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Antitrust Overreach: Undoing Cooperative Standardization in the Digital Economy

Jonathan M. Barnett
University of Southern California

ANTITRUST OVERREACH: UNDOING COOPERATIVE STANDARDIZATION IN THE DIGITAL ECONOMY

*Jonathan M. Barnett**

ABSTRACT

Information technology markets in general, and wireless communications markets in particular, rely on standardization mechanisms to develop interoperable devices for data processing, storage and transmission. From 2G through the emergent 5G standard, wireless communications markets have largely achieved standardization through cooperative multi-firm arrangements that likely outperform the historically dominant alternatives of government monopoly, which is subject to informational deficits and regulatory capture, and private monopoly, which suffers from pricing and other distortions inherent to protected market positions. This cooperative process has successfully relied on three key legal elements: reasonably secure patents, quasi-contractual licensing commitments supplemented by reputation effects, and targeted application of antitrust safeguards against collusion risk. Over approximately the past decade, antitrust agencies and courts in the U.S., Europe and Asia have taken actions that threaten this legal infrastructure by limiting patentees' ability to seek injunctive relief, adopting rigid understandings of "fair, reasonable and non-discriminatory" licensing principles, and addressing collusion risk among licensors-innovators while overlooking (and even exacerbating) collusion risk among licensees-implementers. These judicial and regulatory interventions in IP licensing markets shift value from firms and economies that specialize in generating innovations to firms and economies that specialize in integrating innovations into end-user products. These entity-level and

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country-level redistributive effects are illustrated by lobbying activities in the wireless communications markets and antitrust actions against IP licensors in jurisdictions that have substantial net IP deficits and are principally populated by IP licensees. Current antitrust policy promotes producers' narrow interests in lower input costs while ignoring the broader public interest in preserving the cooperative standardization structures that have supported innovation and commercialization in the digital economy.

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INTRODUCTION

Modern information and communications technology ("ICT") markets depend on standardization and interoperability to achieve the scale economies, communication efficiencies and network effects that have generated radical reductions in user-to-user, business-to-business, and business-to-user transactions. The low-cost, high-quality transmission of data among individuals and entities using Apple iPhones, Samsung Galaxy smartphones, Dell laptops, and Amazon tablets relies on the institutional "plumbing" supplied by the organizational and contractual arrangements that drive market standardization. The growth of standard-dependent technology markets is remarkable. On a worldwide basis, unit shipments in the smartphone industry grew from 123.9 million in 2007 to 1.47 billion in 2017 while the total value of shipments grew from $52 billion in 2007 to $452 billion in 2015.[1] These figures will undoubtedly expand as the 5G network and associated "Internet of Things" are deployed by device makers and telecommunications carriers in household, business and industrial environments. The emerging 5G environment follows the successful implementation of the 2G/GSM, 3G/UMTS and 4G/LTE standards over a period of almost three decades starting with the commercial launch of a 2G/GSM network in 1991.[2] The 5G network will comprise data exchange not only between individuals but also between devices[3], thereby bolstering the necessity to main-

1. Jason Dedrick & Kenneth L. Kraemer, *Intangible Assets and Value Capture in Global Value Chains: The Smartphone Industry* 3-4 (World Intellectual Prop. Org., Working Paper No. 41, 2017).

2. Each "generation" (or "G") in wireless communications reflects an increase in the efficiency with which data can be transmitted, enabling the evolution of wireless markets from mostly voice transmission to the transmission of all types of voice and non-voice data. *See* Rafael Saraiva Campos, *Evolution of Positioning Techniques in Cellular Networks, from 2G to 4G,* WIRELESS COMMS. AND MOBILE COMPUTING 2017, at 1, 2. On the historical timeline of wireless communications standards, see Mudit Ratana Bhalla & Anand Vardhan Bhalla, *Generations of Mobile Wireless Technologies: A Survey,* 5 INT'L J. COMPUTER APPLICATIONS 26 (2010).

3. On the core technological elements and practical applications of 5G networks, see Nicolo Zingales, *Of Coffee Pods, Videogames and Missed Interoperability: Reflections for EU Governance of the Internet of Things* (Tilburg Law and E. Ctr., Discussion Paper 2015-026, 2015); Firooz B. Saghezchi et al., *Drivers for 5G: The 'Pervasive Connected' World, in* FUNDAMENTALS OF MOBILE NETWORKS, 6-11 (Jonathan Rodriguez ed., Wiley 2015); Peter

tain standardized pathways for information transmission. This transformational shift presents not only a technological challenge but also an organizational challenge that demands an appropriate institutional environment to support the necessary R&D and commercialization investments by technology innovators and implementers.

Nothing less than the institutional structure of the information technology markets has been targeted by antitrust agencies in the United States, and other commercially significant jurisdictions, over the past decade. This regulatory campaign has culminated in the landmark antitrust litigation brought by the Federal Trade Commission (the "FTC") against Qualcomm, a semiconductor firm that is widely recognized as the leading innovator in the smartphone industry.[4] On May 21, 2019, the district court in the FTC suit issued an expansive order (which Qualcomm plans to appeal as of this writing[5]) requiring that Qualcomm re-negotiate hundreds of "standard-essential" patent ("SEP") licenses with device manufacturers and offer new SEP licenses to any interested chip manufacturers.[6] If upheld on appeal, this order would substantially rewrite the "rules of the game" in patent licensing for the smartphone market. Prior to and concurrently with the FTC suit, competition regulators (excepting a policy shift in November 2017 at the Department of Justice ("DOJ")'s Antitrust Division[7]) in the U.S., China, the European Union, South Korea, and Taiwan have similarly sought to limit firms' ability to enforce patents and patent licenses in the smartphone market.[8] Both regulators and a concurrent scholarly literature have repeatedly asserted that patents and patent licenses impose a "tax" that threatens the standard-setting initiatives that have accompanied the 2G, 3G, and 4G networks.[9]

Rost et al., *Mobile Network Architecture Evolution Toward 5G,* IEEE COMMS. MAG., May 2016, 84.

4. On Qualcomm's pioneering innovation in the wireless communications market, see DAVE MOCK, THE QUALCOMM EQUATION: HOW A FLEDGLING TELECOM COMPANY FORGED A NEW PATH TO BIG PROFITS AND MARKET DOMINANCE 47-79, 175-85 (2005); Sanford Lakoff, *Upstart Startup: "Constructed Advantage" and the Example of Qualcomm,* 28 TECHNOVATION 831 (2008).

5. *See* Stephen Nellis, *Qualcomm asks U.S. judge to put anti-trust ruling on hold while chipmaker appeals,* REUTERS (May 28, 2019), https://www.reuters.com/article/us-qualcomm-antitrust/qualcomm-asks-u-s-judge-to-put-anti-trust-ruling-on-hold-while-chipmaker-appeals-idUSKCN1SZ04R.

6. Findings of Fact and Conclusions of Law at 227-29, F.T.C. v. Qualcomm, Inc., No. 17-CV-00220-LHK (N.D. Cal. May 21, 2019).

7. On the policy shift at the DOJ, dating from November 2017, *see infra* note 221 and accompanying text.

8. *See infra* note 261, Table 5 and accompanying text.

9. *See, e.g.,* Press Release, FTC, FTC Charges Qualcomm With Monopolizing Key Semiconductor Device Used in Cell Phones (January 17, 2017), https://www.ftc.gov/news-events/press-releases/2017/01/ftc-charges-qualcomm-monopolizing-key-semiconductor-device-used (claiming that royalties assessed by Qualcomm "amount to a tax on the manufacturers' use of baseband processors manufactured by Qualcomm's competitors").

In this Article, I show that this argument has things exactly backward: patents and patent licenses *support* the standardization mechanisms that have driven the exceptional success of the smartphone markets. It is regulators' top-down interventions, rather than the bottom-up network of voluntarily negotiated licensing agreements, that threaten to unravel this remarkable market-driven mechanism for incentivizing innovation, standardization, and dissemination of new technologies across a wide array of products and services for end-users.

The regulatory and academic near-consensus[10] relies on a false factual premise that leads to misguided policy. The factual premise is mistaken because there is simply no compelling empirical evidence to support regulators' claims that even the largest patent owners widely engage in "patent holdup" or "royalty stacking," or even have rational incentives to do so.[11] Consistent with the exceptional growth of the smartphone industry, all empirical studies have reached relatively modest estimates of the total royalty burden typically borne by device manufacturers.[12] The policy conclusion is mistaken because it ignores the basic fact that a secure legal foundation of property rights and contract is a necessary predicate to induce innovators to undertake high-cost, high-risk R&D and then disclose the results in a standard-setting process over which no individual firm exerts unilateral control. If that legal predicate is no longer satisfied, firms that currently specialize in innovation are likely to reduce R&D activities, withdraw from standard-setting activities, or construct closed innovation environments in which firms monetize R&D through proprietary hardware and software products. All those outcomes are almost certainly inferior relative to the *status quo*.

Following the conventional view, scholars and regulators have widely predicted that the combination of abundant intellectual property ("IP") rights, multiple IP holders, and multi-component systems that characterizes wireless device markets is liable to yield a "tragedy of the anti-commons"[13] in which high IP density inflates prices, reduces access and impedes innovation.[14] Those types of statements can be found in scholarly publications, in-

10. To be sure, there are exceptions. For contributions that discuss the enabling role of patents in technology standardization, see for example, Kristen Jakobson Osenga, *Ignorance over Innovation: Why Misunderstanding Standard Setting Organizations Will Hinder Technological Progress,* 56 U. LOUISVILLE L. REV. 159, 159-60 (2018); David J. Kappos, *Innovation-Based Technology Standards Are Under Threat,* MIT SLOAN MGMT. REV. (Feb. 2, 2018), https://sloanreview.mit.edu/article/innovation-based-technology-standards-are-under-threat/.

11. For discussion, see *infra* notes 149-156 and accompanying text.

12. *See id.*

13. For the original application of this concept in the IP context, with respect to biomedical research, see Michael Heller & Rebecca Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research,* 280 SCIENCE 698 (1998).

14. *See, e.g.,* Carl Shapiro, *Navigating the Patent Thicket: Cross Licenses, Patent Pools and Standard Setting, in* 1 INNOVATION POLICY AND THE ECONOMY 120-21 (Adam B. Jaffe et al. eds., 2001) (describing concerns that a "patent thicket" can slow down innovation). For

fluential reports issued by the DOJ, the FTC and the Patent & Trademark Office ("PTO") from 2003 through 2013[15], and statements made by competition agencies in the European Union and Asian jurisdictions.[16] Some scholars are already making similar claims before the Internet of Things has even been deployed, arguing that intensive patent usage in that market "is likely to cause significant social welfare loss in the years ahead."[17]

This near-consensus among much of the scholarly and policymaking communities faces one minor difficulty: it does not describe any actual real-world market. As the wireless communications industry has moved from 2G to 3G to 4G standards, patent issuance and the dispersion of patent ownership has increased.[18] The consensus view would expect to observe some combination of increased prices, reduced output, blocked entry, and delayed innovation. Yet markets have disobeyed that theory. Quality-adjusted prices on mobile telephone devices and computing equipment have fallen, smartphone devices have rapidly achieved high rates of adoption in consumer markets, entry rates in device production have remained robust, and computing and communications functionalities have continuously improved.[19]

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detailed critical reviews of these arguments, see J. Gregory Sidak, *Is Patent Holdup a Hoax?,* 3 CRITERION J. INNOVATION 401, 435-45 (2018) [hereinafter Sidak, *Hoax*]; Jonathan M. Barnett, *Has the Academy Led Patent Law Astray?*, 32 BERK. TECH. L. J. 1313, 1338-56 (2017) [hereinafter Barnett, *Has the Academy*].

15. U.S. DEP'T OF JUSTICE & U.S. PATENT & TRADEMARK OFF., POLICY STATEMENT ON REMEDIES FOR STANDARDS-ESSENTIAL PATENTS SUBJECT TO VOLUNTARY F/RAND COMMITMENTS 4, 6 n.13 (2013) [hereinafter DOJ/USPTO REPORT 2013]; FTC, THE EVOLVING IP MARKETPLACE: ALIGNING PATENT NOTICE AND REMEDIES WITH COMPETITION 28, 191, 234-35 (2011) [hereinafter FTC REPORT 2011]; FTC & U.S. DEP'T OF JUSTICE, ANTITRUST ENFORCEMENT AND INTELLECTUAL PROPERTY RIGHTS: PROMOTING INNOVATION AND COMPETITION 8, 35, 42, 57, 95 (2007) [hereinafter FTC/DOJ REPORT 2007]; FTC, TO PROMOTE INNOVATION: THE PROPER BALANCE OF COMPETITION AND PATENT LAW AND POLICY, *Executive Summary* at 6, 7, 15, ch.1 at 33, ch. 2 at 3, ch. 3 at 30, 37-38, ch. 4 at 5 (2003).

16. For discussion of this global trend, see Douglas H. Ginsburg et al., *The Troubling Use of Antitrust to Regulate FRAND Licensing,* 10 CPI ANTITRUST CHRON. 2, 2 (2015). For an example, see Commission Decision of Apr. 29, 2014, Case AT.39939 – Samsung – Enforcement of UMTS Standard Essential Patents 11 (EC).

17. *See* Fiona Scott Morton & Carl Shapiro, *Patent Assertions: Are We Any Closer to Aligning Reward to Contribution?*, *in* 16 INNOVATION POLICY AND THE ECONOMY 89, 124 (2016) ("For example, the 'Internet of Things' is a new and growing area where royalty stacking and patent holdup appear to be very real dangers.").

18. *See* JORGE PADILLA ET AL., ECONOMIC IMPACT OF TECHNOLOGY STANDARDS 19 tbl. 7 (COMPASS LEXECON 2017). On the increase in patent issuance relating to the smartphone market, see WORLD INTELLECTUAL PROP. ORG., WORLD INTELLECTUAL PROPERTY REPORT 2017: INTANGIBLE CAPITAL IN GLOBAL VALUE CHAINS 106, 110 (2017) [hereinafter WORLD IP REPORT].

19. *See infra* notes 153-156 and accompanying text. For detailed discussion of this evidence, see Barnett, *Has the Academy, supra* note 14, at 1338-61.

The now-standard view has a clear normative implication: namely, weaken IP rights and intervene in privately negotiated licensing arrangements to "protect" the public interest against opportunistic enforcement and royalty rate-setting by patent owners. Illustrated most vividly by the sweeping order issued in the *FTC v. Qualcomm* litigation[20], courts and regulators in the U.S. and other commercially significant jurisdictions (again, with the recent exception of the DOJ Antitrust Division[21]) have adopted policies that threaten the security of SEPs and the associated licensing infrastructure that stands behind the smartphone and related ICT markets. Specifically, courts and regulators have largely withdrawn the possibility of injunctive relief for SEP owners while regulators have advocated approaches for determining "reasonable royalties" in SEP infringement litigation and SEP licenses that would effectively reallocate market surplus away from innovators and toward device producers. This regulatory and judicial "reset" of the property rules in ICT markets distorts market negotiations between innovator-firms that supply the smartphone market with R&D inputs and producer-firms that embed those inputs into devices for the end-user. If there is no credible threat of injunctive relief, a downstream firm that can fund an extended litigation process (an assumption easily satisfied by the largest branded handset manufacturers) will elect what some industry observers now call "efficient" infringement[22]: that is, use the upstream firm's technology and then negotiate the royalty rate in the courthouse, rather than the marketplace.

The sequence of policy actions pursued by competition regulators in the U.S. and other jurisdictions has overlooked the patent-dependent organizational mechanisms that have supported both robust R&D investment and standardization initiatives in wireless communications markets. For several decades, those markets have achieved those two objectives through a bottom-up process of private ordering rooted in three legal anchors: (i) reasonably secure IP rights, (ii) quasi-contractual commitments informed by reputational norms, and (iii) surgically applied antitrust safeguards against collusion. A secure foundation of IP rights and contract enforcement is necessary to induce an innovator-firm to invest in R&D and contribute the resulting output toward a collective standard-setting initiative. A rational manager will only allocate resources to these high-cost, high-risk activities on the expectation that the firm can expect ultimately to earn returns through licensing relationships with producer-firms that have the capital and expertise to embody R&D in products for the end-user market. From a competition policy perspective, this vertically disaggregated structure, over

20. *See supra* notes 5–6 and accompanying text.

21. On the policy shift at the DOJ, dating from November 2017, *see infra* note 211 and accompanying text.

22. *See, e.g.,* Michael T. Renaud et al., *Efficient Infringement and the Undervaluation of Standard-Essential Patents,* 79 INTELL. ASSET MGMT. 59 (2016).

which no individual firm can exercise control, compares favorably with more historically prevalent mechanisms for achieving standardization through the coercive power of a government monopoly regulator or the market power wielded by a single dominant firm.

The approximately three-decade history of wireless communications networks has shown how standardization can be achieved without government direction, thereby harnessing the superior information-gathering and processing capacities of the private market, but without entrenching a single dominant incumbent, thereby avoiding the pricing, output, and other distortions inherent to a monopolized market. When this occurs, there is no quasi-utility entity setting the standard, and government intervention counterproductively substitutes an *ad hoc* rate-setting process, as implemented through legal proceedings, for the collective judgment of market actors, as expressed through the price discovery mechanism. As scholars working in the public choice tradition have emphasized and documented, resource allocation through the political process presumptively underperforms resource allocation through the market due to inherent informational disadvantages, bureaucratic delay and the susceptibility of political entities to capture by well-organized rent-seeking constituencies.[23] In the wireless communications markets, a consistent pattern of political-economic behavior supplies substantial ground for the latter concern, at both the "firm level" and the "country level." Since the inception of these markets, firms and countries that specialize in the production, assembly and distribution segments of the ICT supply chain have advocated for, and achieved substantial success in securing, outcomes in antitrust and patent law that attenuate patent owners' ability to bring enforcement actions against, and negotiate licensing fees with, intermediate users. From a privately interested perspective, the logic is self-evident. Weakening patents shifts the "IP balance of trade" in favor of firms and countries that principally occupy downstream portions of the ICT supply chain while potentially undercompensating firms that specialize in upstream R&D. From a publicly interested perspective, however, regulatory and judicial interventions that erode the property rights and contracting infrastructure behind wireless technology markets endangers the cooperative standardization mechanisms that have supported innovation and commercialization in these markets.

This Article comprises five parts. In Part I, I review the efficiency gains that are attributable to standardization and the principal mechanisms by which ICT markets have achieved standardization. In Part II, I compare the net welfare effects of each principal standardization mechanism. In Part III,

23. For classic statements of this view, see ROBERT E. EKELUND, JR. & ROBERT D. TOLLISON, POLITICIZED ECONOMIES: MONARCHY, MONOPOLY AND MERCANTILISM 27-46 (1997); ROBERT E. EKELUND, JR. & ROBERT D. TOLLISON, MERCANTILISM AS A RENT-SEEKING SOCIETY: ECONOMIC REGULATION IN HISTORICAL PERSPECTIVE 3-25 (1981).

I show that secure IP rights and contract enforcement are a critical predicate for enabling cooperative standardization without recourse to a monopolist entity, whether a government regulator or a dominant incumbent. In Part IV, I explore how regulators and courts' recent interventions in wireless markets endanger cooperative standardization by eroding the security of patents and associated licensing agreements. In Part V, I show how these policy choices advantage firms and economies that specialize in implementation over firms and economies that specialize in innovation, posing risks to a successful innovation ecosystem. Then, I briefly conclude.

I. STANDARDIZATION IN TECHNOLOGY MARKETS: FOUNDATIONAL OBSERVATIONS

This Part addresses two foundational elements in the policy analysis of standardization processes. First, I review the economic benefits that can be reasonably attributed to successful standardization initiatives in technology markets. Second, I review the fundamental types of mechanisms by which governments and markets have sought to achieve standardization.

A. *The Social Value of Standardization*

It is widely recognized that standardization is a precondition for achieving the interoperability that characterizes contemporary ICT markets.[24] Consumers are accustomed to expect that an HP printer can communicate with a Dell PC, or a Samsung handset can communicate with an Apple iPhone, which can in turn communicate with an LG television. But this market structure is not self-evident. Until the launch of the IBM PC in 1981, a user who sought to put together a computing package was generally compelled to purchase all components from a single provider.[25] As the digital economy now proceeds toward engineering a complex network of information pathways between home, office, and industrial devices that extend beyond traditionally defined ICT markets, the importance of interoperability will only increase. The web of data-gathering, processing and transmission relationships that will characterize the 5G ecosystem will depend on standardized protocols by which individual and entity-level users can gather, exchange and analyze data with speed, reliability, and security.[26] This standardization

24. For general treatments of the economics of standardization, with a focus on ICT markets, see KNUT BLIND, THE ECONOMICS OF STANDARDS: THEORY, EVIDENCE, POLICY (2004); PETER GRINDLEY, STANDARDS, STRATEGY AND POLICY: CASES AND STORIES 1-54 (1995); Paul A. David & Shane Greenstein, *The Economics of Compatibility Standards: An Introduction to Recent Research,* 1 ECON. INNOVATION & NEW TECH. 3 (1990).

25. *See* GRINDLEY, *supra* note 24, at 163-64.

26. *See* Saghezchi et al., *supra* note 3, at 3 (stating that "[g]lobal standards are a fundamental cornerstone in reaching ubiquitous connectivity, ensuring worldwide interoperability, enabling multi-vendor harmonization and economies of scale").

process has three principal pro-competitive effects: (i) increased network effects; (ii) reduced entry costs; and (iii) reduced hold-up risk.

1. Network Effects

Network effects refer to the fact that the consumption value of certain goods increases as a function of the number of other users, or the number of uses, of those goods.[27] This is an inherent characteristic of communication devices (for example, a cellphone has greater consumption value as the number of other users of cellphones increases) and communication platforms (for example, Facebook), and a common, if not typical, characteristic of certain computing devices or components of a larger computing environment (for example, the Windows operating system has greater consumption value as the number of Windows-compatible applications increases). Standardization amplifies network effects (and hence, the value of the relevant device or platform) by increasing the number of users with whom any individual user can communicate—or, more precisely, by minimizing the costs incurred by any individual user to communicate with other users.[28] A vivid illustration is provided by the adoption of the GSM standard in the European wireless telecommunications markets starting in the early 1990s. This development created a transnational market for digital transmission of voice communications among hundreds of millions of users, a substantial improvement over what had previously been mostly localized national markets separated by incompatible country-specific standards.[29]

2. Entry Costs

Standardization and interoperability lower entry costs by relieving firms from having to provide an "end-to-end" package of complementary goods and services. This was not the case in the computing markets that predated the advent of the PC: computing firms typically supplied business customers with a complete, or substantially complete, bundle of hardware and software solutions.[30] Given that these packages were not typically interoperable with each other, any new competitor was required to deliver a functionally comparable and approximately cost-equivalent package of products and services. By contrast, in today's "plug and play" computing market, an assembler firm such as Dell can offer customers a bundle comprised of software

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27. *See* S.J. Liebowitz & Stephen E. Margolis, *Network Effects and Externalities, in* 2 THE NEW PALGRAVE DICTIONARY OF ECONOMICS & THE LAW 671 (Peter Newman ed., 1998).

28. *See* GRINDLEY, *supra* note 24, at 2.

29. *See* Rudi Bekkers et al., *Intellectual Property Rights and Standardization: The Case of GSM,* 26 TELECOMM. POL'Y 171, 186 (2002).

30. MICHAEL D. SCOTT, SCOTT ON INFORMATION TECHNOLOGY LAW xxii (3d ed. 2018).

and hardware components supplied by multiple firms. Given a common technological standard, a firm can contemplate entry into a particular ICT market by providing only a superior product or service at a single point on the supply chain[31] or operating as an assembler entity that integrates components supplied by firms with different areas of specialization. This reduces, potentially dramatically, the costs and expertise required to achieve viable entry into a technology market. In the aggregate, the economically attractive results include increased entry opportunities, specialization of labor, and price and quality competition throughout the supply chain.

3. Hold-Up Risk

Any new technology demands that intermediate and end-users incur significant adoption, learning, and other costs. If a user expects to incur comparable costs in switching to any alternative technology, then it anticipates that a technology provider may have incentives to adversely change the terms of access once the user has made the necessary investment to adopt the provider's technology. This scenario is an application of the standard hold-up problem in industrial organization. In its simplest form, the hold-up problem arises whenever one party has made a substantial investment in a business relationship and that investment has no or lesser value in any other use. Setting aside reputation effects or contractual protections, the non-investing party (or the party that has not made a comparably-sized investment in the relationship) then has an incentive to unilaterally alter the terms of the relationship to its advantage given that the investing party cannot credibly threaten to exit except at a substantial loss.[32] In the technology context, this implies that a provider will have an incentive to expropriate value from a user in an amount almost equivalent to the switching costs that the user would incur in migrating to an alternative technology.

Standardization can attenuate the hold-up problem by reducing users' switching costs. To the extent that users do not purchase a complete bundle sold by a single firm but rather have the ability to "mix and match" components from multiple firms, they have lower switching costs. As a consequence, the provider of any particular component (or an assembler that mar-

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31. For relevant discussion, see PADILLA ET AL., *supra* note 18, at 24, 32; BLIND, *supra* note 24, at 17. On the movement of the computing industry from vertically integrated firms that offered stand-alone computing packages to horizontally specialized firms that offer interoperable components, see Joel West, *Does Appropriability Enable or Retard Open Innovation?*, *in* OPEN INNOVATION: RESEARCHING A NEW PARADIGM (Henry Chesbrough et al. eds., 2006).

