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The Economic Case Against Licensing Negotiation Groups in the Internet of Things

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ABSTRACT

Competition policy generally prohibits coordination among buyers or sellers, especially coordination on price, price-related inputs, and output. In licensing markets for standard-essential patents (SEPs), it has been periodically proposed that this rule should be relaxed to permit the formation of licensing negotiation groups (LNGs), which is expected to reduce transaction costs and the purportedly "excessive" royalties paid to SEP licensors. Based on the economic structure of wireless technology markets, and empirical evidence from over three decades of SEP licensing, this policy intervention is likely to degrade, rather than enhance, competitive conditions in wireless communications and other 5G-enabled markets encompassed by the "Internet of Things." In the short term, LNGs would most likely result in a redistributive (not an efficiency) effect that shifts economic value from innovators to implementers in the wireless technology supply chain without necessarily passing on cost-savings to consumers. In the medium to longer term, LNGs are liable to impose significant efficiency losses by endangering the viability of licensing-based monetization models that have funded continuous investment in research and development, promoted broad dissemination of technology inputs, facilitated robust entry in device production, and enabled transformative business models across a wide range of industries. While LNGs may reduce the transaction costs of SEP licensing, pooling structures have a demonstrated record of having achieved the same objective in patent-intensive information technology markets at a substantially lower risk of competitive harm.

KEYWORDS: antitrust law, competition law, standard-essential patents, patent licensing, licensing negotiation groups, monopsony, patent pools
JEL CLASSIFICATIONS: K21, L24, L40, L41, O31, O32, O34

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I. INTRODUCTION

Since the inception of the wireless communications industry over three decades ago, there have been concerns that owners of patents or other intellectual property (IP) rights relating to "standard-essential" technologies have capacities and incentives to extract "excessive" royalties, inflating device prices, discouraging user adoption, and limiting market growth. There have been related concerns that royalties owing to owners of standard-essential patents (SEPs)—that is, patents that cover a technology that is essential to conform to a technical standard—would result in a "royalty stack" that increases device prices with similar adverse effects on market efficiency.[2] Given these purportedly imminent risks of market failure, it has been proposed periodically that competition laws should be relaxed to permit licensees to form "licensing negotiation groups" (or LNGs) that would negotiate royalty rates collectively with SEP owners. The proposal was made initially in a 2005 academic paper[3], was discussed in a report issued in 2007 by US antitrust regulators,[4] and has been debated by scholars.[5] Most recently, the proposal was discussed (and rejected) in a report commissioned by the European Commission in 2016[6], discussed (and endorsed) in a study commissioned by the European Parliament in 2019[7], and discussed further in a report issued in 2021 by the "SEPs Expert Group" established by the European Commission.[8]

It is widely recognized that any form of cooperation between horizontal competitors inherently poses an elevated risk of competitive harm in the form of price or output distortions. This risk arises on both the "sell" and "buy" sides of the market.[9] The conventional collusion scenario takes place on the "sell side": sellers coordinate on price or output, pushing prices above the level that would prevail in a competitive market. Collusion on the "buy side" of the market results in distortions by pushing prices below the level that would prevail in a competitive market. To illustrate, suppose retailers act collectively to negotiate lower wholesale prices paid to producers. While reduced prices paid by retailers to producers may result in lower prices for consumers, producers are likely to respond by

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2 Mark A Lemley and Carl Shapiro, 'Patent Holdup and Royalty Stacking' (2007) 85 Texas Law Review 1991. For a review of scholarly contributions and regulatory statements making the same or related points, see Jonathan M Barnett, 'Antitrust Overreach: Undoing Cooperative Standardization in the Digital Economy' (2019) 25 Michigan Technology Law Review 163 (Barnett 2019); Jonathan M Barnett, 'Has the Academy Led Patent Law Astray?' (2017) 32 Berkeley Technology Law Journal 1313.

3 Robert Skitol, 'Concerted Buying Power: Its Potential for Addressing the Patent Holdup Problem in Standard Setting' (2005) 72 Antitrust Law Journal 727.

