desirable.[306]

IV. CONCLUSION

The United States and the EU must rely upon competitive technological advancement for their continued economic success. That technological advancement is likely to depend upon nanotechnology innovations. The freedom to use restrictive licenses is essential to future competition and innovation in the nanotechnology field. Antitrust laws and regulations should not be allowed to hinder innovative efforts and the licensing regimes that result, especially when those efforts cross international borders.

The EU must therefore abolish the initial self-assessment requirement of the TTBER and eliminate the market share thresholds in favor of an economic approach similar to that of the United States. The protections of the TTBER are important only in the context of litigation and should therefore be considered only in that context. If the EU does not follow this advice, companies likely will be reluctant to license nanotechnology patents in the EU. This chilling effect likely would result in a devastating reduction in nanotechnology innovation, limiting the future economic success of both the EU and the United States.

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such fast-moving technology. *See* Barnett, *supra* note 81 ("Market discipline can be a powerful force.").

303. *See* 35 U.S.C. § 271(a) (2000).

304. LANDES & POSNER, *supra* note 69, at 295.

305. Makan Delrahim, Deputy Assistant Attorney General, US and EU Approaches to the Antitrust Analysis of Intellectual Property Licensing: Observations from the Enforcement Perspective, Remarks at the Spring Meeting of the ABA, Section of Antitrust Law (Apr. 1, 2004), *available at* http://www.usdoj.gov/atr/public/speeches/203228.pdf.

306. *Id.*