32. For the classic source, see OLIVER E. WILLIAMSON, THE ECONOMIC INSTITUTIONS OF CAPITALISM 52-61 (1985). For related and widely-cited treatments, see Oliver E. Williamson, *Transaction-Cost Economics: The Governance of Contractual Relations,* 22 J.L. & ECON. 233, 234 (1979); Benjamin Klein et al., *Vertical Integration, Appropriable Rents and the Competitive Contracting Process,* 21 J.L. & ECON. 297, 297-98 (1978).

kets a package of components) has more limited (although still some) hold-up opportunities. In the aggregate, this operates to the benefit of both providers and users in technology markets. If lower switching costs imply that providers will have more limited hold-up opportunities, then users will no longer demand a discount at the time of adoption to reflect the risk of rationally opportunistic behavior on the part of the provider. The result is a virtuous cycle in which market adoption and size expand, enhancing the network effects, entry opportunities and specialization efficiencies discussed above.

B. *Paradigm Standardization Mechanisms*

Technology standardization represents a coordination problem in which at least a substantial portion of the relevant market must converge upon a common platform on the basis of which firms can develop complementary products and services, each of which then interacts with one another with minimal transactional friction. Both in theory and as a matter of historical experience, there are three types of mechanisms by which economies have achieved (or have sought to achieve) this objective: (i) standardization by a government regulator; (ii) standardization by a dominant firm; and (iii) standardization by cooperative action.[33]

1. Standardization by Government Monopoly

A government entity can specify a particular standard and, using the coercive power of law, compel market actors to comply with that standard. This mechanism is widely used in food and ethical drug markets by the U.S. Department of Agriculture and the Food & Drug Administration, in the automotive market by the National Transportation Safety Board, and in the aviation industry by the Federal Aviation Administration.[34] In a variant on this option, the government may mandate a generally defined standard and then rely on designated private entities to execute the remainder of the

33. For a similar tripartite distinction between governmental, cooperative and monopolist forms of standardization, see Osenga, *supra* note 10, at 164; PADILLA ET AL., *supra* note 18, at 3, 36; Sean P. Gates, *Standards, Innovation, and Antitrust: Integration Innovation Concerns into the Analysis of Collaborative Standard Setting,* 47 EMORY L.J. 583, 597-98 (1998). Much of the literature relies on a more general distinction between *de facto* and *de jure* standardization, in which the former refers to market standardization by a dominant firm or a coalition of firms (sometimes called a consortium) and the latter refers to standardization by a governmental body or a recognized standardization entity that operates on a nonprofit basis. *See, e.g.,* GRINDLEY, *supra* note 24, at 25; Joel West, *The Economic Realities of Open Standards, in* STANDARDS AND PUBLIC POLICY 94 (eds. Shane Greenstein & Victor Stango eds., 2007) [hereinafter West, *Economic realities*]; David & Greenstein, *supra* note 24, at 4.

34. For a discussion of these and other government standard-setting agencies, see SAMUEL KRISLOV, HOW NATIONS CHOOSE PRODUCT STANDARDS AND STANDARDS CHANGE NATIONS 117-18 (1997).

standard-setting and standard-compliance process.[35] A well-known example in the U.S. context is the role of the leading credit rating firms, Standard & Poor's and Moody's, on which the Securities and Exchange Commission partially relies in executing certain regulatory objectives.[36] In other markets, governments have explicitly or implicitly recognized certain national and international organizations (for example, the American National Standards Institute) as the exclusive standard-setting entity, which in turn sometimes delegates standard-setting or accreditation functions to regional and industry-specific entities.[37]

2. Standardization by Private Monopoly

A firm that has a sufficiently large share of the market can effectively specify a quasi-mandatory standard—what is sometimes called a *de facto* standard—by virtue of the fact that its technology has been adopted as a critical component for related products and services in the relevant market.[38] Typically this "monopoly"[39] standard is the result of an initial and intense competition between different standards at the emergence of the relevant market. This scenario is commonly illustrated by the Microsoft Windows operating system ("OS"), which (including its antecedent, MS-DOS) has operated as a near-universal technological component in the PC market since prevailing in an initial "standards war" among competing operating systems in the early 1980s.[40] The Windows platform has provided a common language for developers to write applications for that platform (some-

35. For a discussion of this structure and related public-private standard-setting mechanisms, see Panagiotis Delimatsis, *Introduction: Continuity and Change in International Standardization, in* THE LAW, ECONOMICS AND POLITICS OF INTERNATIONAL STANDARDISATION 4-6 (Panagiotis Delimatsis ed., 2015).

36. The Dodd-Frank Act placed substantial limitations on this practice. *See* Frank Partnoy, *What's (Still) Wrong with Credit Ratings,* 92 WASH. L. REV. 1407, 1419-27 (2017).

37. *See* Carl Cargill & Sherrie Bolin, *Standardization: A Failing Paradigm, in* STANDARDS AND PUBLIC POLICY 302 (Shane Greenstein & Victor Stango 2007).

38. *See* SUSANNE K. SCHMIDT & RAYMUND WERLE, COORDINATING TECHNOLOGY: STUDIES IN THE INTERNATIONAL STANDARDIZATION OF TELECOMMUNICATIONS 86 (1998).

39. Unless otherwise specified, throughout I use the term "monopoly" or "dominant firm" interchangeably to refer to a firm that holds a substantial market share and is protected to some extent from immediate entry, resulting in some appreciable degree of pricing power.

40. Mikko Valimaki and Ville Oksanen, *The impact of free and open source licensing on operating system software markets,* 22 Telematics and Informatics 97, 98 (2005); Martin Campbell-Kelly, *Not Only Microsoft: The Maturing of the Personal Computer Software Industry, 1982-1995,* 75 Bus. Hist. Rev. 103, 112-14 (2001). As of 1992, Microsoft's share of the PC operating system market was estimated to be approximately 90%. *See* Richard J. Gilbert, *Networks, Standards and the Use of Market Dominance: Microsoft, in* THE ANTITRUST REVOLUTION: ECONOMICS, COMPETITION AND POLICY 410-11 (eds. John E. Kwoka, Jr. and Lawrence J. White, 3rd ed. 1999). As of April 2019, its market share was estimated at 79%. *See Desktop Operating System Market Share Worldwide Apr 2018 – Apr 2019,* STATCOUNTER, http://gs.statcounter.com/os-market-share/desktop/worldwide/2018 (last visited May 21, 2019).

thing that Microsoft promoted by providing developers with access to the Windows OS's application programming interfaces[41]), which has in turn promoted adoption by a large population of end-users. The dominance of the MS Windows standard is suggested by its longevity and the failure of the desktop computing market to migrate to the zero-price alternative offered by the Linux OS.[42] Even this powerful standard has ultimately been exposed to some competitive discipline, as demonstrated by Windows' failure to penetrate the handset and mobile device markets that are dominated by the Apple iOS and Linux-based Android operating systems,[43] which mimic some of the functionalities provided by a PC.

3. Standardization by Cooperative Action

A group of firms or other entities can agree collectively upon the specification of a common standard for a particular technology market. This can be accomplished through arrangements that operate at different levels of formalization and openness, ranging from accredited standard-development organizations that operate at high levels of openness and transparency, to unaccredited but still highly formalized standard-setting organizations ("SSOs") that are generally open to all interested parties, and *ad hoc* industry consortia consisting of a relatively small number of industry leaders for purposes of promoting adoption of a particular technology.[44] Analogous to the case of standardization by a monopolist, this scenario is often characterized by an initial stage in which multiple standards groups compete with one another, which typically results in a single or predominant standard. A familiar example is the standards war in the high-definition video player market, in which the HD DVD standard (supported by a consortium led by Toshiba) lost out to the Blu-Ray standard (supported by a consortium led by Sony).[45] More recent examples in the wireless markets include the rivalry between GSM and CDMA-based systems in the U.S., European and Japanese markets (with mostly the latter standard having prevailed in the 3G

41. *See* Jonathan M. Barnett, *The Host's Dilemma: Strategic Forfeiture in Platform Markets,* 124 HARV. L. REV. 1861, 1872-73 (2011) [hereinafter Barnett, *Host's Dilemma*].

42. While the Linux OS has achieved substantial adoption in the server market and, as modified in the Android OS, the mobile device market, this is not the case in the desktop PC market. *See* Jonathan M. Barnett, *The Costs of Free: Commoditization, Bundling and Concentration,* J. INSTITUTIONAL ECON. 1, 4-5 Fig. 1 (2018) [hereinafter Barnett, *Costs of Free*].

43. *See id.*

44. On the distinctions between these types of cooperative standard-setting entities, see Cargill & Bolin, *supra* note 34, at 302-04, 323-26. In this paper, I use the term, "SSO", broadly to cover any type of non-governmental standardization entity.

45. *See* Scott R. Gallagher, *The Battle of the Blue Laser DVDs: The Significance of Corporate Strategy in Standards Battles,* 32 TECHNOVATION 90 (2012).

standardization process[46]), as well as the rivalry in the 4G market between the WiMAX standard advocated by a group led by Intel and the LTE (Long Term Evolution) standard advocated by a group of firms led by Qualcomm (with the latter having prevailed in the 4G standardization process).[47] While some firms have held substantial IP positions in these standards, no single firm has enjoyed independent control over the standard as in the case of Microsoft Windows or a government agency in the case of state-mandated standards. In the emergent 5G network, patent positions are even more widely dispersed[48] and multiple consortia and similar groups have arisen to establish standards for information transmission at different levels of the network.[49]

II. Comparative Welfare Effects of Standardization Mechanisms

There is little doubt that standardization yields substantial social gains in the form of increased network effects, reduced entry costs, and accelerated adoption by intermediate and end-users. This uncontroversial view is illustrated by the explosive growth of the PC and smartphone markets,[50] both of which relied on the establishment of widely adopted market standards: in the former case, Microsoft's Windows OS, and in the latter, the GSM and CDMA technologies in the 2G, 3G and 4G cellular communications markets. As those markets illustrate, standardization can be achieved through various mechanisms (a single dominant firm in the case of Windows; cooperative multi-firm arrangements in the case of the wireless communications markets). Each mechanism inherently gives rise to certain social costs that must be incurred to achieve the gains associated with standardization. Hence, it is necessary to weigh the anticipated social costs and gains reasonably attributable to each mechanism in order to arrive at even an imperfect comparative net welfare assessment of these alternative routes toward standardization.[51] In this Part, I discuss the likely net welfare effects of each

46. *See* Pat Norton, *Newcomers and Innovation in the U.S. Telephone Industry – Then and Now, in* THE EMERGENCE OF THE KNOWLEDGE ECONOMY: A REGIONAL PERSPECTIVE 234-35 (Zoltan J. Acs et al. eds., 2002).

47. *See* PADILLA ET AL., *supra* note 18, at 10, 42.

48. *See infra* Table 2; PADILLA ET AL., *supra* note 18, at 19 tbl. 7.

49. Some of these organizations include 3GPP, the Open Interconnect Consortium (led by Intel), the AllSeen Alliance (led by Qualcomm), the Industrial Internet Consortium, the Thread Group, IEEE P2413 and Open M2M. *See* Zingales, *supra* note 3, at 30-31.

50. *See* Dedrick & Kraemer, *supra* note 1.

51. My discussion builds on prior contributions that have discussed the welfare effects of different mechanisms for achieving standardization. See PADILLA ET AL., *supra* note 18, at 25-44, who compare standard development organizations to standard-setting by government entities and standard-setting by a monopolist. For a comparison of the economic effects of standard-setting through cooperative entities such as SSOs and a market-based "standards

of the three paradigm standardization structures (and referenced in the Table below), taking into account the existing body of theoretical and empirical analysis relating to the economics and (what is sometimes overlooked) history of standardization processes in technology markets. To structure this analysis, I discuss specifically the expected performance of these standardization structures at two critical stages in the standard-setting timeline: (i) *standard selection;* and (ii) *standard implementation.*

TABLE 1: STANDARDIZATION PARADIGMS

PARADIGM	STANDARD-SETTING ENTITIES	LEGAL STATUS	ILLUSTRATIONS
Government monopoly	Government or "quasi-government" entity	De jure	FDA (food and drug); USDA (agricultural goods); FAA (aircraft); NTSA (automotive)
Market monopoly	Single dominant firm	De facto	Microsoft Windows, Word, Excel, PowerPoint; Intel x86 processors; IBM System/370
Cooperative action	Multiple firms or other entities	De facto	Bluetooth; USB; DVD; HDMI; GSM (2G); UMTS (3G); LTE (4G); Firewire; Ethernet; WiFi

war" see Joanne Tsai & Joshua D. Wright, *Standard Setting, Intellectual Property Rights and the Role of Antitrust in Regulating Incomplete Contracts,* 80 ANTITRUST L. J. 157 (2014). See Shane Greenstein & Marc Rysman, *Coordination Costs and Standard Setting, in* STANDARDS AND PUBLIC POLICY (Shane Greenstein & Victor Stango eds., 2007), who compare, through a case study of the "56K modem" standard, the comparative advantages of standard-setting through an SSO as compared to market competition and regulatory intervention. An older theoretical contribution analyzed the relative efficiency of achieving standardization through markets, committees (roughly analogous to SSOs in real-world markets), and hybrid mechanisms. *See* Joseph Farrell & Garth Saloner, *Coordination Through Committees and Markets,* 19 RAND J. ECON. 235 (1988).

A. *Government Standardization*

Historically, standardization by government action has often been viewed as the "default" mechanism by which economies achieve the two critical steps of standard selection and standard implementation (or more precisely, standard adoption, which is then followed by implementation by private entities).[52] This assumption is reflected in the U.S. Constitution, which provides that "Congress shall have Power To . . . fix the Standard of Weights and Measures."[53] This view reflects the intuition that markets left to their own devices would be unable to agree upon a common standard, either because no firm would have an incentive to independently invest in standardization (a costly activity that confers uncompensated benefits on others) or each firm would seek to maximize profits by securing adoption of its proprietary technology as the market standard.[54] A government-based mechanism for achieving standardization has the advantage that, subject to rule-promulgation and enforcement costs, it can use the coercive force of law to induce compliance with a standard. As a practical matter, government standardization mechanisms have operated either directly through regulatory entities or, as has been more common historically in the U.S., indirectly through quasi-governmental nonprofit entities that were subsequently recognized as the authoritative standardization authority in a particular industry.[55] As noted in the Table above, government standardization remains prevalent in markets involving public safety issues such as food, ethical drugs, and transportation.

While government standardization exhibits enforcement efficiencies arising from a state's coercive powers, it suffers from certain *in*efficiencies that are inherent to any monopolized form of standard-setting that is not exposed to competitive discipline. First, a government standardization monopoly may select the "wrong" standard—meaning, a standard that reduces transaction costs less efficiently as compared to other technologically feasible standards—or fail to appropriately update an existing standard. If the government acts as the exclusive entity for setting and updating a particular standard, the risk of inefficient standard selection and maintenance is exacerbated by the fact that there is no process by which prospective standard-setting entities must compete to induce users to invest resources in adopting

52. *See* KRISLOV, *supra* note 34, at 54 (stating that "government regulations represent a rich source—historically, the richest source—of standards); *id.* at 132 (noting that European standard-setting has taken place principally through national standard organizations, which are usually governmental).

53. U.S. CONST., art. I, § 8, cl. 5.

54. *See* David & Greenstein, *supra* note 24, at 33.

55. *See* Pierre Larouche & Geertrui van Overwalle, *Interoperability Standards, Patents and Competition Policy, in* THE LAW, ECONOMICS AND POLITICS OF INTERNATIONAL STANDARDISATION 367, 369-70 (Panagiotis Delimatsis ed., 2015). On the history of standardization in the U.S. in particular, see Cargill & Bolin, *supra* note 34, at 299-300.

(and retaining) a particular standard.[56] Second, a government standardization monopoly gives rise to the social losses associated with rent-seeking efforts by private entities to capture regulators and influence standardization choices to advance private interests. As a result, a government standard-setting entity may pursue collateral policy objectives (such as favoring domestic or otherwise politically favored firms) that are not aligned with market efficiency.[57] Consistent with this logic, the Supreme Court's 2015 decision in *North Carolina State Board of Dental Examiners v. FTC*[58] emphasized the inherent risk of anticompetitive conduct in the case of governmentally authorized standard-setting monopolies that are administered by industry representatives. While similarly opportunistic behavior could arise in private standard-setting entities that may be governed or heavily influenced by affected constituencies (as discussed below[59]), the coercive capacities of a government entity, together with the displacement of a competitive market for standard-setting services, may increase the incidence or severity of such behavior.

As noted above[60], government standardization is sometimes achieved through a hybrid model in which a government agency identifies a standardization objective in general terms and then designates a private entity to execute the standardization process by developing more granular standards and associated verification methodologies. Delegating these functions to entities that operate on a day-to-day basis in the relevant industry may improve the quality of the information that is reflected in the standard. However, there remains some appreciable risk of inefficient standard-setting and maintenance insofar as the challenge of securing the government's blessing acts as an implicit entry barrier against other entities that are not yet designated as officially recognized market gatekeepers, thereby muting the otherwise favorable effects of a competitive standard-setting environment. As noted above,[61] a well-known example is the handful of credit-rating agencies relied upon by the Securities and Exchange Commission in connection with the registration of public debt securities. The performance record of these entities is contested. In the wake of the 2007-08 financial crisis, com-

56. For similar thoughts, see PADILLA ET AL., *supra* note 18, at 40. For a general overview of informational deficiencies in government standard-setting, see David & Greenstein, *supra* note 24, at 29-31. The assumption that a government standardization entity is not subject to competitive discipline may be attenuated in a global economy to the extent that potentially adopting firms can "shop around" among government and private standardization providers. For evidence that this occurred in the Chinese market, see *infra* note 284 and accompanying text. However, note that governments can always elect to compel firms under their jurisdiction to adopt the government-designated standard.

57. *See* GRINDLEY, *supra* note 24, at 62-63; David & Greenstein, *supra* note 24, at 32.

58. 135 S. Ct. 1101, 1106 (2015).

59. *See infra* Part II.C.2.

60. *See supra* note 55.

61. *See supra* note 36 and accompanying text.

mentators widely criticized the rating agencies' apparent failure to appropriately assess the risk of certain financial instruments, which is sometimes attributed to the implicit entry barrier created by the difficulty of securing designation as a "nationally recognized statistical ratings organization" for securities regulatory purposes.[62]

B. *Monopoly Standardization*

Standards are sometimes set by firms with dominant market positions, rather than through government entities (or government-designated private entities) that enjoy a standardization monopoly as a matter of law. During the postwar period and through the 1970s, IBM effectively set the dominant architecture for the mainframe and certain other computing markets through its System/370 family of computers.[63] IBM's influence reflected its overwhelming market share (ranging from 84% of the mainframe market in 1956 to 71% in 1986).[64] Starting in the 1980s, Microsoft has set, and maintains, the *de facto* OS standard for the PC market, a position that Windows OS secured after prevailing against competing systems.[65] As compared to a government standardization monopolist, a private standardization monopolist appears to compare favorably insofar as the initial standards war implies a higher likelihood that the market may have converged upon the maximally efficient standard, at least at the outset. In place of an administrative process that is inherently subject to informational asymmetries, regulatory capture, and bureaucratic delay[66], the monopolist must prevail (at least initially) in competition against other standard-setters to secure adoption by intermediate and end-users. So long as that process is open to entry, there should be a high level of confidence that the standards war has converged, at least initially, upon the most efficient technologically feasible option.

A substantial literature contests this proposition, taking the view that standards wars may either end prematurely, selecting an inferior technological alternative, or exhibit inertia by not migrating to a superior new alterna-

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62. *See* Partnoy, *supra* note 36.

63. *See* Timothy F. Bresnahan & Franco Malerba, *Industrial Dynamics and the Evolution of Firms' and Nations' Competitive Capabilities in the World Computer Industry, in* SOURCES OF INDUSTRIAL LEADERSHIP: STUDIES OF SEVEN INDUSTRIES 79, 96-97 (David C. Mowery & Richard R. Nelson eds., 1999).

64. *Micro Mart Growth Seen Threat to IBM,* 15 COMPUTERWORLD 65 (1981).

65. *See supra* note 40 and accompanying text.

66. An historical episode from the AM radio market illustrates the extent to which bureaucratic inertia can slow down standard selection. The FCC deliberated from 1961 to 1982 over competing standards for the then-novel AM stereo radio market. Once the FCC allowed stations to choose any standard (subject to the station's allocated bandwidth), the market converged on a dominant standard within *three* years and the AM stereo market was launched. *See* GRINDLEY, *supra* note 24, at 73.

tive.[67] This "lock-in" argument, which has mostly been presented in theoretical terms with some anecdotal support, relies on the fact that standards derive value from network effects, which are in turn supported by adoption among certain user populations. Those effects can cause markets to "tip" toward a single standard (in some theoretical models, due to random historical events[68]), which then makes it difficult for entrants to induce any individual user to incur the costs of switching to a competing platform that has not yet achieved substantial adoption. Just as positive externalities can initially inhibit standard development, they can also inhibit migration away from an entrenched standard. Hence, even assuming Windows was once the most efficient computing platform among all feasible technological alternatives, there can be no assurance that this continues to be the case if entrants must incur sufficiently high costs in order to persuade existing users to migrate to a more efficient, but not-yet-widely-adopted, platform. As a result, even a technologically superior standard may be unable to achieve entry—precisely the argument made by the federal government in its antitrust litigation against Microsoft in the late 1990s and early 2000s.[69]

The lock-in argument has been strongly contested on empirical grounds by Stan Liebowitz and Stephen Margolis. Specifically, Liebowitz and Margolis argue that key historical cases cited in support of the lock-in theory (for example, the victory of the allegedly inferior VHS video cassette recording standard over Sony's Betamax standard) do not persuasively demonstrate that the market selected the "wrong" standard.[70] Relatedly, other authors have observed that, while established standards may enjoy dominance as a result of network effects and user switching costs, these obstacles are not insurmountable and incumbent standard-setters are therefore subject to some competitive discipline.[71] Consistent with this view, there are multiple cases in which dominant pioneering standard-setters have rapidly lost market share to entrants. Examples include the downfall of MySpace in the streaming video market (challenged successfully by YouTube), Netscape Navigator in the internet browser market (displaced by Microsoft's Internet

67. *See* W. Brian Arthur, *Competing Technologies, Increasing Returns, and Lock-In by Historical Events,* 99 ECON. J. 116, 117 (1989); Paul A. David, *Clio and the Economics of QWERTY,* 75 AMER. ECON. REV. 332, 336 (1985).

68. *See, e.g.,* Arthur, *supra* note 64.

69. *See* United States v. Microsoft Corp., 253 F.3d 34, 52-53 (D.C. Cir. 2001) (noting district court's finding that users of operating systems are unlikely to switch to rivals, even in response to a substantial increase in price).

70. *See* Stan J. Liebowitz & Stephen E. Margolis, *Network Externality: An Uncommon Tragedy,* 82 J. ECON. PERSPECTIVES 133, 134-35 (1994) (noting that empirical support for lock-in effects are weak); *id.* at 148-49 (noting lack of evidence for popular claim that market selected the "wrong" standard in the video recorder market).

71. *See* Barnett, *Costs of Free*, *supra* note 43, at 16-17; Timothy F. Bresnahan & Pai-Ling Yin, *Standard Setting in Markets: The Browser War, in* STANDARDS AND PUBLIC POLICY 29 (Shane Greenstein & Victor Stango eds., 2007).

Explorer, which was ultimately displaced by Google's Chrome), Yahoo! in the search engine market (challenged successfully by Google), and Palm Pilot in the mobile device market (challenged successfully by Blackberry, which was in turn challenged successfully by Apple's iPhone and other smartphone devices). The fact that even dominant standards are regularly subject to competitive threats casts doubt on the view that markets are likely to be locked into an inefficient standard for a considerable period of time. As some commentators have suggested, the most well-grounded position may be that standards markets exhibit "degrees" of lock-in, depending on the capital and expertise required to achieve entry, which may delay or dissuade entry in certain circumstances.[72] So long as any such lock-in effect is weaker than a "government lock-in" effect enforced by law, however, it is reasonable to maintain the presumption that market-based standard selection and maintenance will tend to outperform assigning those functions to a government monopolist.

C. *Cooperative Standardization*

The final paradigm standardization structure lies approximately at an intermediate point on an organizational spectrum bounded, at one end, by government standardization, in which market selection of a dominant standard is displaced by an administrative expert-based process, and, at the other end, by market standardization, in which standard setting is the result of open-market competition among firms offering alternative coordination solutions. By contrast, what I will call "cooperative" standardization incorporates elements of both (i) market competition, insofar as the standard-setting process is administered by personnel associated with profit-seeking firms exposed to competitive discipline in corresponding product and services markets, and (ii) bureaucratic decision-making, insofar as the standard is specified primarily through cooperative interactions between technical personnel at those firms.[73]

1. The Overlooked Virtues of Dispersed Patent Ownership

At the point of standard selection, the same reasons that suggest that standardization by a private monopolist will outperform standardization by a government monopolist support confidence in the standardization outcomes reached through cooperative arrangements. As compared to govern-

72. *See* Shane & Greenstein, *supra* note 24, at 8-9. For a related view, see Bresnahan & Yin, *supra* note 68, at 29-30, arguing that inertia in standards markets characterized by network effects may represent an "intermediate cost", which persists but can be overcome by sufficiently strong countervailing forces.