4 US Department of Justice and Federal Trade Commission, Antitrust Enforcement and Intellectual Property Rights: Promoting Innovation and Competition (2007) 52-53.

5 For arguments expressing support, see Jorge L Contreras, 'Aggregated Royalties for Top-Down FRAND Determination: Revisiting 'Joint Negotiation'' (2017) 62 Antitrust Bulletin 690; for arguments expressing skepticism, see Igor Nikolic, 'Licensing Negotiation Groups for SEPs—Collusive Technology Buyers Arrangements: Pitfalls and Reasonable Alternatives' (forthcoming 2021) Les Nouvelles.

6 Pierre Regibeau, Raphael De Coninck and Hans Zenger, 'Transparency, Predictability and Efficiency of SSO-Based Standardisation and SEP Licensing', A Report for the European Commission (2016) 44-45.

7 Luke McDonagh and Enrico Bonadio, 'Standard Essential Patents and the Internet of Things', European Parliament, Policy Department for Citizen's Rights and Constitutional Affairs (2019) 30. The authors propose that SDOs should be permitted to negotiate royalty rates on behalf of standard implementers.

8 Group of Experts on Licensing and Valuation of Standard Essential Patents, Contribution to the Debate on SEPs (2021) 168-171. To be precise, one member of the group made this proposal but it was not endorsed by the group as a whole.

9 Roger D Blair and Jeffrey L Harrison, *Monopsony in Law and Economics* (Cambridge University Press 2010) 41-48.

reducing output, resulting in the market contraction and "deadweight losses" associated with sell-side collusion. In innovation-intensive markets, the social costs of buy-side collusion grow over time as reduced expected returns disincentivize producers to allocate funds to the R&D efforts that are necessary to develop new products.

These elevated risks to market efficiency explain why competition laws generally impose strict prohibitions on cooperation among horizontal competitors on price, price-related inputs, or output, whether such cooperation occurs on the sell-side or buy-side of the market.[10] Both in the US and EU, courts and regulators have emphasized that horizontal collusion endangers the integrity of the price-setting mechanism that competition law is fundamentally designed to preserve, as reflected by the harsh treatment of practices such as price-fixing, bid-rigging, and market allocation.[11] Nonetheless there are limited circumstances in which economic theory and competition law recognize that net competitive gains may arise from relaxing this prohibition to a limited extent[12], even after taking into account the short-term and long-term harms that are inherent to direct and indirect forms of coordination on price or output. Even if this standard is met, however, it must also be the case that the particular form of horizontal cooperation represents the "least-cost" mechanism for securing those net competitive gains.

The wireless communications markets have been in operation for over three decades, starting with the 2G/GSM standard in the early 1990s and through the emergent 5G standard that is being deployed in the "Internet of Things" (IoT). As a result, there is substantial evidence that sheds light on the competitive effects of SEP licensing relationships between firms that specialize in innovation and firms that specialize in the production and distribution of SEP-enabled devices. On the basis of this historical evidence, and taking into account emergent 5G SEP licensing practices in the wireless communications and automotive markets, there appears to be a high likelihood that permitting the formation of LNGs would likely constitute a harmful intervention in well-functioning markets for disseminating technological assets through licensing relationships. In the short term, LNGs may simply redistribute economic value from innovator-licensors to producer-licensees, while delivering modest or no pricing gains for consumers. In the longer term, reduced royalties may induce innovator-firms to reduce investment in research and development (R&D) or to fund R&D investment through vertically integrated structures that would limit technology dissemination among device producers compared to licensing-based structures. While LNGs may deliver transaction-cost savings, this same objective can be achieved through pooling and similar licensing platforms at a lower risk of competitive harm. Given that competition policy has no interest in redistributing wealth from licensors to licensees but does have an interest in preserving robust innovation markets, and in light of the fact that existing pooling mechanisms can reduce SEP-related transaction costs, there does not appear to be a plausible

[10] On EU law, see Damien Geradin, Anne Layne-Farrar and Nicolas Petit, *EU Competition Law and Economics* (Oxford University Press 2012) ¶¶ 6.11, 6.15-6.16; on US law, see Federal Trade Commission and US Department of Justice, Antitrust Guidelines for Collaboration Among Competitors (2000) 3.