73. On the technical character of the standard-setting process, and the dominant role of engineers in that process, see SCHMIDT & WERLE, *supra* note 38, at 61; *see* Osenga, *supra* note 10, at 179-80.

ment standardization, there is a higher level of confidence that cooperative standardization would result in selection of the maximally efficient standard to the extent that the standard-setting entity must compete with other such entities and is managed by market participants rather than expert bureaucrats who are not exposed to competitive discipline and are susceptible to regulatory capture. In the case where the cooperative standard-setting entity is not competing with other standard-setting entities, it still faces some market discipline to the extent that it must secure adoption by intermediate and end-users (as contrasted with a government standard-setting entity that can at least partially rely on the force of law to compel adoption).

At the subsequent stage of standard implementation, standardization by cooperative action most likely outperforms standardization by a monopolist as a general matter. Cooperative standardization necessarily implies that the technology inputs required to implement the standard are diffused to some extent across multiple firms, rather than being exclusively controlled by a single firm, which would then be in a position to independently set and implement the standard. Absent collusion between the owners of patents incorporated in the standard, this suggests that the pricing power exercised by any individual firm after cooperative selection of the dominant standard is weaker as compared to a state of affairs in which a single firm sets, and controls implementation of, the standard through its IP portfolio. In the PC OS market, Microsoft sets the standard by virtue of its ownership of the IP rights relating to the Windows OS (and the network effects that may partially shelter the Windows franchise), which in turn confers upon Microsoft the exclusive ability to produce, distribute, and modify the Windows OS.[74] By contrast, multiple firms hold ownership interests in the key technological components required to produce and distribute a smartphone device, potentially resulting in more attenuated pricing power as compared to a market in which a single firm owns all components of the standard.[75] In the 4G/LTE

74. I recognize that the extent to which Microsoft has been able to, or has elected to, exert pricing power with respect to Windows OS is highly debated. For some of those competing views, see MICROSOFT, ANTITRUST AND THE NEW ECONOMY: SELECTED ESSAYS (David S. Evans ed., 2002). My argument simply relies on the assumption that a monopolist provider of a technology standard is in general likely to have greater pricing power as compared to a market in which multiple firms hold ownership interests in various components of a standard.

75. Others would argue just the opposite. Specifically, it might be argued that a state of affairs in which multiple firms hold patents to the critical components of a technology standard would result in a collectively non-profit-maximizing total royalty burden, given that each patent holder will select the individually profit-maximizing rate. A monopolist would rationally eliminate this pricing inefficiency. The empirical strength of this theoretical objection depends closely on the extent to which, as a practical matter, patent holders actually do not take into account the pricing behavior of other licensors. As I discuss subsequently, there is evidence to suggest that the most significant patentee-licensors in the smartphone market make efforts to signal, and commit to, a total aggregate royalty burden. This behavior is consistent with a theoretical model that takes into account repeat-play effects and signaling opportunities

standard, 20 firms account for an estimated 85.5% of all SEP families; and in the 5G standard-setting process, 20 firms account (so far) for an estimated 65.2% of all SEP families.[76] The Table below shows the percentage ownership shares of SEP families relating to the 4G/LTE and 5G standards, illustrating the extent to which those contributions are dispersed among multiple holders.

TABLE 2: OWNERS OF LARGEST ESTIMATED PORTFOLIOS OF STANDARD-ESSENTIAL PATENT FAMILIES[77]

FIRM	ESTIMATED % LTE/4G-RELATED SEP FAMILIES	ESTIMATED % 5G-RELATED SEP FAMILIES
Qualcomm	9.41%	8.6%
Huawei	9.88%	7.92%
LG	6.13%	7.38%
Ericsson	6.58%	6.74%
Samsung	13.49%	5.77%
Nokia	8.74%	3.48%[78]
ZTE	1.4%	4.1%
Intel	—	3.04%
Alcatel-Lucent	1.12%	2.06%
NTT DOCOMO	4.28%	2.61%
NEC	1.56%	1.91%
Sony	1.12%	1.75%
ETRI	1.2%	1.7%
Sharp	2.14%	1.69%
Panasonic	2.08%	1.47%

in an iterative standardization framework. Barnett, *Has the Academy, supra* note 14; s*ee infra* notes 140-141 and accompanying text.

76. *See* Tim Pohlmann (IPlytics GmbH), *Industry report – Who will be the technology leader for 5G? Part two,* IAM, July 18, 2018 (explaining ownership of 5G-related patent families) [hereinafter Pohlmann, *Part two*]; WORLD IP REPORT *supra* note 16, at 111 fig. 4.9 (illustrating ownership of 4G/LTE-related patent families). Note that a "patent family" refers to a group of patents issued in multiple countries but relating to a single invention by a single inventor (or group of inventors). There may be differences between the methodologies used to calculate ownership of 5G and 4G/LTE-related patent families, although I note that the WIPO source relies on the "IPlytics" database that is also the source for the 5G data presented above.

77. *See supra* note 73. Note that a firm without an entry in a particular column indicates that, with respect to the relevant patent family, the firm did not rank among the "top 20" patent owners.

78. Does not include patents acquired by Nokia in acquisition of Alcatel-Lucent in 2016.

Blackberry	2.05%	1.29%
Apple	1.74%	1.12%
InterDigital	4.52%	1.08%
MediaTek	—	0.79%
Motorola	—	0.71%
Google[79]	4.79%	—
Texas Instruments	1.26%	—
Siemens	1.2%	
Others[80]	3.08%	—
Total (Top 20 only)	85.53%	65.21%

Scholars and policymakers tend to view the dispersed ownership of IP rights as a vice rather than a virtue. Specifically, conventional wisdom tends to view dispersed patent ownership as a source of transactional friction in the form of "patent thickets" and related transactional obstacles that can limit access to technology inputs, raise end-user prices, and generally impede the innovation and commercialization process.[81] At least in the ICT context, this broad-brush assumption overlooks the critical role played by patents in reducing the expropriation risk that might otherwise frustrate value-enhancing exchanges of intellectual assets among potentially adverse third parties. Specifically, patent rights support the vertically specialized structure of the wireless communications market, in which upstream chip design firms earn returns on R&D investment through licensing relationships with a broad base of downstream firms that execute the production, assembly, and distribution functions that are necessary to embody R&D in consumption goods for the relevant end-user market.[82] This disaggregated structure has several attractive economic characteristics: (i) it promotes the efficient specialization of labor across technology markets; (ii) it enables entry at discrete portions of the supply chain; and (iii) it promotes the distribution of technology assets among a broad pool of producers and assem-

79. Google's ownership of 4G/LTE-related patents appears to be a result of its acquisition of Motorola Mobility in 2011. Google sold Motorola Mobility to Lenovo in 2014. *See* WORLD IP REPORT, *supra* note 16, at 111 fig. 4.9.

80. These entities include the Institute of Telecommunications Science and Technology and China Academy of Telecommunications Technology. *See id*. These appear to be Chinese governmental research institutes.

81. For the leading source of this view, see Heller & Eisenberg, *supra* note 13. For a critical review of the large follow-on literature among scholars and policymakers, see Sidak, *Hoax, supra* note 14, at 435-45; Barnett, *Has the Academy, supra* note 14, at 1338-56

82. For extensive discussion of this point, see Jonathan M. Barnett, *Intellectual Property as a Law of Organization,* 84 S. CAL. L. REV. 785, 838-53 (2011) [hereinafter Barnett, *Intellectual Property*] (providing case study of "fabless" semiconductor chip industry and showing how patents facilitate specialization); Jonathan M. Barnett, *Three Quasi-Fallacies in the Conventional Understanding of Intellectual Property,* 12 J. L. ECON. & POL'Y 1, 18-20 (2016) [hereinafter Barnett, *Three Quasi-Fallacies*] (providing theoretical argument that patents facilitate entry and specialization by lowering costs of informational exchange).

blers. To the extent that upstream innovators are not engaged in the downstream segments of the supply chain, cannot independently deliver the entire package of technology inputs required to produce a smartphone or similar device, and face a positive rate of technological or commercial obsolescence, they tend to have incentives to extract revenues by licensing their IP assets as broadly as possible to downstream intermediate users. Contrary to the standard assumption that IP rights increase the transaction costs of informational exchange, secure patents enable licensing by permitting upstream innovator-firms to securely transmit valuable intellectual assets to downstream users upon agreed-upon terms of use. This structure not only delivers remunerative streams that support upstream R&D but enables a broad pool of downstream firms to compete in the production, assembly and distribution stages of the supply chain. Counterintuitively, patents can *lower* entry costs by facilitating access to the technology inputs required by production specialists and other downstream firms that lack comparable internal R&D capacities.

The actual performance of the smartphone market is consistent with this enabling view of IP rights. As Kirti Gupta and Keith Mallinson have shown separately, the wireless device market has consistently exhibited robust entry rates[83], a result inconsistent with the view that high levels of patent issuance act as an exorbitant "tax" that increases costs and discourages entry. The Figure below illustrates two trends in the smartphone market during 2007-16, each of which is consistent with the view that high patent intensity is consistent with high competitive intensity: (i) market leadership has regularly changed hands, and (ii) the portion of the market apparently constituted by smaller firms (defined as firms that likely have less than 5% market share individually in each year of the 2007-16 period[84]) has steadily increased. Over a 10-year period, the initial leading manufacturers in the 2G/GSM market (Ericsson, Nokia, and Motorola) have exited. Even Apple's and Samsung's current dominance in the 3G and 4G markets is relatively recent (as of 2007, each represented less than 5% of the global market).[85] Chinese entrants, which can secure the necessary IP inputs through

83. *See* Kirti Gupta, *Technology Standards and Competition in the Mobile Wireless Industry,* 22 GEO. MASON L. REV. 865, 893-94 (2015); Keith Mallinson, *Don't Fix What Isn't Broken: The Extraordinary Record of Innovation and Success in the Cellular Industry Under Existing Licensing Practices,* 23 GEO. MASON L. REV. 967, 989 (2016).

84. More specifically, the Figure refers to "unidentified" firms, which reflects the percentage of the market that is not accounted for by the IDC Worldwide Mobile Phone Tracker data reported in Dedrick & Kraemer, *supra* note 1, at 4. Given that the IDC data covers firms in declining order from large to small market shares, it seems reasonable to presume that unidentified suppliers are most likely firms with trivial market shares, although this cannot be definitively confirmed.

85. Note that Apple's and Samsung's share of the market increases substantially if measured as a percentage of revenues, rather than units shipped, reflecting the fact that Apple

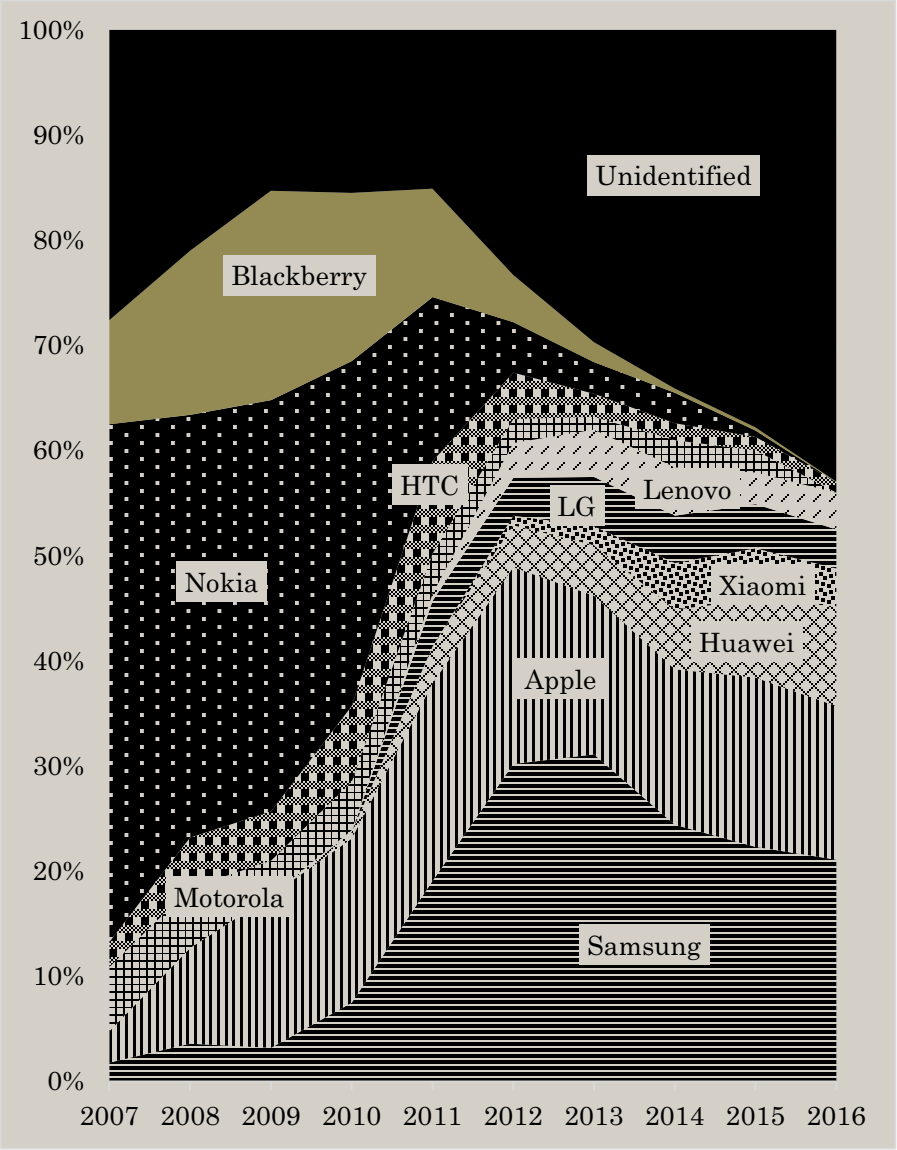
licenses from upstream innovator-firms such as Qualcomm and MediaTek[86], are rapidly accruing market share. Huawei, Xiaomi, and Oppo each entered the market on or after 2010 and, as of 2017 (not shown in the graph below), collectively accounted for almost 25% of the global market and individually were the second, fourth and fifth largest manufacturers of smartphones worldwide (based on number of units shipped).[87]

targets the "higher-end" smartphone market almost entirely and Samsung targets it in part. *See id.* at 5.

86. *See id.* at 4.

87. For source for data through 2016, see Dedrick & Kraemer, *supra* note 1, at 4. For source for data through 2018, see Smartphone Market Share, IDC, https://www.idc.com/promo/smartphone-market-share/vendor (last visited Oct. 30, 2018).

FIGURE 1: MARKET SHARES OF GLOBAL SMARTPHONE SALES (2007-2016, UNITS SHIPPED)[88]



88. Dedrick & Kraemer, *supra* note 1, at 5 tbl. 3 (citing IDC Worldwide Mobile Phone Tracker).

2. Collusion Risk

Cooperative standardization exhibits a notable defect as compared to standardization by a government or private monopolist. As has been extensively addressed, there is an inherent concern that participant-firms in a cooperative standardization process will collusively select a standard in order to erect a barrier or other competitive disadvantage for non-participating firms.[89] In the simplest case, a standardization consortium may select a technology that is incompatible with non-participants' products, which will be effectively excluded from the market in the event the standard secures market adoption and, due to network effects, users then abandon non-compatible products. Those types of claims have been alleged in a handful of antitrust litigations brought by firms whose technology was not selected by an SSO in a particular industry.[90]

While collusion risk is inherent to cooperative standard-setting, there are both internal and external forces that can mitigate this risk. On the internal side, SSOs can mitigate collusion risk through open or semi-open membership and governance policies.[91] Hence, in one of the litigations described above, the court noted favorably that two leading SSOs "provide an open and public standard-setting process, in which all competitors in the market have equal access to the same information at the same time . . . ." and then noted disfavorably that the allegedly anticompetitive consortium had adopted limited membership rules that excluded certain competitors.[92] On the external side, collusion risk can be mitigated to the extent there is competition between the cooperative standard-setting entity and other such entities (or other firms seeking to set a standard independently), in which case the

89. For representative contributions in the economics literature (which address similar collusion issues in the context of patent pools), see Josh Lerner & Jean Tirole, *Public Policy Toward Patent Pools*, *in* 8 INNOVATION POLICY AND THE ECONOMY, (Adam B. Jaffe et al. eds., 2008); Josh Lerner & Jean Tirole, *Efficient Patent Pools,* 94 AMER. ECON. REV. 691, 706 (2004). In the legal literature, see HERBERT HOVENKAMP ET AL., IP AND ANTITRUST: AN ANALYSIS OF ANTITRUST PRINCIPLES APPLIED TO INTELLECTUAL PROPERTY LAW 35-8 to -9 (3rd ed. 2017).

90. *See, e.g.,* GSI Tech. Inc. v. Cypress Semiconductor Corp., No. 5:11-CV-03613-EJD, 2015 U.S. Dist. LEXIS 9378 (N.D. Cal. Jan. 27, 2015) (declining to grant summary judgment in favor of a SSO that comprised the relevant market's dominant firms, which had allegedly used the standard-setting process to exclude the plaintiff's technology for anti-competitive purposes); TruePosition, Inc. v. LM Ericsson Tel. Co., 844 F.Supp. 2d 571 (E.D. Pa. 2012) (finding that, at summary judgment stage, plaintiff had not brought sufficient evidence to show that other members of SSO may have rejected plaintiff's technology through a "common plan"); Golden Bridge Tech., Inc. v. Motorola, Inc., 547 F.3d 266 (5th Cir. 2008) (finding that, at summary judgment stage, plaintiff had not brought sufficient evidence to show that other members of SSO had conspired to exclude plaintiff's technology from the standard), *cert. denied,* 556 U.S. 1216 (2009).

91. Subsequently I discuss this point in greater detail. *See infra* Part III.C.

92. *GSI Technology Inc. v. Cypress Semiconductor Corp.*, No. 5:11-CV-03613-EJD, 2015 U.S. Dist. LEXIS 9378 (N.D. Cal. Jan. 27, 2015).

standard-setting entity is at least initially subject to some discipline by market forces. This appears to be a typical case.[93] An illustration is provided by the standardization process for the 3G wireless communications network. During the late 1990s, European suppliers lobbied for two competing standards (W-CDMA and TD-CDMA) for the 3G network, ultimately agreeing on a common standard (known as "UMTS") that incorporated elements of each, and, together with SSOs from other regions of the world, formed the 3GPP as the SSO to govern the standard-setting process.[94] Concurrently, Qualcomm, which held the largest single portfolio of CDMA-related patents, advocated for an alternative 3G standard known as "cdma2000", governed by a rival U.S.-based SSO known as "3GPP2".[95] As the market moved toward launch of the 3G network, three competing SSOs operated concurrently (3GPP, 3GPP2 and IEEE) and the market ultimately converged upon the LTE standard managed by 3GPP.[96]

D. *Summary and Evaluation*

To summarize, we can make three observations as a presumptive matter—meaning, these are general expectations concerning the comparative welfare effects of paradigm standard mechanisms, which could therefore be rebutted in particular cases. First, as compared to government standardization, both standardization by a single firm or by cooperative action is likely to outperform insofar as standard selection is undertaken by firms that operate in a competitive environment, rather than government regulators that are insulated from market discipline. Second, as compared to standardization by a single firm, cooperative standardization is likely to perform equally well for purposes of standard selection, so long as the standard-setting entity must initially engage in a standards competition with other entities. Even in the less typical case in which no such standards competition takes place, the cooperative entity remains subject to some degree of market discipline insofar as it must secure adoption by downstream users. Third, again as compared to standardization by a single firm, cooperative standardization is likely to outperform in standard implementation to the extent that ownership of the technology inputs required to implement the standard are diffused across multiple firms, which is likely to result in an economically attractive market structure in which upstream R&D-specialist firms license technolo-

93. *See* Delimatsis, *supra* note 35, at 7 ("[C]ompetition not only among firms but also among standard-setting groups constitutes a typical feature of private standard-setting").

94. *See* Rudi Bekkers & Joel West, *The Limits to IPR Standardization Policies as Evidenced by Strategic Patenting in UMTS,* 33 TELECOMM. POLICY 80, 82 (2009); Kirti Gupta, *How SSOs Work: Unpacking the Mobile Industry's 3GPP Standards, in* THE CAMBRIDGE HANDBOOK OF TECHNICAL STANDARDIZATION LAW: COMPETITION, ANTITRUST AND PATENTS 29, 32-33 (Jorge L. Contreras ed., 2018).

95. *See* Bekkers & West, *supra* note 91, at 82; Gupta, *supra* note 91, at 32-33.

96. *See* Gupta, *supra* note 94, at 32-33.

gy inputs to a broad base of downstream producers and other intermediate users.[97]

TABLE 3: PRESUMPTIVE EFFICIENCY RANKING OF STANDARDIZATION MECHANISMS

Standardization Stage	Gov't Standardization	Monopoly Standardization	Cooperative Standardization
Standard Selection	Less preferred	More preferred	More preferred
Standard Implementation	Less preferred	More preferred	Most preferred

III. LEGAL PRECONDITIONS FOR COOPERATIVE STANDARDIZATION

The discussion above has identified a set of circumstances in which cooperative standardization is likely to match or outperform standardization by governmental and private monopolist entities for purposes of both standard selection and standard implementation. In this Part, I describe the legal inputs that are required to support this economically attractive paradigm. Specifically, I identify a medley of legal inputs—robust patent protection, quasi-contractual licensing commitments, and surgical antitrust safeguards—that are necessary to execute three tasks in achieving standardization outcomes through cooperative mechanisms: (i) to induce innovators to invest significant sums in "standard-relevant" R&D and then contribute the resulting output for purposes of standard selection in spite of the inability to exert sole control over the standard; (ii) following standard selection, to induce intermediate users to make the investments required to adopt and implement the new standard in spite of hold-up risk; and (iii) to mitigate the

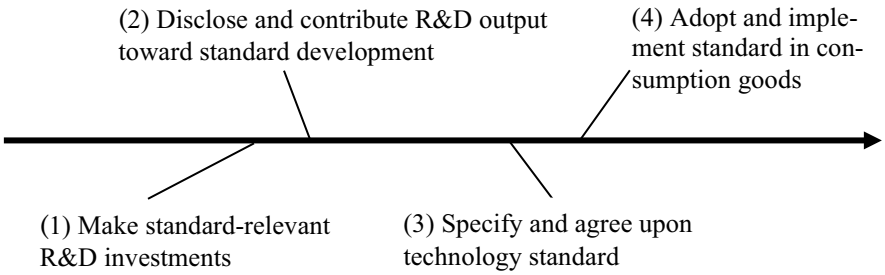
97. There is one respect in which market standardization may possibly underperform relative to government standardization. If multiple firms are competing to become the standardization monopolist, then the firms may expend an aggregate sum in excess of the social value generated through the standards competition. This is an application of the more general observation that "innovation races" with winner-take-all reward structures can yield net welfare losses due to collectively excessive R&D expenditures. However, any such social loss must be weighed against several offsetting social gains, including: (i) increased innovation incentives under a winner-take-all relative to a split-reward contest, (ii) "runner-up" innovators' R&D expenditures may yield valuable follow-on applications, and (iii) allocating a single reward provides the winner with the exclusivity required to negotiate and contract for efficient transactions with partners in the commercialization process. For analysis of these issues, see Vincenzo Denicolò & Luigi A. Franzoni, *Rewarding Innovation Efficiently: The Case for Exclusive Rights, in* COMPETITION POLICY AND PATENT LAW UNDER UNCERTAINTY: REGULATING INNOVATION 287 (Geoffrey A. Manne & Joshua D. Wright eds., 2011); Vincenzo Denicolò & Luigi A. Franzoni, *On the Winner-Take-All Principle in Innovation Races,* 8 J. EURO. ECON. ASSOC. 1133 (2008).

collusion risk that is inherent to cooperative standard-setting interactions among actual and potential competitors.

A. *The R&D Funding Problem*

So far, I have considered various alternatives by which two steps in the standardization process can be achieved: (i) establishment of a technology standard that supports product interoperability; and (ii) adoption of that standard by intermediate and end-users in the relevant product market. This discussion has abstracted away from two predicate steps that must be completed (and have been overlooked in much recent discussion of SSOs): (i) firms and other entities that specialize in innovation must be induced to make the necessary investments in R&D to advance development of a new standard; and (ii) those firms must be induced to disclose and contribute the output of those R&D investments toward development of a common standard over which no individual firm will exert control. The following graphic depicts the full standardization timeline:

FIGURE 2: STANDARDIZATION TIMELINE



In 2017, the three leading innovator-firms in the smartphone supply chain made the following R&D investments: Qualcomm expended $5.74 billion in R&D costs, representing 21.7% of its revenues, Nokia expended $4.8 billion in R&D costs, representing 18.4% of revenues, and Ericsson expended $4.39 billion in R&D costs, representing 14.2% of revenues.[98] Broadly speaking, there are three possible mechanisms by which to fund the large investments that are required to support R&D in wireless communications and other ICT markets. First, the state can fund these activities using tax-supported financing. This mechanism is not widely observed in contemporary U.S. ICT markets,[99] although it was an important component of the

98. Data derived from WORLD IP REPORT, *supra* note 18, at 97 tbl. 4.3. Euro values in original source converted into U.S. dollars at current exchange rates.

99. This statement does not apply to the European market, where the European Commission provided extensive funding for early development of the GSM and UMTS telecom-

postwar U.S. innovation economy, in which government funding extensively supported defense-related computing and communications research by the country's largest technology firms.[100] Second, consortia or other groups of firms or other entities can collectively fund and undertake R&D efforts. This model is not common in contemporary wireless communications and other ICT markets, although it has been used more widely in Japan.[101] Third, firms can independently fund and undertake R&D. This is the most commonly observed structure for funding and performing R&D in contemporary wireless technology and other ICT markets, and the remainder of this discussion will focus on this funding mechanism.