[11] On EU law, see Geradin et al. (n 10) ¶ 6.04 (quoting EU Competition Commissioner Mario Monti describing cartels as "cancers on the open market economy"); on US law, see *Verizon Communications v. Law Offices of Curtis V. Trinko,* 540 U.S. 398, 408 (2004) (calling cartels "the supreme evil of antitrust").

[12] On EU law, see Geradin et al. (n 10) ¶¶ 7.01-7.05; on US law, see Federal Trade Commission and US Department of Justice (n 10) 4.

basis for relaxing the ban on horizontal coordination to permit LNGs in SEP licensing markets.

This paper is organized as follows. In Part II, I describe the economic structure and historical performance of the wireless communications markets. In Part III, I describe theoretical views and empirical evidence relating to the competitive risks posed by SEP licensing practices in these markets. In Part IV, I assess the likely net competitive effects of LNG structures in 5G-enabled environments, informed by evidence relating to SEP licensing practices in the 2G, 3G, and 4G/LTE wireless communications markets and emergent 5G SEP licensing practices in the wireless communications and automotive markets. In Part V, I discuss the extent to which patent pools offer an alternative mechanism for reducing SEP-related transaction costs, taking into account the effects on competitive conditions in wireless-enabled markets. A brief conclusion follows.

II. THE ECONOMIC STRUCTURE OF WIRELESS COMMUNICATIONS MARKETS

Since the launch of the 2G/GSM network in the European market in the early 1990s through the emergent release in the global market of the 5G standard, the wireless communications industry has exhibited three key characteristics. First, the industry has exhibited a division of labor between, on the one hand, firms that specialize in innovation and, on the other hand, firms that specialize in embodying innovations in handsets and other devices.[13] Like all forms of specialization, the division of labor in the wireless ecosystem has enabled an efficient allocation of supply-chain functions, which results in the delivery of products to end-users at the lowest technologically feasible cost. Second, the industry has achieved interoperability so that users of different types of mobile devices can communicate with each other at high transmission quality.[14] Interoperability, which maximizes the number of users with which any individual user can communicate, generates the network effects that drive value in the wireless communications ecosystem and the wide range of related markets that it supports. Third, the industry has made intensive use of the patent system and, in particular, has relied on patent licensing to structure two critical forms of information exchange: vertical relationships between innovators and implementers, which promote specialization, and horizontal relationships among innovators, which promote interoperability. These three elements—specialization, interoperability, and patent licensing—have together driven a powerful "economic multiplier" effect through which wireless communications technologies have enabled business-model innovations involving a broad and expanding range of intermediate and end-user markets.

Patents and specialization

To illustrate the relationship between patents and specialization, consider a chip-design firm that has no capacities in production and distribution and can only acquire such capacities at great cost and significant delay. To the extent that the firm can rely on patents to protect its chip designs and related knowledge assets from imitation by others, it has no need to acquire

[13] Barnett (2019 n 2) 186-87.
[14] ibid, 171-73.

such capacities since it can enter into contractual relationships with other firms that specialize in the production and distribution of chips and devices that implement its technology. Conversely, a firm that specializes in chip or device production and distribution has no need to incur the costs and delay involved in acquiring chip-design and related R&D capacities since it can enter into contractual relationships with other firms that already have such capacities. The result is the 21st-century equivalent of Adam Smith's 18th-century pin factory: each function in the supply chain is allocated to the firm that can execute it most efficiently.

It has long been recognized that parties may abstain from efficient exchanges of informational assets due to the risk that, following disclosure, the counterparty will appropriate the asset without compensation.[15] In the context of the wireless supply chain, patents enable innovators to disclose commercially valuable information to sophisticated producers and other implementers who might otherwise pose a high level of imitation risk. Conversely, patent-enabled information exchanges permit producers to share valuable process-related technology with chip-design specialists. These information exchanges are a precondition for business models in which upstream innovators monetize R&D investment through licensing relationships with producers and other downstream users that embed the licensed technology in devices for end-users. Far from being a "burden" on the market (as it is sometimes misleadingly characterized[16]), the royalty streams that flow from the retail point of sale supply the monetary "fuel" that enables innovators to reinvest in R&D, which continuously generates technological improvements that are widely licensed to device producers, which in turn deliver those innovations to end-users.

It is insightful to consider a hypothetical wireless communications market in which patents were abolished or, equivalently, patent owners were prohibited by law from seeking royalties from users. (This scenario is not entirely hypothetical: at the inception of the 2G/GSM standard, European national telecom carriers had sought to establish a regime in which patent owners would receive zero royalties.[17]) In that legal environment, a licensing-based business model—or, more generally, any vertically disintegrated business model—would no longer be economically feasible. To maintain R&D expenditures, firms that rely on licensing to capture returns on innovation would be compelled to adopt vertically integrated structures that can capture returns on R&D through a production and distribution infrastructure, or a suite of complementary products and services, that is difficult for others to replicate. This distortionary effect on firms' organizational choices is liable to have adverse competitive effects. While innovation specialists maximize revenues by widely licensing new technologies to device producers, vertically integrated firms often have strategic incentives to retain those technologies internally and block knowledge leakage to actual and potential competitors. Counterintuitively, weakening patent protections—and, in particular, constraining licensing freedom through competition law—can induce markets to shift toward

[15] For the classic source, see Kenneth J Arrow, 'Economic Welfare and the Allocation of Resources for Invention', in *The Rate and Direction of Inventive Activity* (National Bureau of Economic Research 1962).

[16] On the fallacies of the "license as a tax" analogy, see Jonathan M Barnett, 'The 'License as Tax' Fallacy' (forthcoming 2022) Michigan Technology Law Review.

[17] Barnett (2019 n 2) 229.

structures that limit technology dissemination and, as a result, protect incumbents by raising the capital and technical requirements to enter the market.[18]

Patents and interoperability

Interoperability is critical for maximizing the network effects that drive economic value in the wireless communications ecosystem. To achieve interoperability, the wireless communications markets have relied on substantial contributions of personnel hours by the industry's lead innovators to standard development organizations (SDOs)[19] for purposes of developing, selecting, and revising thousands of technical specifications that comprise each new wireless technology generation. During 2005-2014, a total of 3,452,040 person hours were contributed to meetings of "working groups" and "technical specification groups" at 3GPP, the SDO that administers the 3G and 4G/LTE wireless communications standards.[20] Members firms' technical contributions to the 3GPP standard-development process are highly skewed: during 2005-2013, the top two percent of member firms (only nine firms) accounted for 60% of the contributions submitted to technical specification groups.[21] This implies that the SDO process, and the interoperability effects on which the global wireless ecosystem relies, depends on the voluntary participation of a small group of R&D-intensive firms that account for the bulk of technical contributions to standards development and refinement.

It might be wondered why these firms are willing not only to contribute valuable personnel without direct compensation but to disclose valuable technical information to competitors in the context of the SDO process. Patents play a critical role in aligning SDO participation with business rationality. There are two reasons. First, as noted above, patents enable contributing firms to disclose commercially valuable technology to other firms that have the technical sophistication and capital resources to imitate such technology. Second, the prospect of patent licensing provides a contributing firm with some assurance that making contributions toward standard development will ultimately be remunerated by licensing fees from implementers if the firm's technology is adopted by the SDO and the SDO's standard is in turn adopted by implementers in the device market. If innovator-firms have significant doubts concerning the ability to enforce and license patents in the far-from-assured outcome in which both these "adoption milestones" are achieved, then those firms are likely to respond by reducing participation in the SDO process and migrating toward internal strategies for monetizing R&D investment.[22] Over time, reduced participation by lead innovators in the SDO process might induce the market to disaggregate into incompatible firm-specific standards, placing at risk the interoperability effects that drive technological and business-model innovation in the digital ecosystem.