Empirical studies generally support the view that the necessity for IP protection to support R&D activity varies across industries and, within industries, across firm types.[102] Landmark survey studies, conducted by the "Levin et al." and "Cohen et al." research teams respectively in the late 1980s and late 1990s, which targeted R&D managers at large firms in a variety of industries, found that the value placed on patent protection was strongest among pharmaceutical and chemical firms[103], while the Berkeley Patent Survey, which surveyed start-ups and smaller firms in the mid-2000s, found that the demand for IP was strongest among biotechnology, medical device, and IT hardware firms.[104] A complementary body of scholarship has identified compelling theoretical reasons, informed by empirical evidence, that IT firms that adopt R&D-intensive models rely especially heavily on patents in order to support licensing models that enable those firms to earn

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munications standards, corresponding to what are also known as 2G and 3G networks. *See* Bekkers & West, *supra* note 91, at 81.

100. *See* Jonathan M. Barnett, *The Great Patent Grab* (Working Paper, 2019) (on file with the Michigan Technology Law Review).

101. On Japanese research consortia in computing and electronics markets, see Bresnahan & Malerba, *supra* note 60, at 104-06. Additionally, South Korea and Taiwan have funded public research institutes that have played a role in technology transfer in the consumer electronics industries. *See* Jonathan M. Barnett, *Patent Tigers: The New Geography of Global Innovation,* 2 CRITERION J. ON INNOVATION 429, 465-66, 476-477 (2017).

102. For discussion, see Jonathan M. Barnett, *Do Patents Matter? Empirical Evidence on the Incentive Thesis, in* HANDBOOK IN LAW, INNOVATION AND GROWTH 178, 180 (Robert E. Litan ed. 2011) (stating that "the incentive effects of patent protection vary considerably (and, at some reasonable level of approximation, systematically) across industries and across firm types").

103. *See* Wesley M. Cohen et al., *Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patents (Or Not),* (Nat'l Bureau of Econ. Research, Working Paper No. 7552, 2000); Richard C. Levin et al., *Appropriating the Returns from Industrial R&D,* 1987 BROOKINGS PAPERS ON ECON. ACTIVITY 783. For extensive discussion of the relevant empirical literature, see Jonathan M. Barnett, *Private Protection of Patentable Goods,* 25 CARDOZO L. REV. 1251, 1257-69 (2004) [hereinafter Barnett, *Private Protection*].

104. *See* Stuart J.H. Graham et al., *High Technology Entrepreneurs and the Patent System: Results of the 2008 Berkeley Patent Survey,* 24 BERKELEY TECH. L. J. 1255, 1261-63, 1278-83 (2009).

returns on R&D investment without incurring the costs and acquiring the expertise required to vertically integrate forward into downstream production and distribution functions.[105]

This existing body of empirical and theoretical scholarship suggests that, in general, the demand for IP protection in the IT market will tend to vary substantially across the following firm types or organizational structures:

Type I: A vertically integrated firm that can independently execute all functions of the supply chain. Demand for IP is relatively weak because the firm operates a "stand-alone" supply chain and therefore does not require IP rights to mediate informational exchanges with third-party suppliers. So long as competitors bear sufficiently high reverse-engineering costs or the market exhibits a sufficiently rapid rate of product obsolescence, this firm may be able to earn a substantial return on its R&D investment in a weak-IP environment. A likely example of this type of firm is Intel, which maintains a vertically integrated structure for chip innovation and design, production, and distribution.

Type II: A firm that employs an "IP giveaway" strategy in which an informational asset is distributed at no charge to promote sales in an excludable complementary goods market in which the firm has a competitive advantage. Demand for IP will then be weak or even "negative". An example of this type of firm is Google, which distributes content at no charge to users in order to extract data it can deliver to paying advertisers. As reflected by its litigation and lobbying strategies, Google consistently prefers weaker to zero forms of IP protection over content assets.[106]

Type III: A firm that (i) specializes in R&D and lacks production and other commercialization functions, (ii) has no competitive advantage in an excludable complementary goods market, and (iii) earns a return on its R&D investments through licensing relationships with intermediate users. Demand for IP will be strong. An example of this type of firm is Qualcomm, which specializes in chip design, largely relies on outside "foundries" for production functions, and earns the bulk of its profits by licensing its patent-protected technologies to device manufacturers.[107]

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105. For extensive discussion of these points, see Barnett, *Intellectual Property, supra* note 79, at 811-29; Barnett, *Three Quasi-Fallacies, supra* note 79, at 18-20.

106. *See* Barnett, *Costs of Free, supra* note 42, at 1104-06.

107. In 2016, Qualcomm earned 33% of its revenues, but 75% of its earnings before taxes from semiconductor licensing (which operated through its "QTL" entity, as distinguished from the sale of physical chipsets through its "QCT" entity). Author's calculations based on revenue and earnings before taxes disclosed in Qualcomm Inc., Annual Report (Form 10-K), at 46. (Nov. 7, 2016). The disparity between revenues and profits (as measured by earnings before taxes) reflects the low marginal costs incurred by Qualcomm in each licensing transaction, as compared with chipset sales.

The firms that are widely viewed as having made the most fundamental contributions to the development of the 3G and 4G wireless communications standards (and are continuing to make substantial contributions to the emergent 5G standard[108]), such as Ericsson, Nokia and Qualcomm, mostly fall into the *Type III* category. Qualcomm conforms closely to this idealized model since it has largely withdrawn from the production segment of the supply chain, while Nokia and Ericsson conform approximately since they retain some production and distribution functions.[109] Without adequate patent security, it is unlikely that these R&D-specialist firms would be prepared either (i) as a first step, to disclose their technology assets to horizontal competitors that participate in the SSO[110] process or (ii) as a second step, to engage in vertical licensing relationships with the downstream manufacturers and assemblers on which they rely in order to reach the end-user market. Consistent with the proposed relationship between R&D incentives, disclosure incentives and patent protection, the Table below shows that firms that have made the ten largest number of technical submissions to SSOs in connection with the 5G network generally exhibit high levels of R&D intensity (R&D as a percentage of sales) and have some of the largest patent portfolios relating to these standards. While not dispositive, this is consistent with theoretical expectations that secure patent protections support firms' incentives to engage in standard-relevant R&D and then disclose at least some of the resulting R&D output for purposes of the standard-setting process.

108. *See supra* Table 2.

109. For discussion of these firms' production and distribution functions, see *Annual Report,* ERICSSON (2017) https://www.ericsson.com/assets/local/investors/documents/2017/ericsson-annual-report-2017-en.pdf; Nokia Corp., Annual Report (Form 20-F) (Mar. 23, 2017); Qualcomm Inc., Annual Report (Form 10-K) (Nov. 27, 2018).

110. On the risks associated with disclosure during the standardization process, see BLIND, *supra* note 24, at 99-100; Richard A. Epstein & Kayvan B. Noroozi, *Why Incentives for "Patent Holdout" Threaten to Dismantle FRAND, and Why It Matters,* 32 BERKELEY TECH. L. J. 1381, 1394 (2017).

TABLE 4: TECHNICAL CONTRIBUTIONS, PATENTING AND R&D ACTIVITY OF FIRMS MOST SUBSTANTIALLY INVOLVED IN 5G STANDARDIZATION[111]

FIRM	% TECHNICAL SUBMISSIONS TO 5G SSO PROCESS (2018)	% 5G-RELATED PATENT FAMILIES (2018)	R&D INTENSITY (2017)
Huawei	11.93%	7.92%	14.9%
Nokia	10.31%	3.48%	18.2%
Ericsson	8.16%	6.74%	18.8%
ZTE	5.84%	4.1%	11.9%
Qualcomm	5.06%	8.6%	23.8%
Intel	3.62%	3.04%	20.9%
Samsung	3.47%	5.77%	5.7%
LG	3.07%	7.38%	5.4%
China Mobile	3.03%	n/a	5.1%[112]
AT&T	1.12%	n/a	n/a[113]

It might nonetheless be argued that, even absent secure patent protection, *Type I* and *II* firms would still have sufficient revenue streams to support substantial investments in R&D, which can then be monetized either through a vertically integrated production and distribution infrastructure (*Type I*) or by cross-subsidizing sales of an excludable complementary good (*Type II*). Certainly, royalty-free giveaway structures have been used for some standard-setting initiatives (for example, the Bluetooth and USB standards[114] as well as the Android operating system in the wireless device market[115]), typically involving firms that seek to earn returns through the

111. For technical contributions, see Tim Pohlmann, *Who will be the technology leader for 5G? Part one*, IAM, July 11, 2018 [hereinafter Pohlmann, *Part one*]. For patent families, see Pohlmann, *Part two, supra* note 73. For R&D intensity (R&D expenditures as a percentage of sales) see the author's calculations, based on information in each company's 2017 annual report. "N/a" refers to the non-availability of the relevant informational item in the "Pohlmann" sources. Given that those sources identify the "top 20" firms with respect to technical contributions or patent ownership, this implies that firms for which "n/a" is indicated (specifically, AT&T and China Mobile) were not especially active in the relevant category.

112. This may overstate the firm's R&D expenditures because the firm's annual report aggregates "operations support and research and development expenditures".

113. AT&T does not appear to report its R&D expenditures separately.

114. These technologies do not assess a royalty but do require payment of relatively modest lump-sum fees. For further information, see *Qualification Fees,* BLUETOOTH, https://www.bluetooth.com/develop-with-bluetooth/qualification-listing/qualification-listing-fees (last visited Nov. 2, 2018); *Getting a Vendor ID*, USB, https://www.usb.org/getting-vendor-id (last visited Nov. 2, 2018).

115. While Android is distributed on a royalty-free basis, Google conditions access to advance releases of updated versions of Android on an agreement by the device maker or telecom carrier to preinstall certain Google applications and provide those applications with pref-

sale of excludable complementary goods and services that rely on the "give-away" technology.[116] However, this argument suffers from two deficiencies. First, it overlooks the fact that these giveaway arrangements provide the best evidence that, even under a robust IP regime, IP owners may have compelling business reasons to waive their IP rights. Second, it rests on the implausible assumption that all mechanisms for funding and monetizing R&D are equally efficient in all markets at all points in time, in which case effectively mandating that firms monetize R&D through vertical integration or cross-subsidization strategies is innocuous or a net gain from a social welfare perspective. A weak-patent regime would distort the market's selection of R&D-monetization structures by endangering the viability of *Type III* firms and, as a result, at least sometimes compelling firms to adopt less than maximally efficient structures for supporting and commercializing innovation.

This organizational distortion (which favors Type I and II structures over Type III structures for innovation and commercialization) is liable to give rise to two related social costs that, in the aggregate, degrade affected markets' competitive vigor.[117] First, as compared to a *Type III* structure, *Type I* and *II* structures tend to inflate the capital and expertise requirements for viable competitive entry given that entrants must either vertically integrate forward (*Type I*) or enter the market at two or more points in order to establish a competitive position in an excludable complementary goods market (*Type II*). Second, as vertically integrated operations, *Type I* firms may have no rational incentive to license their technology to other manufacturers and assemblers (unlike *Type III* firms, which typically have every reason to do so) insofar as they directly compete against those firms in the target product or services market. Contrary to standard intuitions, a weak-IP regime may induce R&D-monetization and standardization structures that pose higher entry barriers and result in reduced dissemination of technology inputs to intermediate users, relative to the structural mix that would emerge under a stronger IP regime in which firms could select from a broader range of organizational options.

B. *The Implementation Problem*

Successful execution of the standard-setting process requires that a broad range of firms, including in particular entities that specialize in inno-

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erential display treatment. *See* Ben Edelman, *Google, Mobile and Competition: The Current State of Play,* COMPETITION POL'Y INT'L Jan. 2017, at 1, 1.

116. *See* Barnett, *Host's Dilemma, supra* note 41, at 1890 (noting that platform owners can generate revenues by giving away access to the platform, which then drives sales of excludable complementary goods); *id.* at 1910-13 (showing how corporate sponsors fund open-source operating systems in order to drive demand for complementary proprietary services).

117. For further discussion of these points, see Barnett, *Intellectual Property, supra* note 79, at 854-56; Barnett, *Three Quasi-Fallacies, supra* note 79, at 18-20.

vation and entities that specialize in implementation, have rational incentives to make adequate investments at their respective points of specialization on the standardization timeline. In the smartphone market, it is necessary to support both (i) upstream firms' incentives to develop chip designs for integration into a technology standard, and (ii) downstream firms' incentives to embed those chip designs in computing and communications devices for distribution to end-users. The discussion above showed that patents are likely to be necessary predicates for inducing innovation by R&D-specialist firms that mostly lack downstream commercialization capacities. As has been emphasized in scholarly and policy commentary, however, patents may deter implementation by manufacturers and other intermediate users who anticipate that IP owners will opportunistically demand "excessive" royalties once those users have made irrevocable investments in adopting the standard.[118] Without adequate assurance against this hold-up threat, downstream firms will decline to adopt the standardized technology. By anticipation, the upstream firm will decline to make the R&D investments required to develop the standard (unless it has, or can acquire at a feasible cost, production and distribution capacities in order to vertically integrate forward through market release). Hence, a solution to this second-step implementation problem is necessary to resolve the first-step R&D funding problem.

1. Re-Understanding the Holdup Problem

The holdup problem in the context of wireless device markets is typically characterized as a problem from the perspective of downstream implementer firms who, once having adopted a standard, are exposed to opportunistic behavior on the part of upstream IP owners that threaten to withhold technology that is critical to the standard. This characterization overlooks the fact that upstream innovators are also exposed to opportunism—namely, by downstream implementers, who have a difficult-to-replicate production and distribution infrastructure as well as, in some cases, a difficult-to-replicate brand in the relevant end-user market. Recall that holdup risk arises in any situation in which one party must make an irrevocable investment that has no or lesser value elsewhere and there is no contractual solution by which the investing party can fully specify and deter opportunistic action by the counterparty. These conditions are satisfied in the case of an upstream innovator, who incurs substantial R&D costs starting several years prior to finalization of the standard-setting process, under substantial uncertainty

118. For commonly cited sources in the legal literature, see Mark A. Lemley, *Ten Things to Do About Patent Holdup of Standards (and One Not to),* 48 B.C. L. REV. 149 (2007); Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking,* 85 TEX. L. REV. 1991 (2007). For similar views expressed in reports and policy statements issued by antitrust regulators, *see supra* note 15.

concerning which standard will ultimately be selected or the commercial applications of the selected standard, and with no feasible opportunity to negotiate with downstream firms for purposes of implementing a still-emergent technology.[119] Upstream firms' R&D investments can easily prove to be mostly in vain: out of all contributions made by firms in the course of the 3G and 4G standard-setting processes, only 30% were ultimately incorporated into the standard.[120] Data on the relatively low percentages of a firm's technical contributions that have been accepted for inclusion in the 5G standard (ranging from 29.2% to 41.5% for the 10 leading contributors)[121] similarly illustrate the stiff challenges, and high risk of zero returns on R&D investments, faced by innovator entities. These observations have a key implication. While innovators may be overcompensated by holding up intermediate users that have incurred substantial adoption costs and do not easily have access to any comparable technology inputs, it is just as plausible that innovators may be *under*compensated given that the bulk of their R&D investments takes place well before initiating licensing discussions with intermediate users.

2. Re-Understanding the "FRAND" Commitment

Both innovator and implementer firms in wireless communications markets have sought to allay holdup concerns by agreeing upon certain licensing principles in connection with standard implementation.[122] Specifically, contributors of technology inputs toward a standard typically commit to disclose all "essential" patents relating to the standard and to license those patents on a "fair, reasonable and non-discriminatory" ("FRAND") basis.[123] It is often lamented that the FRAND slogan lacks any objective content and is therefore liable to give rise to either hold-up behavior by IP owners or litigation between IP owners and implementers.[124] The proposed

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119. *See* Kappos, *supra* note 10; Gupta, *supra* note 91, at 32-33, 42; Damien Geradin & Miguel Rato, *Can Standard-Setting Lead to Exploitative Abuse? A Dissonant View on Patent Hold-Up, Royalty Stacking and the Meaning of FRAND,* 3 EURO. COMPETITION L. J. 101, 106 (2015).

120. *See* Gupta, *supra* note 94, at 42.

121. *See* Pohlmann, *Part one, supra* note 108.

122. To be clear, this is not the only purpose of the FRAND requirement. Subsequently I discuss historical evidence indicating that, at least at its inception, the FRAND requirement was advocated by European telecom carriers in order to mitigate the anticipated increase in input costs arising from the movement away from protected markets dominated by national monopolies to a more competitive environment in which certain technology inputs would be supplied by outside providers. *See infra* notes 226-34 and accompanying text.

123. *See* C. Bradford Biddle, *No Standard for Standards: Understanding the ICT Standards-Development Ecosystem, in* THE CAMBRIDGE HANDBOOK OF TECHNICAL STANDARDIZATION LAW: COMPETITION, ANTITRUST AND PATENTS 25 (Jorge L. Contreras ed., 2018).

124. *See, e.g.*, Geradin & Rato, *supra* note 119, at 112; Timothy S. Simcoe & Allan L. Shampine, *Economics of Patents and Standardization: Network Effects, Hold-Up, Hold-Out,*

solution is for the parties to agree to a more fully specified FRAND commitment—for example, a fully specified royalty rate or at least a royalty rate cap.[125] Antitrust regulators in the U.S. (at least prior to the recent policy shift at the DOJ, as discussed below[126]) and Europe have endorsed these types of policy actions in various communications in 2006, 2007, 2009 and 2015.[127] These remarkably uniform policy signals have given some SSOs sufficient legal comfort to impose royalty caps or close equivalents in connection with the FRAND commitment. In 2006, the VMEbus International Trade Association ("VITA"), an SSO organized in connection with the "VMEbus" computer bus standard, adopted a policy requiring that a firm disclose its maximum royalty rates and most restrictive non-royalty terms prior to inclusion of the firm's technology in the standard.[128] This policy was reviewed favorably by the DOJ as part of the "business review letter" process (a type of pre-clearance review[129]).[130] In 2015, the Institute for Electrical and Electronics Engineers ("IEEE"), a leading SSO associated with the 802.11 WiFi standard, adopted two critical changes to its FRAND policy: (i) SEP holders may not seek injunctions against potential licensees unless the licensee

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Stacking, in THE CAMBRIDGE HANDBOOK OF TECHNICAL STANDARDIZATION LAW: COMPETITION, ANTITRUST AND PATENTS 111 (Jorge L. Contreras ed., 2018).

125. *See id.* at 114-116; Gil Ohana and C. Bradford Biddle, *The Disclosure of Patents and Licensing Terms in Standards Development*, *in* THE CAMBRIDGE HANDBOOK OF TECHNICAL STANDARDIZATION LAW: COMPETITION, ANTITRUST AND PATENTS 256-58 (Jorge L. Contreras ed., 2018).

126. *See infra* note 211 and accompanying text.

127. For examples of U.S. antitrust regulators' endorsement of the practice, see Renata B. Hesse, Ass't Atty. Gen., U.S. Dep't of Justice, Antitrust Div., Response to Institute of Electrical and Electronics Engineers, Inc. (Feb. 2, 2015); Thomas O. Barnett, Asst. Att'y Gen., U.S. Dep't of Justice, Antitrust Div., Response to VMEbus International Trade Association (VITA)'s Request for Business Review Letter (Oct. 30, 2006); Thomas O. Barnett, Asst. Att'y Gen., U.S. Dep't of Justice, Response to Institute of Electrical and Electronics' Engineers, Inc.'s Request for Business Review Letter (Apr. 30, 2007). For an example of a European antitrust regulator's endorsement of the practice, see Neelie Kroes, European Commissioner for Competition Policy, Setting the standards high, Address at Harvard Club of Belgium, "De Warande" Brussels (Oct. 15, 2009), https://www.montesquieu-institute.eu/9353000/1/j9vvj72dlowskug/vi9cg60e6xxu?ctx=vh84exkkodyi&tab=1 (stating that "competition law should not stand in the way . . . of unilateral ex ante disclosure of maximum royalty rates and the most restrictive licensing terms that would apply should a company's technology be made the standard").

128. *See* Anne Layne-Farrar, *Ex Ante Rate Disclosure in Tech Standards, A Decade Later,* CRA INSIGHTS (Dec. 1, 2017, 12:07PM), http://www.crai.com/publication/ex-ante-rate-disclosure-tech-standards-decade-later; Ohana & Biddle, *supra* note 125, at 256. For the actual policy, see VITA STANDARDS ORG., VSO POLICIES AND PROCEDURES § 10.3.2 (2015).

129. The DOJ's Antitrust Division issues these letters pursuant to 28 C.F.R. §50.6. For an explanation, see DEP'T OF JUSTICE, ANTITRUST DIV. BUS. REVIEW PROCEDURE (June 25, 2015), https://www.justice.gov/atr/28-cfr-section-506-antitrust-division-business-review-procedure.

130. *See* Thomas O. Barnett, Asst. Att'y Gen., U.S. Dep't. of Justice, Antitrust Div., Response to VMEbus International Trade Association (VITA)'s Request for Business Review Letter (Oct. 30, 2006).

"fails to participate in, or to comply with the outcome of an adjudication"; and (ii) SEP holders may not charge more than a reasonable royalty, which must exclude the value attributable to inclusion of the technology in the standard and "should include . . . consideration of the value the technology contributes to the smallest saleable practicing unit."[131]

These policy changes (which effectively imposed a *de facto* cap on the royalty rate that can be negotiated by SEP holders) were also reviewed favorably in a business review letter issued by the DOJ,[132] and, as Gregory Sidak has shown, reflected prior recommendations by DOJ Antitrust officials as early as 2012 and views advanced by prominent intermediate users in the IT supply chain, such as Apple, Cisco, Intel, Samsung, and Microsoft.[133]

The commonly held view that incompletely defined FRAND commitments are defective suffers from a critical oversight. Namely, it neglects the possibility that the very ambiguity of the FRAND commitment may constitute an efficient term that arises out of negotiations between innovators and implementers within the framework of the SSO process, which in turn reflects the parties' mutual uncertainty concerning the range of applications and commercial value of the relevant technology.[134] In the case of ETSI, a leading SSO in the 4G and 5G markets, it specifically rejected on two occasions (in 2003 and 2006) proposals to render the FRAND royalty commitment in more precise terms.[135] In 2007, ETSI published a document that stated: "Specific licensing terms and negotiations are commercial issues between the companies and shall not be addressed by ETSI."[136] Given that innovator and implementer firms that are involved in the SSO process in wireless device markets are typically sophisticated entities with extensive market experience across multiple standardization initiatives, it is appropri-

131. *See* Institute of Electrical and Electronics Engineers, Inc., *IEEE-SA Standard Board Bylaws* 16-18 (2019), http://standards.ieee.org/develop/policies/bylaws/sb_bylaws.pdf [hereinafter IEEE Bylaws].

132. *See* Renata B. Hesse, *supra* note 124.

133. *See* J. Gregory Sidak, *The Antitrust Division's Devaluation of Standard-Essential Patents,* GEO. L. J. ONLINE 48, 49-52 (2015) [hereinafter Sidak, *Devaluation*].

134. For related views, see Epstein & Noroozi, *supra* note 108, at 1396 (arguing that ETSI's 1994 FRAND policy was "deliberately vague, leaving flexibility for parties to bilaterally negotiate its meaning in the context of their particular circumstances"); Tsai & Wright, *supra* note 51, at 163 (describing the FRAND commitment as an example of "intentional contractual incompleteness" and a choice made by "sophisticated parties"); Geradin & Rato, *supra* note 119, at 112 (stating that "it is the very absence of a definition mechanically translatable into concrete terms that bestows on the FRAND commitment the suppleness required to . . . ensure the widest availability of the technology embodied in the standard")).

135. *See* Epstein & Noroozi, *supra* note 108, at 1396-97; Rogers G. Brooks & Damien Geradin, *Interpreting and Enforcing the Voluntary FRAND Commitment,* 9 INT'L J. IT STANDARDS AND STANDARDIZATION RES. 1, 10 (2011).

136. *See* Brooks & Geradin, *supra* note 135, at 10 (citing ETSI, "Guide to IPRs" (2007)).

ate for outside observers to at least consider why the ambiguously formulated FRAND commitment may be efficient, rather than conclusively determining that it represents a market failure that calls for government intervention.

Specifically, there is reasonable ground to believe that the ambiguities of the FRAND commitment constitute an efficient form of commitment in an environment in which parties have limited information with respect to the potential value and applications of an enabling technology at the onset of standardization.[137] Following the well-recognized tradeoff between the marginal costs and gains of increased investment in contractual precision, the uncertain content of the FRAND commitment may reflect parties' forecasting, negotiating, and drafting costs at the onset of the standardization process, rather than any strategic effort to preserve a hold-up option for IP rights holders. As several scholars have proposed, the looseness of the FRAND commitment, supplemented by reputational norms in a repeat-play environment, may provide an efficient framework for future negotiation and adjustment of royalty rates in response to circumstances that cannot be foreseen at the point of standardization.[138] Reputational forces, as expressed through market norms concerning royalty rates and related licensing terms, may be especially potent in standard-setting environments in which a relatively small number of IP licensors and implementers routinely interact over the course of the standard-setting process.[139] Consistent with this possibility,

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137. On the difficulties in bargaining at an early stage over the commercial value of an "enabling" technology, see David J. Teece, *The "Tragedy of the Anticommons" Fallacy: A Law and Economics Analysis of Patent Thickets and FRAND Licensing,* 32 BERKELEY TECH. L. J. 1489, 1521 (2017).