These concerns are not merely hypothetical. In 2015, the Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA or IEEE), the SDO that administers

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[18] For more extensive theoretical and empirical analysis of this point, see Jonathan M Barnett, *Innovators, Firms and Markets: The Organizational Logic of Intellectual Property* (Oxford University Press 2021).

[19] An alternative term is standard-setting organizations (or SSOs).

[20] Justus Baron and Kirti Gupta, 'Unpacking 3GPP Standards' (2018) 27 Journal of Economics & Management Strategy 433.

[21] ibibid

[22] For historical evidence showing that weak-IP environments tend to induce firms to adopt internal strategies for monetizing R&D investment, see Barnett (n 18) 89-114.

the 802.11 WiFi standard, implemented a policy that reinterpreted standard contributors' commitment to fair, reasonable and non-discriminatory (FRAND) licensing. The IEEE's revised bylaws state that the FRAND commitment bars contributors from seeking injunctive relief against infringers (except in limited circumstances) and recommends licensing at the component level (rather than device level as is customary in the industry).[23] The response by industry was unequivocal. During the following six and a half years, 75% of SEP owners that submitted to IEEE letters of assurance (LOAs, which memorialize contributors' FRAND commitments) chose to do so under the pre-amendment policy or submitted "negative" LOAs that specifically rejected any FRAND commitment.[24] (Prior to 2015, a "negative" LOA was almost never submitted.[25]) As a result of the reduced number of positive LOAs, the American National Standards Institute, a standards accreditation body, declined to approve certain IEEE 802.11 standards amendments, and the International Standards Organization has reportedly raised similar concerns in connection with IEEE's petition for "ISO" status for such amendments.[26]

As this ongoing episode indicates, SEP owners' incentives to participate in the SDO process are fragile and rely on robust expectations that patents can be reliably enforced against infringers and licensed to producers and other intermediate users, which in turn supports the revenue streams that fund the infrastructural levels of R&D investment that are typical in the industry. This suggests that competition policies that limit SEP owners' ability to enforce and license patents at a reasonable level of confidence, based on largely conjectural assertions of competitive harm developed through theoretical models, bear a high risk of "false positive" error that can result in significant efficiency losses. As constraints on patent enforcement and licensing increase in severity, the R&D-intensive firms that make the highest-value contributions to the SDO process are likely to reduce participation, impeding development of the technological standards that support the interoperable environment in which the wireless ecosystem has developed and thrived.

III. THEORY AND EVIDENCE CONCERNING LICENSING STRUCTURES IN WIRELESS COMMUNICATIONS MARKETS

Advances in wireless communications have generated immense economic value for intermediate and end-users by enabling novel business models that have transformed industries by decreasing prices and transaction costs and increasing product variety and convenience. Notwithstanding this technical and economic success, some commentators and regulators have repeatedly asserted that the wireless device industry is prone to two related forms of market failure that are purportedly inherent to SEP licensing relationships between

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[23] IEEE-SA, Standards Board Bylaws, Approved Clause 6 of the SASB Bylaws (2015), <https://standards.ieee.org/content/dam/ieee-standards/standards/web/documents/other/approved-changes.pdf>.

[24] David L Cohen 'New Empirical Data Demonstrates Continued Failure of IEEE 2015 Patent Policy', *JDSupra* (7 October 2021), <https://www.jdsupra.com/legalnews/new-empirical-data-demonstrates-7697896/>. Similar adverse effects on positive LOA submissions are shown in Kirti Gupta, Georgios Effraimidis and Urska Petrovcic, 'Was the Update of the 2015 Business Review Letter to the IEEE Justified?' *IEEE Communications Standards Magazine* (2021); Kirti Gupta and Georgios Effraimidis, 'IEEE Patent Policy Revisions: An Empirical Examination of Impact' (2018) 64 Antitrust Bulletin 151.

[25] Gupta, Effraimidis and Petrovcic (n 24).

[26] Cohen (n 24).

innovators and implementers.[27] These asserted risks of market failure support the proposal to permit producers and other intermediate users to form LNGs to negotiate licensing terms collectively with SEP owners. To assess the merits of this proposal, it is therefore necessary first to assess the empirical evidence relevant to this market failure assertion. This "order of operations" follows logically: without sufficient evidence that there exists or is likely to exist the asserted economic malady in SEP licensing markets, there is no reason to adopt the proposed course of regulatory treatment.