138. In particular, Damien Geradin suggests that the incomplete specification of the FRAND commitment may provide parties with valuable "suppleness" in structuring the licensor-licensee relationship going forward. *See* Damien Geradin, *What's Wrong with Royalties in High-Technology Industries, in* COMPETITION POLICY AND PATENT LAW UNDER UNCERTAINTY 462, 476 (Geoffrey A. Manne & Joshua D. Wright eds., Cambridge University Press 2011) [hereinafter Geradin, *What's Wrong with Royalties*]; Damien Geradin, *Standardization and Technological Innovation: Some Reflections on Ex-Ante Licensing, FRAND, and the Proper Means to Reward Innovators,* 39 WORLD COMPETITION 511, 532 (2006). Nicolas Petit argues that FRAND commitments are not intended to specify a particular royalty rate but rather, are designed to set up a structure for good-faith negotiations over royalty and non-royalty terms of licensor-licensee relationships. *See* Nicolas Petit, *EU Competition Law Analysis of FRAND Disputes, in* THE CAMBRIDGE HANDBOOK OF TECHNICAL STANDARDIZATION LAW 290, 296-300 (Jorge L. Contreras ed., 2016). Richard Epstein and David Kappos have argued that SEP-intensive markets implement the FRAND commitment largely through "informal mechanisms of dispute resolution" that are likely to "work far better than any systematic effort to judicialize or otherwise formalize the dispute resolution process in connection with FRAND-encumbered patents." *See* Richard A. Epstein & David J. Kappos, *Legal Remedies for Patent Infringement: From General Principles to FRAND Obligations for Standard Essential Patents,* 9 COMPETITION POL'Y INT'L Autumn 2013, at 69, 71.

139. *See* Anne Layne-Farrar & Karen Wong-Ervin, *Methodologies for Calculating FRAND Damages: An Economic and Comparative Analysis of the Case Law From China, the European Union, India, and the United States,* JINDAL GLOBAL L. REV. (2017) (stating that,

leading IP holders in the smartphone market have periodically announced commitments to "single-digit" (or, in one case, a 5%) aggregate royalty with respect to the 3G and 4G platforms[140], which is within the range of aggregate royalty rates that have been subsequently estimated by empirical studies.[141]

C. *The Collusion Problem*

Standardization by cooperative action is attractive from an efficiency perspective insofar as it avoids the informational asymmetries and rent-seeking distortions inherent to standard *selection* by government fiat as well as the distorted pricing and output effects inherent to standard *implementation* by a private monopolist. However, there remains an important anti-competitive risk that is inherent to standardization by cooperative action: namely, the risk that firms involved in cooperative standardization will use that process to collude on price, output, or some other competitive parameter. There are at least three possibilities, which arise at both the time of standard selection and the time of standard implementation: (i) the firms that hold ownership interests in the technology assets required to implement the standard may exclude competitors from access to those inputs (or may set the standard in a manner that disadvantages certain competitors and effectively blocks access for those firms); (ii) participating firms may collude over the royalty rates for use of the technology assets included in the standard, which may effectively exclude certain firms from accessing those inputs; or (iii) participating firms may collude over royalty rates in order to indirectly collude over the price of the consumption goods in which the relevant technology is embedded.[142]

"because standards evolve over time . . . repeated interactions among the participants provide strong behavioral incentives for good faith bargaining"); Knut Blind & Brian Kahin, *Standards and the Global Economy*, *in* THE CAMBRIDGE HANDBOOK OF TECHNICAL STANDARDIZATION LAW: COMPETITION, ANTITRUST AND PATENTS 7, 13-14 (Jorge L. Contreras ed., 2018) (noting that most firms that participate in the standard-setting process are repeat players and have incentives to avoid "disruptive behavior"); Epstein & Kappos, *supra* note 138, at 79 (observing that repeat-play pressures may discourage IP licensors from acting opportunistically).

140. *See* Barnett, *Has the Academy, supra* note 14, at 1359-60 tbl. 2 (noting multiple instances in which leading IP holders in the 3G and 4G smartphone market announced maximum cumulative royalty rates). On market announcements of anticipated royalty rates in the 5G market, see Richard Lloyd, *Nokia reveals expected licensing rate for 5G phones,* IAM, (last updated Aug. 21, 2018), https://www.iam-media.com/frandseps/nokia-reveals-expected-licensing-rate-5g-phones (reporting that leading IP licensors such as Nokia, Ericsson and Qualcomm have announced maximum royalty rates, ranging in Qualcomm's case up to 3.25% of a device's wholesale price).

141. These studies are discussed subsequently, *see infra* note 155.

142. The last scenario would only raise plausible competition concerns where (i) the firms holding the technology inputs are vertically integrated forward into the production of

Antitrust law has recognized that collective standardization efforts, and especially collective licensing arrangements, raise concerns that these arrangements may be used to promote exclusionary strategies that protect incumbents from entry. At the same time, it is widely recognized that standard-setting can have pro-competitive effects insofar as doing so facilitates interoperability, reduces transaction costs, and yields related efficiency gains. This tradeoff has arisen in cases such as *Allied Tube & Conduit Corp. v. Indian Head, Inc.*[143] and *American Society of Mechanical Engineers, Inc. v. Hydrolevel Corp.*[144], in which members of SSOs were alleged to have manipulated the standard-setting process in order to exclude the plaintiff from the relevant market. While the Standards Development Organization Advancement Act of 2004[145] provides for "rule of reason" treatment for all SSOs (which largely codified existing judicial tendencies[146]), antitrust precedent demands that collective standard-setting and licensing arrangements adopt meaningful precautions to mitigate the risk of collusion and other anti-competitive behavior.[147] This middle-of-the-road approach follows a balancing analysis that trades off the anti-competitive risks that are inherent to any form of interfirm cooperation against the pro-competitive benefits that can arise from standardization by collective action.

In the information technology context, a leading source of guidance on these matters is a series of "business review letters" issued by the DOJ's Antitrust Division, concerning patent pooling structures in the DVD, DVD-ROM, MPEG-2, and 3G standards markets.[148] For the sake of brevity, I will focus on the letter issued by the DOJ in 1997 with respect to a collective licensing arrangement proposed by MPEG-LA, a pioneer in the organization and administration of patent pools. The MPEG-LA business review letter has provided a template for the construction and governance of patent pools

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consumption goods embodying those inputs; and (ii) all other components of those consumption goods are substantially the same across all such firms.

143. Allied Tube & Conduit Corp. v. Indian Head, Inc., 486 U.S. 492, 503 (1988).

144. Am. Soc'y of Mech. Eng'rs, Inc. v. Hydrolevel Corp., 456 U.S. 556, 576 (1982).

145. 15 U.S.C. §§ 4301, 4303 (2014).

146. Allied Tube & Conduit Corp. v. Indian Head, Inc., 486 U.S. 492, 501 (1988) (noting that most lower courts apply rule of reason standard to SSOs).

147. *See id.* at 500-01 (noting that SSOs are inherently prone to collusive behavior and should adopt "safeguards" such as basing standard-selection decisions on "objective expert judgments and through procedures that prevent the standard-setting process from being biased by members with economic interests in stifling product competition").

148. Joel I. Klein, Asst. Att'y Gen., U.S. Dep't of Justice, Antitrust Div., Response to MPEG LA, L.L.C. et al.'s Request for Business Review Letter (June 26, 1997) (MPEG-2); Charles A. James, Asst. Att'y Gen., U.S. Dep't of Justice, Antitrust Div., Response to 3G Patent Platform Partnership's Request for Business Review Letter (Nov. 12, 2002); Joel I. Klein, Asst. Att'y Gen., U.S. Dept of Justice, Antitrust Div., Response to Hitachi et al.'s Request for Business Review Letter (June 10, 1999) (DVD-ROM); Joel I. Klein, Asst. Att'y Gen., U.S. Dep't of Justice, Antitrust Div., Response to Koninklijke Philips Electronics, N.V. et al.'s Request for Business Review Letter (Dec. 16, 1998) (DVD).

in the IT industry.[149] While recognizing the collusive and other anti-competitive risks inherent to a collective licensing arrangement, the Division observed that the proposed arrangement (which sought to pool patents held by multiple entities relating to the MPEG-2 "codec" standard for digital audio and video transmission) comprised several features to mitigate that risk. These included: (i) the pool would be administered by a third-party entity with no business interest in the downstream product markets; (ii) all IP rights in the pool would be available for licensing by any party willing to pay the royalty fee; (iii) all licensees (including licensors in their capacity as licensees) would pay a uniform royalty; and (iv) the pool would be restricted to patents deemed "essential" to the technology standard. Unlike the "closed" pooling arrangements that were more commonly observed in the early decades of the 20th century[150], the "MPEG LA" pool structure offers licenses on uniform terms to the downstream population of manufacturers, distributors, and other entities. Critically, given that upstream licensors must pay royalties to the pool at the same rate as downstream licensees, there is a reduced risk that licensors would have incentives to "unreasonably" inflate royalty rates. Consistent with this expectation, the MPEG LA pool has widely licensed its technology to device producers and other firms and, based on preliminary estimates, imposes no more than a small to nominal increase in the price of the end-user devices that are ultimately subject to the pool's patent portfolio.[151]

IV. Undoing Cooperative Standardization

In the discussion above, I identified the attractive features of the hybrid structure observed in the smartphone and related ICT markets, which have achieved standardization through a collective mechanism that outperforms standardization by government fiat as a matter of standard selection, matches standardization by a monopolist as a matter of standard selection (so long as the SSO initially operates in competition with other standard-setting entities), and outperforms standardization by a monopolist as a matter of standard implementation. Additionally, I identified the institutional inputs that sustain cooperative standardization in the smartphone and related ICT markets—specifically, reasonably secure patents, loosely defined quasi-contractual licensing commitments, and antitrust safeguards that together support R&D incentives, promote implementation, and mitigate collusion risk. Based on these observations, we can now assess the antitrust and IP policies relating to the smartphone and other ICT markets that have been

149. *See* Jonathan M. Barnett, *From Patent Thickets to Patent Networks: The Legal Infrastructure for the Digital Economy,* 55 JURIMETRICS 1, 14-15, 15 n.40 (2015).

150. *Id.* at 16-17.

151. *Id.* at 43-45.

implemented since approximately the mid-2000s by courts and antitrust agencies in the U.S. and other major jurisdictions. The baseline conclusion is straightforward: this international sequence of policy actions has placed at risk the institutional underpinnings behind the collective standardization mechanisms that have supported technological development and implementation in the smartphone and other ICT markets.

A. *"Depropertizing" Standard-Essential Patents*

Agencies and courts have devoted substantial attention to the *potential* risk that holders of SEPs would be able to dictate "exorbitant" pricing or impose other access constraints on device manufacturers in the wireless communications markets. The dispersion of IP ownership interests naturally gives rise to concerns that the total licensing and transaction costs involved in assembling the IP package required to deploy a standard-dependent product will be so high (the so-called "royalty stack") that prices for end-user products will move beyond the reach of most consumers as well as discourage entry into the market by manufacturers and other intermediate users.[152] However plausible in theory, these arguments have not been supported by *actual* market performance.

Two key pieces of empirical evidence suggest that these scenarios should no longer be key areas of policy concern. First, empirical evidence shows that, adjusted for quality improvements, the prices of smartphones and other IT products that are dependent on SEPs have fallen both absolutely and relative to products that are not dependent on SEPs.[153] Second, empirical studies of aggregate royalty burdens in the smartphone markets have found no evidence to support widely stated claims that device manufacturers are burdened by double-digit royalty rates[154]; rather, the best available evi-

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152. For the most well-known statement of this assertion, see Lemley & Shapiro, *supra* note 118. The same authors have made similar assertions together and separately in subsequent writings. See *also* Mark A. Lemley & Carl Shapiro, *A Simple Approach to Setting Reasonable Royalties for Standard-Essential Patents,* 28 BERKLEY TECH. L.J. 1135, 1149-50 (2013) [hereinafter Lemley & Shapiro, *A Simple Approach*]; A. Douglas Melamed & Carl Shapiro, *How Antitrust Law Can Make FRAND Commitments More Effective,* 127 YALE L. J. 2110, 2116 (2018).

153. Alexander Galetovic et al., *An Empirical Examination of Patent Holdup,* 11 J. COMPETITION L. & ECON. 549, 572 (2015).

154. *See* Ann Armstrong, et al., *The Smartphone Royalty Stack: Surveying Royalty Demands for the Components Within Modern Smartphones,* 68-69 (May 29, 2014) (WilmerHale, Working Paper), https://www.wilmerhale.com/-/media/ed1be41360634d1fa5c3ab08647e8ada.pdf (aggregating royalty estimates for leading patent holders and arguing that "potential royalties demands on a smartphone could equal or even exceed the cost of the device's components," but that "many of the so-called 'headline' rates on which these royalty figures are based may not withstand negotiation or litigation"); Lemley & Shapiro, *supra* note 118, at 2027 (describing sources supporting estimated total royalty rates in excess of 30% for a dual-band smartphone). As I have observed elsewhere, these types of estimates uniformly fail to take into account that licensors and licensees engage

dence indicates that total royalty rates are typically in the low to mid-single digits.[155] These findings are broadly consistent with general tendencies in the smartphone markets, which have exhibited remarkable rates of growth in output and market adoption[156] and continuous entry into the device production market.[157] These well-established tendencies are inconsistent with widespread assertions of endemic "patent hold-up" and "royalty stacking" that characterize the current international regulatory consensus.

Based on these theories, and without supporting empirical evidence, antitrust regulators in the U.S. (subject to an important recent shift in policy at the DOJ's Antitrust Division, as described below[158]) and other commercially significant jurisdictions (including the European Union, China and South Korea[159]) have taken a series of actions, starting in the mid-2000s, that have substantially limited the enforcement and licensing capacities of SEP owners. As discussed below, some U.S. federal courts have issued rulings in patent and antitrust litigations that follow a similar policy trajectory and reflect, explicitly or implicitly, similar assumptions about the purportedly adverse effects of patents in standard-dependent IT markets. Remarkably, a theoretical conjecture with little supporting evidence has supported actions that have incrementally subjected the worldwide smartphone market—a market representing billions of dollars in annual worldwide revenues—to what in certain respects resembles a generalized scheme of case-specific rate-regulation through the vehicle of actual or threatened antitrust enforce-

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in negotiations resulting in offsets to reflect each side's patent portfolios. Barnett, *Has the Academy, supra* note 12, at 1348-49.

155. Dedrick & Kraemer, *supra* note 1, at 1 (finding that license fees paid to owners of SEPs relating to smartphones constitute about 5% of the retail price); Alexander Galetovic, et al., *An Estimate of the Average Cumulative Royalty Yield in the World Mobile Phone Industry: Theory, Measurement and Results,* 42 TELECOMM. POL'Y 263, 266 (2018) (finding that the average estimated "cumulative royalty yield" for patent owners collectively in 2016 was 3.4% or $9.60 per device); Alexander Galetovic, et al., *Is There an Anticommons Tragedy in the World Smartphone Industry?*, 32 BERKLEY TECH. L. J. 1527, 1527, 1532-33 (2017) (finding that, as of 2016, the average total patent royalty burden on a smartphone device represented 3.4% of the average selling price); Keith Mallinson, *Cumulative Mobile-SEP Royalty Payments No More Than Around 5% of Mobile Handset Revenues,* WiseHarbor (2015), http://www.wiseharbor.com/pdfs/Mallinson%20on%20cumulative%20mobile%20SEP%20royalties%20for%20IP%20Finance%202015Aug19.pdf (estimating aggregate royalty burden paid by smartphone manufacturers to IP licensors to be approximately 5% of mobile handset revenues); J. Gregory Sidak, *What Aggregate Royalty Do Manufacturers of Mobile Phones Pay to License Standard-Essential Patents?,* 1 CRITERION J. ON INNOVATION 701 (2016) (estimating aggregate royalty burden paid by smartphone manufacturers to IP licensors and reaching upper bound of 4-5%).

156. *See supra* note 1 and accompanying text.

157. *See supra* notes 83-87 and accompanying text.

158. *See infra* note 221 and accompanying text.

159. On actual and proposed interventions by antitrust authorities and courts in those jurisdictions with respect to SEP and FRAND licensing, see Ginsburg et al., *supra* note 16, at 3.

ment. These policy actions fall into two categories: (i) actions that seek to limit SEP owners' ability to secure injunctive relief against alleged infringers (and, in certain jurisdictions, expose SEP owners to antitrust liability for seeking an injunction); and (ii) actions that seek to limit the "reasonable royalty" that SEP owners can expect to recover in the case of a successful infringement litigation or assess in licensing transactions.[160] I will discuss each of these forms of regulatory and judicial intervention.

1. The Disappearing Patent Injunction

In a 2006 decision, *eBay Inc. v. MercExchange LLC*,[161] the Supreme Court issued a decision that has substantially eroded the availability of injunctive relief in patent infringement litigation. Specifically, the Court upset the long-standing presumption that injunctive relief follows once a patent owner successfully defends the presumption of validity and shows that its patent has been infringed.[162] As interpreted by the lower courts, the *eBay* decision has effectively put in place an entity-dependent remedies regime in which non-practicing entities are generally ineligible for injunctive relief and are confined to seeking relief through monetary damages.[163] In litigations involving alleged infringement of SEPs, both courts and agencies in the U.S. and other jurisdictions have adopted the related view that the availability of injunctive relief should vary based on the type of patent held by a particular entity. Specifically, courts and agencies have taken a series of actions that have largely eliminated the ability of SEP owners (whether practicing or non-practicing) to obtain injunctive relief, based on an expansive and rigid view of the meaning of the "FRAND" requirement as discussed above.[164] In some jurisdictions, courts and agencies have taken the view that even seeking injunctive relief can give rise to antitrust liability for a SEP owner.

a. *Judicial Actions*

In 2012, Judge Richard Posner (acting as a district court judge by designation) issued a widely publicized decision denying injunctive relief for a

160. The "reasonable royalty" standard is the principal measure of monetary damages under U.S. patent law, which provides that patent damages will be an amount "adequate to compensate for the infringement, but in no event less than a reasonable royalty for the use made of the invention by the infringer." 35 U.S.C. §284 (2012).

161. eBay Inc. v. MercExchange LLC, 547 U.S. 388 (2006).

162. *See id.* at 392-94.

163. For an empirical study showing this clear pattern in remedies outcomes in patent infringement litigation, see Christopher B. Seaman, *Permanent Injunctions in Patent Litigation After* eBay: *An Empirical Study,* 101 IOWA L. REV. 1949, 1952-53 (2016) (finding that "while the vast majority of patentees still obtain injunctive relief following *eBay*, PAEs rarely do").

164. *See supra* notes 120-30 and accompanying text.

SEP holder (Motorola) and awarding attorneys' fees to the *infringer* (Apple), on the grounds that seeking an injunction was generally inconsistent with the FRAND commitment.[165] In 2013, a district court in another patent infringement litigation similarly determined that a SEP holder's pursuit of an injunction against an infringing party was inconsistent with its FRAND commitment.[166] Although the Federal Circuit later rejected any unqualified "no injunctions for SEPs" rule, it did hold that a SEP holder could only seek injunctive relief if the infringer were deemed unwilling to enter into a FRAND-compliant license.[167] The Federal Circuit stated further that, in cases in which a patent owner subject to FRAND had entered into licenses with other parties, there is a strong suggestion that "money damages are adequate to fully compensate" the patentee.[168] Putting these principles into practice, the court then upheld the denial of injunctive relief, despite at least some evidence that Apple had allegedly engaged in stalling tactics that may reasonably have placed it in the category of an "unwilling licensee."[169] Following a similar line of reasoning, the Ninth Circuit, in a litigation between Microsoft and Motorola (effectively, Google, having acquired Motorola Mobility in 2011[170]) upheld both the denial of an injunction to the patent holder (Motorola), adopting the principle that seeking injunctive relief is inconsistent with a FRAND commitment, and the award of attorneys' fees against the patent holder for *seeking* an injunction.[171] In September 2018, an administrative judge at the International Trade Commission, a U.S. administrative entity, declined to issue a "block importation" order sought by Qualcomm against certain Apple iPhone and iPad devices, notwithstanding the fact that the infringed patents were not SEPs (and therefore not subject to a FRAND commitment) and the judge had determined that the Apple devices were in-

165. Apple, Inc. v. Motorola, Inc., 869 F.Supp. 2d 901, 913-15 (N.D. Ill. 2012), *modified on other grounds,* 757 F.3d 1286 (Fed. Cir. 2014).

166. Realtek Semiconductor Corp. v. LSI Corp., 946 F.Supp. 2d 998 (N.D. Cal. 2013). The court's decision was influenced by the fact that it found that the patent owner had not made a qualifying license offer to the allegedly infringing party prior to seeking an injunction. *See id.* at 1007 ("Defendants make no meaningful argument that they offered a RAND license to Realtek prior to naming Realtek in the ITC action").

167. Apple, Inc. v. Motorola, Inc., 757 F.3d 1286, 1332 (Fed. Cir. 2014).

168. *Id.* This finding is material because, under the multi-factor test for injunctive relief as set forth in *eBay Inc. v. MercExchange LLC,* a patentee must show that monetary damages do not provide adequate relief. *See* eBay Inc. v. MercExchange LLC*,* 547 U.S. 388, 391 (2006) ("A plaintiff must demonstrate . . . that remedies available at law, such as monetary damages, are inadequate to compensate for that injury").

169. *See Apple, Inc. v. Motorola, Inc.,* 757 F.3d 1286, 1332-34, 1342-43 (Rader, J., dissenting in part) (Fed. Cir. 2014).

170. *See* Evelyn M. Rusli & Claire Cain Miller, *Google to Buy Motorola Mobility for $12.5 Billion,* N.Y. TIMES (Aug. 15, 2011, 7:43 AM), https://dealbook.nytimes.com/2011/08/15/google-to-buy-motorola-mobility/.

171. Microsoft Corp. v. Motorola, Inc., 795 F.3d 1024, 1049 (9th Cir. 2015).

fringing upon those patents.[172] This is only the fourth occasion in which the ITC has denied injunctive relief for a patent owner who has successfully defended the validity of its patent and shown infringement.[173]

b. *Antitrust Actions*

During approximately the same period, U.S. antitrust regulators took actions that either deter SEP holders from pursuing injunctive relief against infringing users or facilitate efforts by SSOs to achieve the same objective. In a 2007 policy statement, the DOJ's Antitrust Division expressed concern over patent holdup and took the view that SEP owners, by virtue of having committed to license their patents on FRAND terms, had forfeited the right to seek injunctive relief against infringers.[174] In 2011, the FTC expressed a similar view.[175] In 2012, a DOJ antitrust regulator encouraged SSOs to adopt policies that would address patent holdup by limiting SEP owners' ability to pursue injunctions and pre-specifying SEP royalty rates.[176] In 2013, the FTC filed a complaint against Google, alleging that Google and its newly-acquired subsidiary, Motorola Mobility, had pursued injunctive remedies against allegedly infringing third parties in violation of Motorola's FRAND

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172. Certain Mobile Electronic Devices and Radio Frequency and Processing Components Thereof, Notice of Comm. Determination Not to Review an Initial Determination Granting Complaint's Unopposed Motion to Terminate the Investigation as to Certain Patent Claims Based Upon Withdrawal of Allegations Pertaining to Those Claims from the Complaint, Inv. No. 337-TA-1065 (April 6, 2018). https://www.usitc.gov/secretary/fed_reg_notices/337/337_1065_notice_04062018sgl.pdf [hereinafter Certain Mobile Electronic Devices].

173. *See* Michael T. Renaud et al., *ALJ Pender: Apple Infringes, but No Exclusion Order for Qualcomm,* MINTZ INSIGHTS, Oct. 4, 2018, https://www.mintz.com/insights-center/viewpoints/2231/2018-10-alj-pender-apple-infringes-no-exclusion-order-qualcomm. Note that the ITC is not subject to the Supreme Court's decision in *eBay Inc. v. MercExchange LLC,* 547 U.S. 388 (2006), which limits courts' latitude to issue injunctions in patent infringement cases. *See* Spansion, Inc. et al. v. Int'l Trade Comm'n, 629 F.3d 1331, 1359 (Fed. Cir. 2010) ("Given the different statutory underpinnings for relief before the Commission in Section 337 actions and before the district courts in suits for patent infringement, this court holds that *eBay* does not apply to Commission remedy determinations under Section 337"). Upon appeal in March 2019, the ITC commissioners ruled the underlying patent invalid, thereby rendering moot the refusal to issue the exclusion order. Asa Fitch & Tripp Mickle, *Apple, Qualcomm Trade Blows in Patent Fight,* WALL ST. J. (March 26, 2019, 9:44 PM), https://www.wsj.com/articles/apple-violated-qualcomm-patent-u-s-trade-judge-rules-11553624866. For further details, see *infra* notes 229-17 and accompanying text.

174. *See* FTC/DOJ REPORT 2007, *supra* note 15, at 8 n.11, 35 n.42.

175. *See* FTC REPORT 2011, *supra* note 15, at 235 (stating that "[a] prior FRAND commitment can provide strong evidence that denial of the injunction and ongoing royalties will not irreparably harm the patentee").

176. *See* Renata Hesse, Deputy Assistant Att'y Gen., U.S. Dep't of Justice, Remarks as Prepared for the ITU-T Patent Roundtable: Six "Small" Proposals for SSOs Before Lunch 6, 9 (Oct. 10, 2012), https://www.justice.gov/atr/file/518951/download. For discussion of this speech and other similar statements during this period by DOJ antitrust regulators, see Sidak, *Devaluation, supra* note 130, at 49-50.

commitment.[177] In 2013, a joint report issued by the DOJ and the USPTO expressed the view that issuing an injunction in the case of a SEP infringement litigation "may be inconsistent with the public interest."[178]

In 2013, the FTC conditioned approval of Google's acquisition of Motorola Mobility (a new entity formed in connection with the split of Motorola into two entities in 2011[179]) upon Google's agreement not to seek injunctions in connection with SEPs to be acquired in the acquisition (unless a potential licensee refuses a "FRAND-compliant" licensing offer).[180] In 2015, as noted previously, the DOJ's Antitrust Division granted a favorable business review letter to IEEE, a leading SSO that had proposed to preclude contributing patent owners from seeking injunctive relief, except in limited circumstances.[181] Given these developments, it seems fair to say that a SEP owner has little expectation that it can secure injunctive relief in U.S. courts. Outside the U.S., European, Chinese and Korean competition agencies have moved one step further in this policy direction and taken actions or issued statements suggesting that even seeking injunctive relief against an infringer could expose a SEP owner to antitrust liability.[182]

2. Reasonable Royalties: Regulatory v. Market Wisdom

Any economically plausible defense of a no-injunction policy toward SEPs necessarily relies on the assumption that SEP owners will be adequately compensated through monetary damages awarded by a court in infringement litigation, taking into account the costs and risks borne by an innovator-firm in developing technology for possible inclusion in a standard. There are two factors that challenge this assumption in the current legal environment. First, even a patentee who is awarded economically commensurate damages is still not "made whole" since, absent a showing of willful infringement or other exceptional circumstances, it cannot typically recover

177. *See* J. Gregory Sidak, *Injunctive Relief and the FRAND Commitment in the United States, in* THE CAMBRIDGE HANDBOOK OF TECHNICAL STANDARDIZATION LAW: COMPETITION, ANTITRUST AND PATENTS 389, 403 (Jorge L. Contreras ed., 2018) [hereinafter Sidak, *Injunctive Relief*]. For the original complaint, see In the Matter of Motorola Mobility and Google Inc., Docket No. C-4410, July 23, 2013.

178. *See* DOJ/USPTO REPORT 2013, *supra* note 15, at 6. To be clear, the report does recognize that injunctive relief may be appropriate if an infringing firm declines a FRAND-compliant offer from the patent holder. *See id.*

179. Associated Press, *Motorola to Officially Split into Two Firms Tuesday,* CNBC (Jan. 3, 2011, 6:38 PM), https://www.cnbc.com/id/40897532.

180. Motorola Mobility LLC, Docket No. C-4410 (July 23, 2013), at ¶¶ II.B, II.C, II.D, IV, https://www.ftc.gov/sites/default/files/documents/cases/2013/07/130724googlemotorolado.pdf.

181. Renata B. Hesse, *supra* note 127.

182. For discussion, see Maureen K. Ohlhausen, *The Elusive Role of Competition in the Standard-Setting Antitrust Debate,* 20 STAN. TECH. L. REV. 93, 118-19 (2017).

compensation for the legal fees incurred as part of the litigation process.[183] Second, antitrust regulators have advocated that courts should determine reasonable royalty damages in SEP infringement litigation based on the "smallest salable patent-practicing unit" ("SSPPU"), as distinguished from the larger device of which the component is a part.[184] By extension, regulators have argued further that SEP owners should assess royalties in licensing transactions at the level of the SSPPU[185], which runs counter to long-established practices in the smartphone market of portfolio licensing at the device level.[186] This regulatory effort to remake SEP licensing practices in the smartphone market—dramatically illustrated by the district court's order in the *FTC v. Qualcomm* litigation[187]—ultimately rests on the view that allocating to the innovator any portion of the value generated by the standardization process implies a form of patent holdup that confers a windfall on the patent owner.[188] To the extent that courts regularly implement this principle for purposes of determining reasonable royalty damages and SSOs widely adopt this principle for licensing purposes, SEP owners would have reduced confidence that R&D investments can be reliably monetized through the patent licensing infrastructure that has supported four successive generations of wireless communications technologies.

a. *Regulatory Override*

Under the Patent Act, a patentee that has defended the presumption of validity and shown infringement is entitled to "damages adequate to compensate for the infringement, but in no event less than a reasonable royalty for the use made of the invention by the infringer . . . ."[189] Following the framework set forth in *Georgia-Pacific Corp. v. U.S. Plywood Corp.*,[190] courts generally determine the reasonable royalty by simulating a hypothet-

183. For details on the extensive transaction costs associated with FRAND-related litigation, see Epstein & Kappos, *supra* note 135, at 80-82. On the infrequency with which willful infringement is found in SEP infringement litigation, see *infra* note 211.

184. *See infra* notes 198-210 and accompanying discussion.

185. For an example of a regulator expressing this view, see HESSE, *supra* note 176; for further discussion of these views, see *infra* notes 201-03 and accompanying text.

186. On the market preference for device-level licensing, see *infra* notes 196 and 214-17 and accompanying text.

187. *FTC v. Qualcomm, Inc.,* N.D. Cal., Case No. 17-CV-00220-LHK, May 21, 2019 (Koh, J.), at 227-229 (requiring that Qualcomm renegotiate existing SEP licenses).

188. *See e.g.,* Lemley & Shapiro, *A Simple Approach, supra* note 149, at 1148 ("By construction, the reasonable royalty does *not* include the value attaching to the creation and adoption of the standard itself."). For a critique of this assumption, see Edward F. Sherry et al., *FRAND Commitments in Theory and Practice: A Response to Lemley and Shapiro's "A Simple Approach"* (Univ. of Cal. Berkeley Ctr. for the Mgmt. of Intellectual Capital, Working Paper No. 3, 2015).

189. 35 U.S.C. § 284 (2012).

190. Georgia-Pacific Corp. v. U.S. Plywood Corp., 318 F.Supp. 1116, 1120 (S.D.N.Y. 1970), *modified and aff'd,* 446 F.2d 295 (2d Cir. 1971).

ical negotiation between a willing licensor and licensee of the relevant patent. Although there is a rich and complex body of case law on the appropriate methodologies for putting this principle into practice[191], any such exercise ultimately reduces to a determination of the appropriate royalty base and the appropriate rate to generate the damages award. While *Georgia-Pacific* identifies multiple factors that may be relevant in a reasonable royalty analysis, the Federal Circuit has emphasized the special importance of evidence concerning the royalty rates in economically comparable licensing transactions.[192] This makes perfect sense: market prices reflect a much richer pool of transactions than a court could reasonably expect to discover through competing expert witness testimonies in a single litigation. In the SEP context, the *Georgia-Pacific* framework would imply that courts should pay special attention to the fact that prevailing market practice in the smartphone and other related IT industries has used the end-user price of the relevant device as the base to which the royalty rate is applied.[193] Yet some academics, regulators and litigants have urged courts to *ignore* market practice in SEP infringement litigation. Based on the assumption that patent holdup and royalty stacking widely afflict patent-intensive IT markets, Mark Lemley and Carl Shapiro argued in 2007 (both separately and in co-authored papers) that courts should avoid overcompensating SEP owners by determining the reasonable royalty by reference to the incremental value of the patented component, rather than the entire value of the product.[194]

In 2009, Judge Rader of the Federal Circuit (but sitting as a district court judge by designation) held, in the context of damages proceedings involving infringement of a patent relating to a component of a computing system, that the reasonable royalty should be calculated using the SSPPU as the royalty base.[195] It is important to note that he made this holding in the context of an evidentiary ruling and specifically for the purpose of limiting

191. For a review, see THOMAS F. COTTER, COMPARATIVE PATENT REMEDIES: A LEGAL AND ECONOMIC ANALYSIS 119-139 (2006).

192. *See* Versata Software, Inc. v. SAP Am., Inc., 717 F.3d 1255, 1267-68 (Fed. Cir. 2013) (stating that, if there is evidence of an "established" royalty rate, that evidence should be the principal basis for determining reasonable royalty damages, as compared with other evidence that may be less certain).

193. *See* J. Gregory Sidak, *The Proper Royalty Base for Patent Damages,* 10 J. COMPETITION L. & ECON. 989, 993, 996 (2014) [hereinafter Sidak, *Proper Royalty Base*] (providing examples from royalty practices of Nokia, ZTE, Nortel and IBM); Sherry et al., *supra* note 182, at 3-4 n.14 (noting that market practice favors calculating royalty based on the device's wholesale selling price).

194. *See* Carl Shapiro, *Patent Reform: Aligning Patent Reward and Contribution*, *in* 8 INNOVATION POLICY AND THE ECONOMY (2007). In a co-authored paper, Shapiro and Mark Lemley argue that the royalty should be calculated based on the incremental value of the patented component, *discounted* by the probability that the patent would be deemed valid by a court – meaning, the patent owner would recover an amount that is even less than the incremental value measure. *See* Lemley & Shapiro, *A Simple Approach, supra* note 149, at 1148.

195. *Cornell Univ. v. Hewlett-Packard Co.,* 609 F.Supp. 279, 287-88 (N.D.N.Y. 2009).

the possibility that a jury would be misled by a broader royalty base above the level of the SSPPU.[196] As the Federal Circuit has subsequently explained, this reflects prudential concerns that a jury's "damages horizon" would be skewed by using a broader royalty base, even if instructed to adjust the royalty rate to reflect the patented component's relative contribution.[197] Despite this limited application as a precautionary step to mitigate jury confusion, Judge Rader's ruling has nonetheless been interpreted by some commentators, regulators and courts as having set forth a substantive requirement that courts in SEP infringement litigation must always calculate the reasonable royalty, and, by logical extension, SEPs must always be licensed, on the basis of the SSPPU.[198] In 2015, the IEEE, a leading SSO in the IT market, implemented this approach and amended its IPR licensing policy (after receiving effective pre-clearance through a DOJ Antitrust business review letter[199]) to provide that determination of FRAND-compliant "reasonable" royalties "should include . . . the consideration of [t]he value that the functionality of the claimed invention . . . contributes to the value of the relevant functionality of the smallest saleable Compliant Implementation that practices the Essential Patent Claim."[200]

b. *Judicial Restraint*

While regulators have largely succeeded in entrenching a lightly qualified no-injunction principle in SEP infringement jurisprudence, they have had mixed success in securing judicial adoption of the SSPPU approach as a mandatory rule that uniformly governs reasonable royalty determinations in SEP infringement litigation and licensing transactions. As of 2018, David Kappos and Paul Michel showed that, while courts had addressed the SSPPU concept in over 75 district court cases, they had done so in almost all cases for purposes of avoiding the perceived risk of patentee overcom-

196. *See id.*, at 283 (stating that the trial court had properly excluded testimony from an expert witness who had used the "CPU" module as the royalty base because doing so would "mislead the jury to award damages far in excess of their compensatory purpose").

197. *See LaserDynamics, Inc. v. Quanta Computer, Inc.*, 694 F.3d 51, 67-68 (Fed. Cir. 2012), *citing* Uniloc USA Inc. et al. v. Microsoft Corp., 632 F.3d 1292, 1320 (Fed. Cir. 2011).

198. For a description of these views, see David Kappos & Paul Michel, *The Smallest Saleable Patent-Practicing Unit: Observations on its Origins Development and Future,* 32 BERKLEY TECH. L. J. 1433, 1446-47 (2018). For an example of a regulator advocating that SSOs should adopt the "SSPPU" as a mandatory rule for licensing standard-essential patents, see HESSE, *supra* note 173. For an example of a court deeming the SSPPU to be a mandatory principle in SEP licensing transactions, see *FTC v. Qualcomm, Inc.,* N.D. Cal., Case No. 17-CV-00220-LHK, May 21, 2019 (Koh, J.), at 172-73 (holding that device-level licensing is inconsistent with the Federal Circuit's interpretation of the SSPPU requirement).

199. Renata B. Hesse, *supra* note 124.

200. IEEE Bylaws, *supra* note 128, at 15-16.

pensation by a jury unfamiliar with patent licensing.[201] In a recent SEP infringement litigation in the Eastern District of Texas, a jury even rejected the SSPPU approach on the grounds that it did not track market practices as reflected in comparable licenses.[202] In short: there is considerable evidence that courts are continuing to hew closely to the emphasis that patent case law generally places on comparable licenses and other indicia of market practice as the primary source of evidence for purposes of determining reasonable royalty damages.[203]

It is helpful to appreciate why courts might generally prefer relying on market wisdom over regulatory wisdom in infringement litigation involving SEPs and multi-component technology more generally. SEP licensing transactions take place in a market environment that is typically populated by sophisticated parties on both side of the negotiating table. If that is the case, then the choice of royalty base should not matter. The reason is simple: any given royalty amount can be replicated at the component *or* device level simply by adjusting the percentage rate appropriately to reflect the size of the base.[204] It is precisely the mathematical equivalence of device-level and component-level royalty-setting that explains the limited "pedagogical" purpose for which Judge Rader initially adopted in the context of a jury trial the progenitor of what some commentators and policymakers have since transformed into the "SSPPU rule" that would apply across-the-board in all SEP infringement litigations and licensing transactions. To correct any such substantive misinterpretation, the Federal Circuit, in 2014 and 2015, specifically rejected the proposition that damages calculations in infringement litigations involving multi-component products must always use the SSPPU approach, clarifying that this is an "evidentiary principle" designed to avoid

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201. For a detailed account, see Kappos & Michel, *supra* note 198, at 1444-45. As Kappos and Michel note, the court in one case did apply the SSPPU principle outside the jury context to identify the royalty base for purposes of determining damages. *See In re* Innovatio IP Ventures, LLC*,* 2013 WL 5593609 (N.D. Ill., Oct. 3, 2013) (applying SSPPU in a bench trial to identify the royalty base to determine damages and not to avoid jury confusion).

202. *HTC Corp et al. v. Telefonaktiebolaget LM Ericsson et al.,* Civil Action No. 6:18-CV-00243-JRG (E.D. Tex., May 23, 2019). The court stated: "Ericsson [the patentee] established, and HTC's [the infringer's] own experts conceded, that there are no examples in the industry of licenses that have been negotiated based on the profit margin, or even the cost, of a baseband processor [the SSPPU proposed by HTC for damages purposes]. HTC's license expert . . . was unable to identify a single industry license based on the profit margin of a chip", *see id.*, at 10.

203. *See supra* note 193.

204. To illustrate: a 10% royalty on a component-level royalty base of $100 is equivalent to a 1% royalty on a device-level royalty base of $1000. The Federal Circuit has made the same observation, noting that "an appropriate apportioned royalty award could . . . be fashioned by starting with the entire market value of a multi-component product—by, for instance, dramatically reducing the royalty rate to be applied in those cases . . . ." *See Ericsson, Inc. v. D-Link Syss., Inc.,* 773 F.3d 1201, 1227 (Fed. Cir. 2014).

jury confusion.[205] This limited function of the SSPPU as a preemptive error-mitigation tool in the litigation context in turn casts doubt on assertions that the SSPPU "requirement" applies more broadly to SEP licensing transactions in the marketplace.[206] The assumed lack of sophistication among jury members that drove adoption of the SSPPU approach in the litigation context is implausible in the case of business parties that regularly engage in IP licensing transactions.

c. *Market Backlash*

If sophisticated licensors and licensees have converged over the course of the wireless markets on device-level royalty rates as an efficient market norm, then it would be expected that regulatory efforts to move the market away from that norm would meet with resistance. This is exactly what has happened. The IEEE's aforementioned 2015 amendment, which effectively mandated component-level SEP licensing, rapidly produced an observable adverse effect on the SSO process. Following adoption of the amendment by the IEEE and through 2017, most researchers have observed a significant to dramatic decline in the number of new technical contributions to the IEEE 802.11 ("WiFi") working groups that were accompanied by positive letters of assurance ("LOAs") (that is, indicating a commitment to FRAND licensing principles) and a dramatic increase in the number of new technical contributions accompanied by *negative* LOAs (that is, disclaiming any commitment to FRAND licensing principles).[207] The drop-off in the sub-

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205. Commonwealth Sci. & Indus. Research Org. v. Cisco Syss., Inc., 809 F.3d 1295, 1303-04 (Fed. Cir. 2015) (upholding the trial court's calculation of a reasonable royalty based on a royalty base consisting of end-product sales); Ericsson, Inc. v. D-Link Syss., Inc., 773 F.3d 1201, 1226 (Fed. Cir. 2014) (stating that the SSPPU is an "evidentiary principle . . . assisting in reliably implementing the [apportionment] rule when—in a case involving a per-unit royalty—the jury is asked to choose a royalty base as the starting point for calculating a reasonable royalty award").

206. This type of assertion is found in *FTC v. Qualcomm, Inc.,* N.D. Cal., Case No. 17-CV-00220-LHK, May 21, 2019 (Koh, J.), at 172-73 (holding that device-level licensing is "inconsistent with . . . Federal Circuit case law on the smallest salable patent practicing unit"). This statement suffers from two flaws. First, it ignores the fact that the Federal Circuit has specifically rejected use of the SSPPU as a mandatory rule for determining damages in all cases involving multi-component technologies, *see* Commonwealth Sci. & Indus. Research Org. v. Cisco Syss., Inc., 809 F.3d 1295, 1303 (Fed. Cir. 2015) ("The rule Cisco advances—which would require all damages models to begin with the smallest salable patent-practicing unit—is untenable"). Second, it implausibly derives the proposition that privately negotiated licensing transactions are subject to the SSPPU approach from Federal Circuit case law requiring use of the SSPPU approach for the limited purpose of avoiding jury error in determining reasonable royalty damages.

207. *See* Kirti Gupta & Georgios Effraimidis, *IEEE Patent Policy Revisions: An Empirical Examination of Impact* (March 2018), http://www.law.northwestern.edu/research-faculty/searlecenter/events/roundtable/documents/effraimidis_gupta.pdf (providing data on letters of assurance filed for IEEE 802.11 standard during 2005-2017); KEITH MALLINSON, DEVELOPMENT OF INNOVATIVE NEW STANDARDS JEOPARDIZED BY IEEE PATENT POLICY,

mission of positive LOAs is especially large among firms that have historically been among the leading submitters of positive LOAs to the IEEE.[208] Prior to this period, only one negative LOA had ever accompanied a new technical submission.[209]

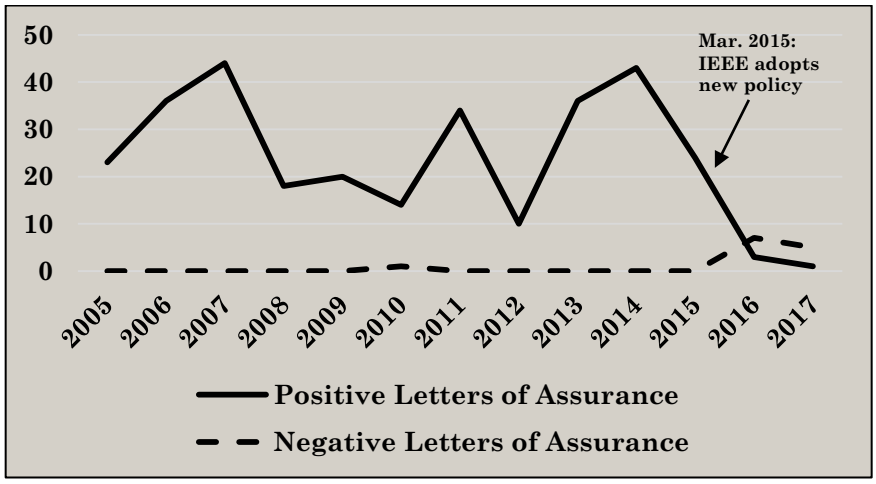
The Figure below shows this striking response of innovator-firms to IEEE's attempt starting in 2015 to entrench the SSPPU rule as part of the mandatory content of FRAND licensing principles.

4IP COUNCIL, Sept. 7, 2017, https://www.4ipcouncil.com/application/files/6015/0479/2147/Mallinson_IEEE_LOA_report.pdf (studying letters of assurance filed for IEEE 802.11 standard for 18-month period ending June 2017); Ron Katznelson, *The IEEE Controversial Policy on Standard Essential Patents – The Empirical Record Since Adoption,* Oct. 29, 2016 (updated March 2018), https://works.bepress.com/rkatznelson/80/. Note that these researchers distinguish between new and "duplicate" or "repeat" submissions; the trends described in the text above relate solely to new (also known as "non-duplicate" or "unique") submissions. This distinction appears to account in part for the contrary results reached by TIM POHLMANN, EMPIRICAL STUDY ON PATENTING AND STANDARDIZATION ACTIVITIES AT IEEE*,* (Mar. 2017), https://www.iplytics.com/wp-content/uploads/2018/01/IPlytics_2017_Patenting-and-standardization-activities-at-IEEE.pdf. Pohlmann presents data showing that submission of positive letters of assurance to IEEE following adoption of the IEEE policy change persisted in 2015 and 2016 consistently with historical averages, but (unlike the researchers mentioned above) counts "duplicate" letters of assurance filed in connection with an amendment of a standard. *See id.* at 10-11. Mallinson argues that some firms have strategic motivations to file duplicate positive letters of assurance in response to merely clarifying policy amendments and, therefore, counting duplicates can distort the use of filing data for purposes of assessing the "health" of the standardization process. *See* Mallinson, *supra* note 197, at 11-12. Note that, even if duplicate positive letters of assurance were included, this would not alter the finding that firms only started filing negative letters of assurance for the IEEE 802.11 standard following adoption of the IEEE policy change (except for a single such filing in 2010). *See* Gupta & Effraimidis, *supra* note 197, at 15.

208. *See* Mallinson, *supra* note 197, at 13-14.

209. *See* Gupta & Effraimidis, *supra* note 197, at 15.

FIGURE 3: LETTERS OF ASSURANCE TO 802.11 IEEE STANDARD (2005-2017, NEW SUBMISSIONS ONLY)[210]



It is possible that the market's resistance to the IEEE's re-interpretation of the FRAND commitment represents a self-interested effort by patent owners to preserve a licensing arrangement by which they had earned royalties in excess of the levels required to support R&D investment incentives. Yet, given the market's long-standing preference for device-level royalty licensing, coupled with the ability of reasonably sophisticated entities to replicate agreed-upon divisions of value irrespective of the selected royalty base, it is worth considering whether this practice represents an efficient contracting device that has evolved through the trial-and-error process of market experience. If that is the case, then efforts to substitute the SSPPU standard for existing market practices may be a misguided undertaking that endangers efficient arrangements for licensing intellectual assets, and implementing agreed-upon divisions of market value, among the diverse pool of innovators, producers, and distributors that each play important functions in the smartphone ecosystem.

There are at least three transaction-cost considerations that can plausibly explain why licensors *and* licensees would collectively benefit from licensing at the device rather than the component level. First, the smartphone market may calculate the license fee payable by device makers as a percentage of the sale price for the simple reason that this is an observable figure that is not amenable to manipulation or dispute by licensees or licensors. Second, the retail device market, being more liquid than upstream and mid-

210. *See id.* at 22.

stream component markets, may offer the best measure of the IP licensor's contribution to the total product-and-services bundle.[211] Relatedly, as Alex Galetovic and Stephen Haber have argued, pricing a component at the device level provides the most accurate indication of economic value since it captures the value that consumers place on that component in interaction with other components of the same product package.[212] Third, situating IP licensing at the device level imposes considerably fewer transaction costs than engaging in multiple licensing transactions at discrete component levels in the IT supply chain.[213] This would require a laborious effort to identify the "SSPPU" with respect to each component of a multi-component product package.[214]

In the aggregate, these considerations suggest that the growing academic and regulatory consensus in favor of mandatory component-level licensing, which necessarily presumes that device-level licensing represents patentee overreaching, may have things backward. Rather than assuming without empirical inquiry that a well-established market practice reflects market failure (especially in an environment populated by well-resourced and sophisticated licensors and licensees), it may be more prudent for commentators and policymakers to start from the rebuttable presumption that any such practice reflects an efficient response to the technological and economic conditions of the smartphone and related IT markets.

B. *From Patent Holdup to Patent Holdout*

To the extent that antitrust agencies, courts and SSOs in commercially significant jurisdictions have adopted a no-injunction principle (or mildly qualified variants thereof), it is reasonable to assert that the worldwide smartphone and related SEP-intensive device markets now operate under a *de facto* regime of compulsory licensing in which SEP owners are restricted to securing monetary damages from infringing third parties. This reduction in patent strength is at risk of being compounded further by regulatory efforts to embed the SSPPU principle as a substantive rule for determining royalties in SEP infringement litigation and SSO licensing policies. This would effectively override and impose a judicial ceiling on existing market-negotiated royalty rates. The logic behind this infringer-friendly regime is straightforward. In the absence of injunctive relief, a SEP holder can no longer credibly threaten an infringer with shutdown and, as a result, cannot

211. *See* Bowman Heiden & Jens Andreasson, *Reevaluating Patent Damages in the Knowledge Economy: The Intellectual Value Chain and the Royalty Base for Standard-Essential Patents,* 1 CRITERION J. ON INNOVATION 229, 261-62 (2016).

212. *See* Alexander Galetovic & Stephen H. Haber, *SEP Royalties: What Theory of Value and Distribution Should Courts Apply?,* 4 (Hoover IP2, Working Paper No. 19001, 2019). For related discussion, see Sidak, *Proper Royalty Base, supra* note 187, at 993-94.

213. *See* Kappos & Michel, *supra* note 190, at 1446-47.

214. *See id.*

extract "excessive" royalties or other payments from entities that have made irrevocable investments in the patented technology and have no cost-feasible non-infringing alternative.

This "patent-lite" regime rests on a straightforward argument. So long as monetary damages as determined in court provide upstream IP holders with a sufficient return on their R&D investment (net of litigation and related costs), this regime would appear to preserve R&D incentives while protecting downstream implementers against opportunistic hold-up. While plausible in theory, this argument has two critical failings. First, it heroically assumes that courts typically have adequate information to calculate the "efficient" patent royalty such that innovators are perfectly compensated for the costs and risks they have uniquely borne in R&D and related product-development activities. As discussed above, at least some courts and agencies have pursued damages calculation methodologies that are likely to generate sums that undercompensate innovators for the costs and risks undertaken in connection with the relevant standard-setting process. Second, it does not address the fact that an injunction-free regime necessarily induces opportunistic "hold-out" by downstream users, especially in circumstances in which (i) litigation is costly, lengthy and uncertain, (ii) the downstream user has ample litigation resources at its disposal, (iii) the patented technology exhibits some positive rate of commercial or technological obsolescence, (iv) monetary damages tend to be undercompensatory (whether due to judicial methodology or collection difficulties), and (v) there is a sufficiently limited possibility that a court will find willful infringement and award supercompensatory damages.[215] Without a credible injunction threat

215. It appears that a willfulness finding and enhanced damages (which a court has discretion to award following a willfulness finding) are an unlikely possibility in a SEP infringement litigation. *See* Contreras et al., *supra* note 181, at 293-95 (noting that only one district court has awarded supercompensatory damages to a SEP holder and describing the view that such damages are inappropriate in the case of a SEP holder because of the high percentage of SEPs that are likely not essential). More generally, empirical evidence indicates that a willfulness finding is not a typical outcome in patent infringement litigation. For all patent cases filed between September 2004 and July 2010, 1.9% reached a final decision on willfulness, of which 48% reached a positive finding prior to August 2007 (when the Federal Circuit adopted a more stringent standard for finding willfulness) and 37% reached a positive finding after that date. Among cases that resulted in a willfulness finding, the mean enhanced damages multiplier applied by the court was 213% during Sept 2004-August 2007 and 198% thereafter through July 2010. *See* Christopher B. Seaman, *Willful Patent Infringement and Enhanced Damages After In re Seagate: An Empirical Study,* 97 IOWA L. REV. 417, 441 (evidence on willful infringement) and 469-70 (evidence on enhanced damages) (2012). As is the case in civil litigation more generally, only a small percentage of filed patent cases are ever finally adjudicated, with estimates in the range of 3-5%, *see id.,* at 436-37. A more recent study finds that, out of a sample of 88 cases in which plaintiffs filed a motion for willful infringement, the court found willful infringement 36% of the time prior to the Court's decision in *Halo Elecs, Inc. v. Pulse Elecs, Inc.* 136 S. Ct. 1923 (2016) (which relaxed the standard for finding willful infringement) and 54% of the time thereafter, although the average damages multiplier decreased from 2.5x to 2.1x. *See* PRICEWATERHOUSECOOPERS, 2018 PATENT

and limited assurance that a substantial damages award (net of legal fees) are a likely prospect, an upstream innovator may be deterred from pursuing an infringement action and will rationally settle for a reduced royalty payment from the implementer firm. While this outcome would reduce implementers' technology input costs and, depending on competitive conditions, potentially result in static efficiency gains in the form of lower prices for end-users, the absence of a credible shutdown threat (compounded by reduced expected damages) may depress licensing fees below the dynamically efficient levels required to remunerate innovators for the costs and risks inherent to R&D activities. In response, those firms would respond by reducing the allocation of funds to R&D, vertically integrating forward into production and distribution, or seeking to monetize R&D outside the cooperative standard-setting process and the associated FRAND licensing framework. Even assuming R&D and follow-on standardization activities could still be successfully achieved at a comparable scale, cost and level of functionality, the result may be a mix of organizational structures that is less efficient in the aggregate relative to the mix of structures that would prevail under a more secure IP regime.

To be clear, courts and regulators have paid some attention to the hold-out risk that would necessarily arise in the case of a flat prohibition on injunctions for SEP holders. In the *Apple v. Motorola* case, Judge Posner (acting as the district court judge) had qualified the denial of injunctive relief, stating that a SEP holder could not seek an injunction against a third party that had demonstrated a "willingness" to license on FRAND terms.[216] In reviewing Posner's decision, the Federal Circuit made a similar "willing licensee" precondition for the denial of injunctive relief to SEP holders subject to the FRAND commitment.[217] In a 2015 decision in the European Union, *Huawei v. ZTE,* the European Court of Justice held that a SEP holder could pursue an injunction against an alleged infringer without antitrust liability for "abuse of dominance", so long as the patentee provides sufficient notice and the alleged infringer rejects, or fails to " diligently respond" to, a licensing offer deemed to be FRAND-compliant.[218] Similarly, in 2017, the United Kingdom's High Court of Justice (Patents) held that an injunction may be available to a SEP holder if the infringing user "refuses to take a license on terms found by the court to be FRAND."[219] In another deviation from dominant tendencies, a Chinese court in December 2018 granted lim-

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LITIGATION STUDY 17 (2018), http://www.ipwatchdog.com/wp-content/uploads/2018/09/2018-pwc-patent-litigation-study.pdf.

216. Apple, Inc. v. Motorola, Inc., 869 F.Supp. 2d 901, 913-14 (N.D. Ill. 2012), *modified on other grounds,* 757 F.3d 1286 (Fed. Cir. 2014).

217. Apple, Inc. v. Motorola, Inc., 757 F.3d 1286, 1331-32 (Fed. Cir. 2014).

218. Case C-170/13, Huawei Techs. Co. v. ZTE Deutschland GmbH 2014 E.C.R. 477 ¶¶ 61-67.

219. Unwired Planet Int'l Ltd. v. Huawei Techs. Co. [2017] EWHC (Pat) 711.

ited preliminary injunctive relief to Qualcomm in its patent infringement litigation against Apple, barring the import of certain Apple phones and other devices.[220]

The Antitrust Division of the Department of Justice has recently taken even more substantial steps in this direction. In a November 2017 speech, the head of the DOJ's Antitrust Division, Makan Delrahim, stated that patent hold-out by implementer firms represents a more substantial risk than holdup by innovator firms (due to the fact, as discussed earlier, that the innovator must incur R&D expenditures well before the standard is set and adopted), and rejected any no-injunction policy with respect to SEPs, specifically criticizing the Federal Circuit's qualified support for such a rule in the *Apple v. Motorola* litigation.[221] On December 7, 2018, Delrahim announced that the DOJ would withdraw from the joint policy statement that had been co-released in 2003 by the DOJ and the PTO and had suggested that SEP owners should not be entitled to an injunction given the risk of patent holdup.[222]

Yet it is important not to overstate the practical importance of these qualifications to the quasi-prohibition on injunctions for SEP owners. Even the dramatic shift in policy indicated by DOJ Antitrust has not yet been reflected in decisions by the federal courts or adopted by any other competition law agency.[223] Second, even under the more patentee-friendly framework adopted by the European and UK courts, the SEP owner will always be uncertain whether a particular licensing offer to an infringer will subse-

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220. *See China: iPhone Import and Sale Ban Over Qualcomm Dispute,* COMPETITION POL'Y INT'L (Dec. 10, 2018) https://www.competitionpolicyinternational.com/china-iphone-import-and-sale-ban-over-qualcomm-dispute/.

221. Makan Delrahim, Assistant Att'y Gen., Dep't of Justice, Remarks at the USC Gould School of Law's Center for Transnational Law and Business Conference (Nov. 10, 2017), https://www.justice.gov/opa/speech/assistant-attorney-general-makan-delrahim-delivers-remarks-usc-gould-school-laws-center. In speeches delivered in March and September 2018, Delrahim reiterated those views. *See* Makan Delrahim, Assistant Att'y Gen., U.S. Dep't of Justice, Remarks as Prepared for IAM's Patent Licensing Conference: Antitrust Law and Patent Licensing in the New Wild West (Sept. 18, 2018), https://www.justice.gov/opa/speech/file/1095011/download; Makan Delrahim, Assistant Att'y Gen., U.S. Dep't of Justice, Remarks as Prepared for Delivery at University of Pennsylvania Law School: The "New Madison" Approach to Antitrust and Intellectual Property Law (Mar. 16, 2018), https://www.justice.gov/opa/speech/file/1044316/download.

222. Makan Delrahim, Assistant Att'y Gen., U.S. Dep't of Justice, Remarks at the 19th Annual Berkeley-Stanford Advanced Patent Law Institute: "Telegraph Road": Incentivizing Innovation at the Intersection of Patent and Antitrust Law (Dec. 7, 2018).

223. There are some limited qualifications to this general tendency. A recent statement by the European competition authority acknowledges the risk of "patent holdout" under a no-injunction regime. *See* Eur. Comm., *Communication from the Commission to the European Parliament, the Council and the European Economic and Social Committee* 9-10 (Nov. 29, 2017). Recent guidelines released by the Japan Patent Office acknowledge the risk of both patent holdup and patent holdout in connection with the enforcement of SEPs. *See* Japan Pat. Off., *Guide to Licensing Negotiations Involving Standard Essential Patents* 1 (June 5, 2018).

quently be deemed as FRAND-compliant.[224] As a general matter, it remains the case that upstream innovator-firms continue to operate in commercially significant markets under a truncated IP regime in which injunctive relief is largely foreclosed and the availability of monetary damages is subject to substantial uncertainty. As a result, an R&D-specialist firm has considerably reduced confidence that it can capture adequate returns on its R&D investments through negotiated licensing transactions. Any innovator that enters into a licensing agreement with an implementer-firm (especially, a well-resourced firm that can fund an extended litigation) must take into account some positive likelihood that the counterparty will unilaterally cease making payments, and then either the counterparty will challenge the agreement on antitrust grounds or the relevant antitrust authority will do so.

In the extended sequence of litigations in U.S. courts involving Qualcomm, the FTC and Apple, both possibilities have been realized. On January 17, 2017, the FTC filed an antitrust lawsuit against Qualcomm concerning its licensing practices,[225] which was followed three days later by a suit by Apple against Qualcomm (Apple's primary chip supplier for the iPhone) on antitrust and breach of contract grounds.[226] In April 2017, Apple ceased to reimburse its contract manufacturers for royalty payments to Qualcomm, which unsurprisingly led the contract manufacturers to cease making those payments.[227] While those billions of dollars in licensing fees remained outstanding, Qualcomm and Apple engaged in dueling patent infringement suits and countersuits.[228] In September 2018, an administrative judge at the International Trade Commission rejected Qualcomm's demand for a limited

224. Similarly, Anne Layne-Farrar notes that, in practice, "establishing that a firm is an 'unwilling licensee' is an extremely difficult hurdle for SEP holders to clear", *see* Anne Layne-Farrar, *Moving Past the SEP RAND Obsession: Some Thoughts on the Economic Implications of Unilateral Commitments and the Complexities of Patent Licensing*, 21 GEO. MASON L. REV. 1093, 1105 n. 38 (2014). Illustrating this predicament, a Korean court granted injunctive relief to a patent holder (Samsung) based on the finding that a defendant (Apple) was an "unwilling licensee", *see* Contreras et al., *supra* note 181, at 331-33 (discussing Samsung Elecs. Co. v. Apple Korea Ltd. (Seoul S. Cent. D.C. 2012)), while, in apparently related litigation, a Japanese court found that Apple was a "willing licensee" and declined to grant Samsung injunctive relief. *Id.* at 333-36 (discussing Samsung Elecs. Co. v. Apple Japan LLC (Japan IP High Court 2014)).

225. Fed. Trade Comm.'s Complaint for Equitable Relief, FTC v. Qualcomm Inc., Case No. 5:17-cv-00220 (N.D. Cal., filed Jan. 17, 2017).

226. *See* Shara Tibken, *Apple sues Qualcomm over unfair licensing terms,* CNET (Jan. 20, 2017); Redacted First Amended Complaint for Damages, Declaratory Relief and Injunctive Relief, Apple, Inc. v. Qualcomm Inc., Case No. 17-cv-0108-GPC-MDD (S.D. Cal., filed June 20, 2017).

227. *See* Aaron Pressman, *Apple Stops Paying iPhone Royalties, Escalating Feud with Qualcomm,* FORTUNE (Apr. 28, 2017), http://fortune.com/2017/04/28/apple-iphone-royalties-qualcomm/.

228. *See* Stephen Nellis, *Apple accuses Qualcomm of patent infringement in countersuit,* REUTERS, Nov. 29, 2017 (describing patent infringement suit filed by Qualcomm against Apple in July 2017 and patent infringement counterclaim filed by Apple in November 2017).

exclusion order that would have banned certain Apple phones and other devices, even though those devices had been deemed to be infringing upon Qualcomm's patents.[229] On April 16, 2019, these overlapping disputes (other than the ITC proceeding and the FTC suit) abruptly ended when Apple and Qualcomm announced a global settlement of all pending patent litigation[230] (which reportedly includes a payment of approximately $4.5 billion by Apple to Qualcomm[231]). However, the effect of the settlement on the legal landscape in the wireless market was soon placed in considerable doubt. On May 21, 2019, a federal district court ruled in the FTC's favor in its antitrust suit against Qualcomm and issued an especially broad remedy requiring Qualcomm to renegotiate its existing SEP licenses (subject to judicial or arbitral resolution) and offer new SEP licenses to any interested chipmakers.[232] As of this writing, Qualcomm has announced that it plans to appeal the decision to the Ninth Circuit.[233]

The deteriorating legal environment for patent owners in the wireless industry is nicely illustrated by Apple's decision to withhold several billions of dollars in licensing payments during its more than two years of litigation against Qualcomm. This "don't pay, litigate and maybe pay less (or nothing) later" strategy is perfectly rational from the perspective of a well-resourced licensee that operates in a legal environment in which even firms with strong patent portfolios cannot make a credible threat to secure injunctive relief against an infringing party. As of October 2018, Qualcomm claimed that Apple owed it approximately $7 billion in unpaid license fees.[234] Absent long-term reputation effects, it would be economically irrational for Apple to make that outstanding payment (or even some lesser agreed-upon amount) without first attempting to potentially reduce the licensing fees to zero through patent and antitrust litigation. Given a sufficiently limited risk of a willfulness finding[235] (which could trigger super-

229. *See supra* notes 173-173 and accompanying text. In March 2019, the ITC commissioners rendered the judge's decision moot by finding Qualcomm's underlying patent invalid. Concurrently, in another ITC proceeding, an administrative judge issued a limited exclusion order concerning certain Apple iPhone models found to infringe another Qualcomm patent. The exclusion order is still subject to review by the ITC commissioners. *See* Elise Reuter, *ITC Rejects Qualcomm Patent in Final Decision,* SAN DIEGO BUS. J., Mar. 26, 2019.

230. *See* Tripp Micklie and Asa Fitch, *Apple, Qualcomm Agree to Drop All Patent Litigation,* Wall St. J., Apr. 16, 2019.

231. *See* Asa Fitch, *Qualcomm to Get at Least $4.5 Billion in Apple Settlement,* Wall St. J., May 1, 2019.

232. *FTC v. Qualcomm, Inc.,* N.D. Cal., Case No. 17-CV-00220-LHK, May 21, 2019 (Koh, J.), at 227-32.

233. *See* Nellis, *supra* note 5.

234. *See* Jean Baptiste Su, *Qualcomm Claims $7 Billion from Apple for Unpaid Royalty Fees,* FORBES (Oct. 28, 2018, 2:26 PM), https://www.forbes.com/sites/jeanbaptiste/2018/10/28/qualcomm-claims-7-billion-from-apple-for-unpaid-royalty-fees/#60b7c39a6cb7.

235. *See supra* note 205 and accompanying text.

compensatory damages) and continuing to assume little prospect of being subject to economically meaningful injunctive relief[236], the infringer's worst-case scenario would result in payment of a sum equal to (i) a hypothetical royalty on past sales (plus interest), plus (ii) a continuing royalty on future sales, plus (iii) legal fees. Aside from legal fees (effectively an option paid to reveal information concerning the validity of the licensor's patent), this puts the infringing party in approximately the same position it would have been in if it had *not* contested the license and underlying patents. In practice, this so-called "efficient infringement" strategy is likely to result in a renegotiated royalty rate being agreed upon in a settlement between the licensor and licensee in advance of trial, discounted to reflect the likelihood of an invalidity or non-infringement ruling. While this downward adjustment in patent royalty rates merely constitutes a wealth transfer among different parties on the supply chain (a matter of indifference from an efficiency perspective) and may even benefit consumers in the short term to the extent that implementers reflect lower input costs in the form of lower prices[237], it raises the concern that licensing fees are being pushed below dynamically efficient levels, which could reduce the R&D incentives of upstream innovator-firms or compel those firms to adopt less efficient R&D-monetization structures.

V. The Political Economy of SEPs, FRAND and Standardization Policy

Scholarly debates over antitrust and IP policy concerning standardization processes in ICT markets implicitly assume a benevolent and publicly-interested regulator who seeks to maximize the net welfare gains generated by innovation activity. Real-world policymakers, however, are exposed to the efforts of privately interested firms that rationally seek to influence IP and antitrust policy for individual profit-maximization purposes. The otherwise rich literature on SEPs and the FRAND standard has paid relatively little attention to the political economic considerations that play a substantial part in real-world lobbying and policymaking on these issues. In this Part, I undertake the beginnings of such an analysis. Based on evidence re-

236. The strength of this assumption may merit being revisited to a limited extent, in light of two developments that are pending as of this writing: (i) a Chinese court's decision in December 2018 to grant preliminary injunctive relief to Qualcomm with respect to certain Apple phones and other devices found to infringe upon Qualcomm's patents, a decision that is now being appealed to a higher court, and (ii) a decision in March 2019 by an administrative judge of the International Trade Commission to issue a limited import exclusion order against certain Apple devices found to infringe upon a Qualcomm patent, a decision that is subject to review by the ITC commissioners. *See supra* note 210-220; *supra* note 173 and accompanying text.

237. This is not a necessary outcome. *See* discussion *infra* Part V.C.

lating to the historical origins of the FRAND requirement and recent SEP-related enforcement actions by certain competition agencies, I argue that downstream firms and economies that specialize in the production and assembly of ICT devices have consistently (and with substantial success) sought to adjust the "IP balance of trade" by advocating for, and sometimes successfully imposing, limitations on patentees' ability to seek injunctive relief and enforce market-negotiated royalty agreements. This incremental devaluation of IP rights, and the associated IP licensing infrastructure, effectively shifts revenue streams away from firms and economies that specialize in generating technology inputs and toward firms and economies that specialize in integrating technology inputs into consumption goods. These antitrust enforcement actions are inconsistent with the fundamental objective of antitrust law, which seeks to preserve the conditions under which the price discovery mechanism can allocate resources efficiently, rather than influencing the price mechanism to favor certain constituencies. While an enforcement strategy targeting SEPs operates to the private interest of licensees (and economies that are principally populated by licensees), there is considerable doubt whether it is consistent with a broader public interest in preserving the vertically disaggregated structure, and cooperative standardization mechanisms, that have supported innovation and commercialization in wireless communication markets.

A. *The Origins of the FRAND Requirement*

The FRAND requirement is typically presented as an instrument for shielding licensees, and as a result consumers, from the pricing power of patent holders after a technology standard has been widely adopted. This objective aligns with the private interests of implementer firms in reducing their input costs and, to the extent that implementers pass on any resulting cost-savings, is compatible with at least the short-term interest of consumers. Without excluding the latter possibility (although, contrary to theoretical assumptions, recent empirical findings discussed above[238] suggest that patentees exert limited pricing power in smartphone markets), the historical origins of the FRAND requirement in wireless communications markets cast doubt on the purpose conventionally attributed to this requirement and related policy actions commonly characterized as measures to protect against opportunism by patent owners. Rather, those origins suggest that the FRAND requirement was at least initially deployed as part of a protectionist strategy to reduce the input costs, and perpetuate the dominant position, of national European telecommunications carriers.

Some background is helpful. Historically, European telecommunications markets had been dominated by legally recognized or government-

238. *See supra* note 152 and accompanying text.

controlled national telecommunications monopolies (akin to the role of AT&T, which enjoyed a legally recognized monopoly in national telephone service in the U.S. market until its break-up in 1982), which in turn maintained standing relationships with local "national champion" equipment suppliers.[239] It had been common practice for telecom standard-setting bodies to provide that patent holders would license to all interested parties on "reasonable" terms, which were left unspecified on the understanding that the precise meaning would be established through case-by-case negotiation.[240] In general, patent-related issues do not appear to have been a key concern, as illustrated by the fact that neither the telephone carriers nor equipment suppliers in the European telecom markets were especially active in obtaining, licensing, or litigating patents.[241] This is most likely attributable to the fact that both the national carriers and equipment suppliers operated in sheltered markets, and, therefore, did not require IP rights to protect against competitive entry.

In 1987, the European Union created the European Telecommunications Standards Institute ("ETSI") in order to form a standard-setting entity for wireless communications that reflected a range of constituencies, rather than only the national telephone carriers.[242] Reflecting this view, one author writes that "ETSI removed European telecommunication standardization from the domain of confidential agreements struck between monopoly network operators and their preferred suppliers."[243] Nonetheless, the monopoly carriers did not easily yield to the new paradigm, taking steps to perpetuate the existing weak-IP and entry-protected environment.[244] In 1992-93, ETSI adopted, on an interim basis, a "licensing by default" standard[245] that included three key components largely favorable to licensees. These included: (i)

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239. *See* RUDI BEKKERS, MOBILE TELECOMMUNICATIONS STANDARDS: GSM, UMTS, TETRA AND ERMES 223 (2001); Eric J. Iversen, *Standardization and Intellectual Property Rights: ETSI's Controversial Search for New IPR-Procedures, in* THE STANDARDS EDGE 298 (Sherrie Bolin ed., 2002) [hereinafter Iversen, *ETSI*]; Eric J. Iversen, *Standardization and Intellectual Property Rights: Conflicts Between Innovation and Diffusion in New Telecommunication Systems, in* INFORMATION TECHNOLOGY STANDARDS AND STANDARDIZATION: A GLOBAL PERSPECTIVE 80, 83 (Meehdi Khosrowpour et al. eds., 2000) [hereinafter Iversen, *Standardization*].

240. *See* Rudi Bekkers & Isabelle Liotard, *European Standards for Mobile Communications: The Tense Relationship Between Standards and Intellectual Property Rights,* 3 EUR. INTELL. PROP. REV. 110, 119-20 (1999).

241. *See* Iversen, *Standardization, supra* note 227, at 94-95.

242. *See* Bekkers & Liotard, *supra* note 228, at 112; Iversen, *ETSI, supra* note 227, at 299.

243. *See* Richard W. Hawkins, *Standards-Making as Technological Diplomacy: Assessing Objectives and Methodologies in Standards Institutions, in* STANDARDS, INNOVATION AND COMPETITIVENESS: THE POLITICS AND ECONOMICS OF STANDARDS IN NATURAL AND TECHNICAL ENVIRONMENTS 147, 154 (Richard W. Hawkins, et al. eds., 1995).

244. *See* Brooks & Geradin, *supra* note 132, at 17-18.

245. *See* Bekkers & Liotard, *supra* note 228, at 120-21; Brooks & Geradin, *supra* note 132, at 17-18; Iversen, *ETSI, supra* note 227, at 302-04.

IP holders would agree to license all patents deemed essential to the standard on reasonable and non-discriminatory terms, subject to a maximum royalty rate; (ii) an IP holder could not refuse a license to a SEP unless it had given timely notice to ETSI during the standard development process; and (iii) IP holders could not seek injunctive relief when enforcing an "essential" patent.[246] This policy was dissatisfactory to IP owners—especially Motorola, which held the largest portfolio of patents relating to the GSM standard[247] and had previously resisted a collective agreement by European carriers to require royalty-free licensing.[248] In 1993, the Computer and Business Equipment Manufacturers Association, a U.S. trade association, filed a complaint with the European competition agency alleging that elements of the modified policy were anticompetitive.[249] In 1994, ETSI abandoned its policy in favor of an approach that only required IP holders to commit to FRAND licensing and to disclose all essential IP rights during the standardization process[250]—essentially, the customary principles that govern standard-setting in wireless telecommunications to this day.

At its inception, the FRAND requirement emerged out of an intensive effort to preserve a "pre-wireless" *status quo* in which dominant national carriers and local equipment champions were largely protected from entry, and, as a result, firms generally invested few resources in obtaining, litigating, or licensing patents. These historical origins stand in contrast to the typical characterization of the FRAND requirement as an instrument by which to protect intermediate users against opportunistic conduct by upstream patent holders. At least at its origins, the FRAND requirement effectively operated as an instrument by which a downstream buyer monopsony consisting of national monopoly carriers sought to reduce the royalties owing to upstream innovators (in particular, Motorola) that were not part of the group of national carriers and equipment suppliers that had dominated European national telecom markets. Approximately the same strategy is consistent with subsequent lobbying activity leading to European antitrust enforcement

246. Bekkers and Liotard, *supra* note 240, at 121; Bekkers et al., *supra* note 29, at 181; Sidak, *Injunctive Relief, supra* note 182, at 391; Iversen, *ETSI, supra* note 239, at 302-04.

247. *See* Iversen, *Standardization, supra* note 241, at 94.

248. *See* GARRY A. GARRARD, CELLULAR COMMUNICATIONS: WORLDWIDE MARKET DEVELOPMENT 140 (1998); Jorge L. Contreras, *Origins of FRAND Licensing Commitments in the United States and Europe, in* THE CAMBRIDGE HANDBOOK OF TECHNICAL STANDARDIZATION LAW: COMPETITION, ANTITRUST, AND PATENTS 164-65 (Jorge L. Contreras ed., 2018). On the agreement among European carriers, see Iversen, *Standardization, supra* note 241, at 93.

249. *See* Bekkers et al., *supra* note 29, at 181; Brooks & Geradin, *supra* note 135, at 9; Iversen, *ETSI, supra* note 239, at 303-05.

250. *See* Bekkers & Liotard, *supra* note 240, at 122; Brooks & Geradin, *supra* note 135, at 9; Iversen, *ETSI, supra* note 239, at 307-08. For these elements in the current policy, see EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE, ETSI INTELLECTUAL PROPERTY RIGHTS POLICY 37 (VERSION 37).

actions against Qualcomm, the leading technology contributor to the 3G wireless standard, which relied on its patent portfolio to challenge U.S. and European telecom carriers that had adopted what was later shown to be the technically inferior TDMA/GSM standard.[251] In 2007, the European Commission initiated an antitrust enforcement action against Qualcomm, following a formal complaint filed in 2005 with the Commission by Broadcom, Ericsson, NEC, Nokia, Panasonic, and Texas Instruments. Those firms, all of which were licensees of Qualcomm's CDMA chip technology[252], claimed that Qualcomm's licensing practices were inconsistent with its FRAND commitment and would impede the rollout of the 3G wireless network.[253] After four years, the Commission closed the investigation into Qualcomm[254], following a settlement agreement between Qualcomm and Nokia.[255] Contrary to the dire predictions of the carriers and device manufacturers, the 3G wireless network was nonetheless widely adopted across a broad range of consumer income segments[256], suggesting that royalty rates did not reach the "exorbitant" levels that had been predicted. As discussed previously, empirical evidence confirms this implication, showing that royalty rates in the 3G and 4G smartphone markets have generally constituted no more than single-digit percentages of the device's sale price.[257]

B. *SEPs, Antitrust Policy and the IP Balance of Trade*

Policy positions expressed by firms with respect to the treatment of SEPs and the FRAND commitment under antitrust and patent law align closely with firms' position on the industry supply chain. As I have shown elsewhere,[258] the policy preferences expressed in amicus briefs filed in SEP-related litigation demonstrate a consistent pattern: net technology users that specialize in production, distribution and other implementation activities tend to favor weaker enforcement of SEPs and stricter construction of the FRAND commitment; approximately the opposite policy positions are expressed by net technology producers that specialize in R&D. This same divergence can be observed at the "country level" among jurisdictions that are populated principally by firms that specialize in the implementation func-

251. *See* Bekkers & West, *supra* note 94, at 81-82, 85, 90-91.

252. *See* Geradin, *What's Wrong with Royalties*, *supra* note 138, at 463 n.6.

253. *See* BJORN LUNDQVIST, STANDARDIZATION UNDER EU COMPETITION RULES AND US ANTITRUST LAWS: THE RISE AND LIMITS OF SELF-REGULATION 64-65 (2014); Geradin & Rato, *supra* note 119, at 106, 122.

254. *See* Adam Cohen, *European Commission Closes Qualcomm Investigation,* WALL ST. J., Nov. 25, 2009.

255. *See* LUNDQVIST, *supra* note 241; Don Clark, *Qualcomm, Nokia Reach Deal to End Fight Over Patents,* WALL ST. J., July 24, 2008. As part of the settlement, Nokia withdrew its complaint with the European antitrust commission.

256. *See* Iversen, *Standardization, supra* note 241, at 95-96.

257. *See supra* note 155.

258. *See* Barnett, *Has the Academy, supra* note 14, at 1373-75.

tions of the technology supply chain. Antitrust policies pursued in certain Asian jurisdictions with respect to SEPs reflect sensitivity to the input costs borne by local device manufacturers, which are generally net technology users in the global supply chain and typically assert that the licensing fees paid to IP holders are "excessive."[259] As noted by former FTC Chairman Maureen Ohlhausen antitrust enforcers in these jurisdictions appear to use antitrust law (specifically, the "abuse of dominance" principle that extends beyond "monopolization" offenses as understood in U.S. antitrust law) to take action against what are perceived to be "'unfairly' high prices" or, in the IP context, excessively high royalty fees.[260] With respect specifically to SEP licensing markets, antitrust authorities in China, South Korea, and Taiwan have pursued actions resulting in hundreds of millions of dollars in fines and, in some cases, settlements reducing the royalty rates under which Qualcomm licenses its patented technologies for use in CDMA-based 3G and 4G (and now 5G) devices and networks.[261] The Table below summarizes these enforcement actions and remedies, as well as contemporaneous enforcement actions taken by European and U.S. antitrust regulators, concerning Qualcomm's licensing practices.

259. A statement made by an executive at Xiaomi, a leading Chinese handset maker, illustrates this perspective. In an interview with a journalist, the executive bemoans the licensing fees that Chinese firms must pay to foreign SEP owners: "(1) I pay but others don't pay (2) I pay a higher rate than others (3) the rate is too expensive to afford." Quoted in Joff Wild, *Licensors must understand that what is FRAND in US and EU may not be in China, says Xiaomi IP strategy chief,* IAM-MEDIA.COM, http://www.iam-media.com/blog/detail.aspx?g=18521233-ec1e-4e90-9af0-a9b57de41504 (last visited Jan. 9, 2017).

260. OHLHAUSEN, *supra* note 179, at 93.

261. On the Korean enforcement actions, see *S. Korea fines Qualcomm $208 mln in anti-trust case,* REUTERS, (July 23, 2009, 4:42 AM), https://www.reuters.com/article/qualcomm-korea/update-2-s-korea-fines-qualcomm-208-mln-in-anti-trust-case-idUSSEO19318620090723, and Se Young Lee & Stephen Nellis, *South Korea fines Qualcomm $854 million for violating competition laws,* REUTERS (Dec. 27, 2016, 10:06 PM), https://www.reuters.com/article/us-qualcomm-antitrust-idUSKBN14H062?il=0; for the Chinese enforcement action, see Paul Mozur and Quentin Hardy, *China Hits Qualcomm with Fine,* N.Y. TIMES, (Feb. 9, 2015), https://www.nytimes.com/2015/02/10/business/international/qualcomm-fine-china-antitrust-investigation.html; and for the Taiwanese enforcement action, see *Qualcomm Fined Record $773 Million in Taiwan Antitrust Probe,* BLOOMBERG (Oct. 11, 2017, 7:41 AM), https://www.bloomberg.com/news/articles/2017-10-11/qualcomm-fined-773-million-in-taiwan-for-antitrust-violations.

TABLE 5: MAJOR ANTITRUST ACTIONS CONCERNING QUALCOMM LICENSING PRACTICES (2009-2018)

YEAR[262]	LEGAL AUTHORITY	FINE/REMEDY	MAJOR LOCAL DEVICE MAKERS/ LICENSEES[263]	COUNTRY'S IP BALANCE OF TRADE[264]
2009	KFTC (Korea)	$243M (reduced to $200M)[265]	Samsung, LG	-$4.1B
2009	JFTC (Japan)	Behavioral[266]	Sony, Sharp	+$4.86B
2015	NDRC (China)	$975M; reduced royalty rates[267]	Huawei, Oppo, Vivo, Xiaomi, ZTE	-$20.9B

262. The year denotes the year in which the fine or other remedy was issued. In the case of the FTC action, which is still pending, it denotes the year in which the enforcement action was commenced.

263. *Qualcomm Technology Licensing*, QUALCOMM.COM, https://www.qualcomm.com/invention/licensing (last visited Oct. 11, 2018).

264. All figures represent the IP "balance of payments" as of the year indicated in the Table (or the nearest year for which data is available). The calculations are based on (except for Taiwan): THE WORLD BANK, DATA, https://data.worldbank.org/indicator/BX.GSR.ROYL.CD and https://data.worldbank.org/indicator/BM.GSR.ROYL.CD. The World Bank figures are in current dollars and measure all payments made, or received, for the use of intellectual property rights. Data for Taiwan (which may be underestimated) was sourced from OECD. *Main Science and Technology Indicators*, OECD: STATS, https://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB.

265. *South Korean watchdog cuts fine on Qualcomm after decade-old legal battles,* REUTERS, Mar. 20, 2019.

266. *See* Press Release, Japan Fair Trade Commission, Cease and Desist Order Against Qualcomm Inc [sic] orporated (Sept. 30, 2009), https://www.jftc.go.jp/en/pressreleases/yearly-2009/sep/individual-000038.html.

267. Qualcomm Inc., Current Report (Form 8-K) (Feb. 9, 2015) (describing fine, settlement and resolution of investigation with China competition authority). Qualcomm also agreed to the following reduction in the royalty rates charged to local device manufacturers: "For licenses of Qualcomm's 3G and 4G essential Chinese patents for branded devices sold for use in China, Qualcomm will charge royalties of 5% for 3G devices (including multimode 3G/4G devices) and 3.5% for 4G devices (including 3-mode LTETDD devices) that do not implement CDMA or WCDMA, in each case using a royalty base of 65% of the net selling price of the device." *See id.,* at Exhibit 99.1.

YEAR	LEGAL AUTHORITY	FINE/REMEDY	MAJOR LOCAL DEVICE MAKERS/ LICENSEES	COUNTRY'S IP BALANCE OF TRADE
2016	KFTC (Korea)	$868M (under appeal)[268]	Samsung, LG	-$2.12B
2017	TFTC (Taiwan)	$778M (reduced to $93M)[269]	HTC	-$4.07B
2017	FTC (U.S.)	Various modifications to patent licenses (order expected to be appealed)[270]	Apple	+$79.58B
2018	Euro. Cmm'n (EU)	$1.2B (under appeal)[271]	Nokia, Ericsson	-$64.73B

In the case of China, Korea, and Taiwan, the pattern of antitrust enforcement, hefty fines, and modified licensing terms bears indications of a protectionist use of competition law to reduce the royalty burden of local device manufacturers, and, more generally, mitigate the jurisdiction's negative IP balance of payments (equal to receipts less payments for IP).[272] Each

268. It appears that Qualcomm is currently appealing this penalty and decision. *See Qualcomm fends off Korea antitrust woes with Samsung backing*, TELECOMREVIEW (Feb. 4, 2018), www.telecomreview.com/index.php/articles/telecom-vendors/2032-qualcomm-fends-off-korea-antitrust-woes-with-samsung-backing (reporting that Samsung had entered into expanded cross-licensing agreement with Qualcomm and had agreed to withdraw its support for the Korean antitrust regulator's suit against Qualcomm).

269. Yimou Lee & Stephen Nellis, *Qualcomm Settles Anti-Trust Case with Taiwan Regulator for $93 Million,* REUTERS (Aug. 9, 2018, 10:14 PM), https://www.reuters.com/article/us-usa-qualcomm-taiwan/qualcomm-settles-anti-trust-case-with-taiwan-regulator-for-93-million-idUSKBN1KV07Z?feedType=RSS&feedName=businessNews. As part of the settlement, Qualcomm agreed to invest $700 million in Taiwan over a period of several years. Additionally, it agreed to provide licenses to competing chip manufacturers, Intel and MediaTek (a Taiwanese corporation), in the event it sought to enforce a patent against those firms.

270. *See* Nellis, *supra* note 5.

271. Press Release, European Commission, Antitrust: Commission Fines Qualcomm €997 Million for Abuse of Dominant Position (Jan. 24, 2018), http://europa.eu/rapid/press-release_IP-18-421_en.htm. Qualcomm has appealed the fine. *Qualcomm Asks EU Court to Scrap $1.2 Billion Fine,* REUTERS (June 4, 2018, 1:28 PM), https://www.reuters.com/article/us-eu-qualcomm-antitrust-court/qualcomm-asks-eu-court-to-scrap-1-2-billion-antitrust-fine-idUSKCN1J02EO.

272. Note that I am not addressing decisions by courts in these jurisdictions that relate specifically to patent law, which may in some cases deviate from the IP-skeptical tendencies observed in policy statements and enforcement actions pursued by competition regulators in these countries. In particular, I note the decision in December 2018 by a Chinese court to

jurisdiction shown in the Table above, with the exception of Japan and the U.S., has a net IP deficit (that is, the amount paid by domestic to foreign firms for IP rights exceeded payments received by domestic firms from foreign firms for IP rights), and, in the case of China, Korea, and Taiwan, has one or more major wireless handset device manufacturers.[273] For example, China had a net IP deficit of $20.9 billion in 2015 and has several major wireless device manufacturers, which rely on licensing IP from foreign firms, due either to incomplete patent coverage or lack of sufficient technological expertise.[274] If Chinese competition law actions with respect to SEPs are situated within a broader government-sponsored standardization strategy, there are even stronger indications of protectionist motivations. Chinese authorities have actively promoted the development of Chinese-specific variations on international standards in a broad range of technologies, including DVD players, audio/visual "codec" standards, local area networking, optimal media storage, cloud computing, and the internet of things.[275] In particular, China invested heavily (and unsuccessfully) in developing alternative "indigenous" standards in wireless communications[276]: (i) the TD-SCDMA standard, which would have substituted for the dominant W-CDMA standard, and (ii) the "WAPI" standard, which would have substituted for the dominant WiFi standard.[277] These domestic standards are typically launched together with IP policies that mandate or encourage royalty-free or nominal-

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grant limited injunctive relief to Qualcomm with respect to certain Apple phones and other devices found to infringe upon Qualcomm's patents. *See supra* note 220.

273. The Japanese and European firms listed in the Table above are licensees of Qualcomm but have either withdrawn from, or do not have a substantial share in, the worldwide smartphone production market. *See Smartphone Rankings Shaken Up Once Again as Huawei Surpasses Apple*, INT'L DATA CORP. (July 31, 2018), https://www.idc.com/getdoc.jsp?containerId=prUS44188018.

274. *See* DIETER ERNST, CHINA'S STANDARD-ESSENTIAL PATENTS CHALLENGE: FROM LATECOMER TO (ALMOST) EQUAL PLAYER 22 (Centre for International Governance Innovation ed., 2017).

275. *See generally* Michael Murphree & Dan Breznitz, *Standards, Patents and National Competitiveness*, 40 GLOBAL COMMISSION ON INTERNET GOVERNANCE 2, 7-8, 14, 21 (2016); STEPHEN J. EZELL & ROBERT D. ATKINSON, THE MIDDLE KINGDOM GALAPAGOS ISLAND SYNDROME: THE CUL-DE-SAC OF CHINESE TECHNOLOGY STANDARDS 13 (Information Technology & Innovation Foundation ed., 2014); DAN BREZNITZ & MICHAEL MURPHREE, U.S.-CHINA ECON. & SEC. REV. COMM'N, THE RISE OF CHINA IN TECHNOLOGY STANDARDS: NEW NORMS IN OLD INSTITUTIONS (2013); SCOTT KENNEDY, RICHARD P. STUTTMEIER & JUN SU, NAT'L BUREAU OF ECON. RES., STANDARDS, STAKEHOLDERS AND INNOVATION: CHINA'S EVOLVING ROLE IN THE GLOBAL KNOWLEDGE ECONOMY, NBER SPECIAL REPORT #15 21-25 (2008); Scott Kennedy, *The Political Economy of Standards Coalitions: Explaining China's Involvement in High-Tech Standards Wars*, 2 ASIA POLICY 41 (2006).

276. China: Effects of Intellectual Property Infringement and Indigenous Innovation Policies on the U.S. Economy, Inv. No. 332-519, USITC Pub. 4266 (May 2011) (Final), at 5-24.

277. *Id.* at 5-22 to 5-24. On the WAPI standard, see Ping Gao, *WAPI: A Chinese Attempt to Establish Wireless Standards and the International Coalition that Resisted*, 23 COMM. OF THE ASSOC. FOR INFO. SYS. 151 (2008).

royalty licensing[278], and, as formalized in recent amendments to the Standardization Law of the People's Republic of China, require the exclusive or mostly exclusive use of technology owned by Chinese firms.[279] The strategy is clear. By developing standards that are not reliant on foreign-owned IP and launching those standards subject to IP policies that mandate or encourage royalty-free or nominal-royalty licensing,[280] local manufacturers' royalty fees payable to foreign IP holders can be reduced,[281] export margins can be improved,[282] and foreign entrants may be compelled to adopt the Chinese standard, which could then promote adoption in non-Chinese markets.[283] While these efforts have largely been unsuccessful (due, in several cases, to the lack of technological equivalence leading to underadoption by the domestic market),[284] often are unable to avoid using foreign IP,[285] and have never led to international adoption,[286] they illustrate the political-economic motivations that may at least partially drive competition law policy actions by Chinese regulators on SEP/FRAND issues.

C. *Do Consumers Always Benefit from Reduced Input Costs?*

It might be argued that competition law enforcement actions that limit the pricing power of IP licensors nonetheless promote consumer interests (at

278. *See* BREZNITZ & MURPHREE, *supra* note 262, at 3, 33-34.

279. OFFICE OF THE U.S. TRADE REPRESENTATIVE, FINDINGS OF THE INVESTIGATION INTO CHINA'S ACTS, POLICIES AND PRACTICES RELATED TO TECHNOLOGY TRANSFER, INTELLECTUAL PROPERTY, AND INNOVATION UNDER SECTION 301 OF THE TRADE ACT OF 1974 (2018), at 181. These amendments appear to track existing policies described by other commentators. *See* Murphree & Breznitz, *supra* note 275, at 7-8, 14; EZELL & ATKINSON, *supra* note 262, at 13.

280. *See* Murphree & Breznitz, *supra* note 262, at 7-8.

281. *See* BREZNITZ & MURPHREE, *supra* note 262, at 34; *see also* USITC, *supra* note 276, at 5-22 to 5-24.

282. *See, e.g.*, *id.* at 2-3 (describing how Chinese standardization policy is designed to reduce manufacturers' costs of accessing IP).

283. *Id.* at 36; EZELL & ATKINSON, *supra* note 275, at 14-19. With respect to China's development of an alternative to the MPEG audio-video codec standard, the authors write: "China's clear intent in developing AVS was to keep Chinese companies from having to pay high licensing fees to foreign companies and to give them an edge over their American competitors." *Id.* at 19. This strategy is not unique to China. In the 1950s, West Germany developed the "PAL" standard specifically in order to avoid having to pay royalties for use of the "SECAM" standard that prevailed in France and the Soviet Union. *See* PADILLA ET AL., *supra* note 18, at 5.

284. *See* EZELL & ATKINSON, *supra* note 275, at 16 (describing failure of Chinese indigenous 3G technology standard, in competition with superior foreign 3G technologies).

285. *See* BREZNITZ & MURPHREE, *supra* note 275, at 7; KENNEDY, STUTTMEIER & SU, *supra* note 275, at 10 (noting that, although China established indigenous wireless communications standard, only 7.3% of the patents in the standard are Chinese-owned).

286. *See* EZELL & ATKINSON, *supra* note 279, at 23; BREZNITZ & MURPHREE, *supra* note 275, at 2; Kennedy, *supra* note 275, at 43. Kennedy describes in particular China's failed to attempt to develop a competing indigenous standard to the international WiFi standard. *Id.* at 48-56.

least in the short term) by promoting reduced retail prices for end-users that purchase the products and services embodying the licensors' technology. But there is no assurance that this will occur. If the implementer firm holds a dominant branded position in the retail market, and is therefore substantially protected against entry, then it may have no or little incentive to pass on the cost-savings to consumers.[287] Consistent with this possibility, in the second quarter of 2018, Apple enjoyed record profits despite having *increased* prices on its newest model iPhones,[288] while Apple's principal suppliers and assemblers suffered a revenue *decline*, reportedly due in part to Apple's bargaining leverage in renegotiating the fees paid to those firms.[289] The first development—an increase in Apple's profits concurrently with an increase in prices—suggests that Apple enjoyed during this period some degree of pricing power in the retail market, due potentially to brand power, inelastic demand among higher-income consumers[290] (the average price of an Apple iPhone in 2016 was $690, as compared to $214 for an average Android-compatible phone),[291] and consumers' switching costs arising from Apple's "walled garden" ecosystem.[292] The second development—a decline in suppliers' revenues—suggests that Apple enjoys buying power in the upstream inputs market, which may account in part for the fact that Apple captures by far the largest portion (42%) of the retail price of each iPhone 7 sold, substantially in excess of the value captured by any other firm in the supply chain.[293] By contrast, all IP licensors collectively captured only about 5% of the retail price.[294]

Apple's bargaining power with respect to upstream input suppliers may be especially strong in the case of components that Apple (or other distribu-

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287. For a similar view, see Geradin & Rato, *supra* note 119, at 106.

288. *See* Therese Poletti, *Apple Earnings Show Why You Can Expect More $1000 iPhones*, MARKETWATCH (Aug. 1, 2018, 10:02 AM), https://www.marketwatch.com/story/apple-earnings-show-why-you-can-expect-more-1000-iphones-2018-07-31.

289. *See* Debby Wu, *What's Good for Apple Isn't Always Best for iPhone Suppliers*, BLOOMBERG (May 1, 2018, 10:24 PM), https://www.bloomberg.com/news/articles/2018-05-02/what-s-good-for-apple-isn-t-always-good-for-iphone-suppliers.

290. Mark Sullivan, *Apple Bet That We'd Pay More for Phones. It Was Right*, FAST COMPANY (Feb. 1, 2018), https://www.fastcompany.com/40525598/apple-bet-that-wed-pay-more-for-phones-it-was-right. More recently, it appears that Apple's pricing on its highest-end models may have overestimated consumers' demand for these devices, suggesting that the market has identified limits to Apple's pricing power. *See* Jefferson Graham, *Did Apple Retail Prices Get Too High in 2018? Consumers Say Yes,* USA TODAY (Dec. 29, 2018, 11:41 AM), https://www.usatoday.com/story/tech/talkingtech/2018/12/29/did-apple-retail-prices-get-too-high-2018-consumers-say-way-yes/2432445002/.

291. *E.g.*, Dedrick & Kraemer, *supra* note 84, at 6 (citing IDC data).

292. On Apple's "walled garden" strategy, see Thomas W. Hazlett, David Teece and Leonard Waverman, *Walled Garden Rivalry: The Creation of Mobile Network Ecosystems* (George Mason Univ., Working Paper No. 11-50) (2011), http://ssrn.com/abstract=1963427.

293. Dedrick & Kraemer, *supra* note 84, at 16-17; WORLD IP REPORT, *supra* note 18, at 100.

294. Dedrick & Kraemer, *supra* note 84, at 17.

tors that enjoy uniquely branded positions on the supply chain), given its ample financial and human capital, can credibly source internally or from competing suppliers. This risk is not theoretical: in 2017, Apple terminated its relationship with two chip suppliers (while reportedly poaching engineers from both firms), reportedly because it had developed the expertise to produce the chips internally.[295] Given the absence of a credible injunctive threat as discussed above (or contractual restrictions that may limit a supplier's ability to bring an infringement suit),[296] even input suppliers with fairly substantial patent portfolios may have little leverage by which to negotiate meaningful royalties from a large branded distributor. While this reduces the producer/distributor firm's input costs, it is not clear that this would result in any pricing benefit for consumers in the short term and would likely depress the investment incentives of upstream R&D-specialist firms over a longer time period.

CONCLUSION

Conventional wisdom assumes that wireless communications markets are widely failing at standardization and the government can improve it. In this paper, I have argued that those markets are widely succeeding at standardization and government intervention risks undermining it. For approximately a decade, antitrust regulators and some courts, supported by large intermediate users and substantial portions of the scholarly community, have adopted the view that patent-intensive ICT markets suffer from endemic market failure, which in turn invites regulatory intervention to "protect" against overreaching by patent licensors. Yet empirical inquiry and several decades of market performance suggest otherwise. In particular, the explosive growth of the wireless communications markets—characterized by declining (quality-adjusted) prices, expanding output, and continuous innovation—has relied on an overlooked institutional infrastructure largely

295. These companies included Imagination Technologies (a supplier of graphics processing units, *see* Paul Sandle, *Imagination Technologies' Shares Plunge 70 Percent After Apple Ditches Firm,* REUTERS (Apr. 2, 2017, 2:40 AM), https://www.reuters.com/article/us-imagntn-tchnlgs-apple-idUSKBN1750HR; and Dialog (a supplier of a power management integrated circuit), *see* Eric Auchard & Harro Ten Wolde, *Apple May Ditch Dialog, Analyst Says, Hitting Chipmakers' Shares*, REUTERS (Apr. 11, 2017, 4:54 AM), https://www.reuters.com/article/us-dialog-apple/apple-may-ditch-dialog-analyst-says-hitting-chipmakers-shares-idUSKBN17D0VF.

296. This was apparently the case with respect to Imagination Technologies, a supplier of graphics chipsets to Apple, which terminated the supply relationship when it elected to design and produce the chipsets internally. The supplier was bound by a dispute resolution agreement that apparently limited its' ability to bring a patent infringement claim in court. *See* Ben Lovejoy, *Apple's Supplier Battles Intensify as Imagination Technologies Files Formal Dispute*, 9TO5MAC (May 4, 2017, 3:54 AM), https://9to5mac.com/2017/05/04/imagination-technologies-apple-dispute-resolution-procedure/.

assembled by market actors and reliant on the two key legal inputs of secure IP rights and contract enforcement. Leading contributors to the 3G and 4G markets have demonstrated the capacity to deliver standardization outcomes through cooperative arrangements that likely outperform the alternatives of government monopoly, which is subject to informational deficits and regulatory capture, and private monopoly, which triggers the risk of pricing and other distortions inherent to protected dominant positions. That market-driven standardization process has relied on reasonably secure property rights, quasi-contractual licensing commitments supplemented by reputational discipline, and targeted application of antitrust safeguards against collusion risk. The international policy trajectory in SEP markets not only threatens that mix but rewards implementer firms and jurisdictions that seek to shift the "IP balance of trade" by lobbying for policy actions that reduce those firms' and jurisdictions' input costs but endanger the viability of R&D-specialist entities and cooperative standardization arrangements that have promoted innovation and commercialization in wireless communications markets.