Patent holdup and royalty stacking

The popular assertion of market failure contemplates two risk scenarios. First, it has been argued that the owners of SEPs relating to wireless technology—typically, firms that undertake the bulk of R&D expenditures in the industry—have the capacity and incentives to demand royalty rates from producers that are "excessive" relative to a socially efficient (but undefined) royalty rate.[28] Second, it has been argued that the rates demanded by individual SEP owners will result in an aggregate "royalty stack" that producers will pass on to end-users in the form of inflated retail prices, which will suppress consumer demand and reduce royalty revenues for SEP owners.[29] This is an application to the wireless market of the standard "double-marginalization" problem in which uncoordinated price-setting by monopolist component suppliers results in an aggregate price for the end-product that both imposes deadweight losses on consumers and fails to maximize profits for suppliers.[30]

These arguments have been made almost entirely on the basis of theoretical models of SEP licensing under certain assumed conditions, sometimes supplemented by anecdotal observations.[31] While a theoretical model can be a useful guide at the initial stages of analyzing the competitive effects of a particular practice, a higher level of confidence in a model's accuracy can only be achieved by testing the model against empirical evidence. In some cases, this is not feasible due to the lack of relevant data or the immaturity of the relevant market. That is not the case here. The wireless communications markets have been in operation for over three decades. Hence there is ample evidence available to assess the extent to which patent holdup and royalty stacking models track market performance.

If the standard model of market failure in SEP licensing is correct, we should expect to observe low rates of technology adoption and market growth in SEP-enabled markets. Under both the patent holdup and royalty stacking theories, device producers and other implementers would be burdened with an onerous royalty burden, which would be reflected

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[27] For a detailed intellectual history of these arguments, see Barnett (2019 n 2) 1321-24, 1345-51.

[28] For an example from the scholarly literature, see Lemley and Shapiro (n 2) 2013-2016. For an example from the regulatory literature, see US Department of Justice and US Patent & Trademark Office, Policy Statement on Remedies for Standard-Essential Patents Subject to Voluntary F/RAND Commitments (2013) 4, 6 n.13. In 2018, the agencies revised this statement and expressed the view that patent holdup is not a significant issue in SEP licensing markets, see US Department of Justice, US Patent & Trademark Office, and National Institute of Standards and Technology (2019) 5.

[29] Mark A Lemley, 'Ten Things To Do About Patent Holdup of Standards (and One Not To)' (2007) 48 Boston College Law Review 149, 152-53; US Department of Justice and Federal Trade Commission (n 4) 95.

[30] For the classic source, see Antoine Augustin Cournot, *Recherches sur les principes mathémathiques de la théorie des richesses* (Hachette 1838).

[31] See, e.g., Joseph Farrell, John Hayes, Carl Shapiro, and Theresa Sullivan, 'Standard Setting, Patents, and Hold-Up' (2007) 74 Antitrust Law Journal 603; Lemley and Shapiro (n 2); Lemley (n 29).

in high retail prices beyond the budgetary constraints of most users. Consequently, device producers would be reluctant to enter the market or expand operations and chip suppliers and other R&D-specialists would cut back on investment. None of these outcomes are observed in real-world markets. Wireless communications markets have exhibited an exceptionally accelerated rate of adoption, extending across a wide range of income groups and geographic regions.[32] Rapid adoption, coupled with evidence that device prices have fallen over time when adjusted for quality[33], suggest that royalty rates are not especially onerous, which translates into reasonable device prices that fall within the budget of most consumers.

This interpretation is confirmed by empirical analyses of the aggregate royalty rate in mobile communications device markets. Contrary to widespread assertions that SEP owners extract double-digit aggregate royalty rates (which typically reflect the sum of publicly announced, rather than actually negotiated, royalty rates) [34], these studies have found that aggregate royalty rates fall within an estimated range of 3.4 to 5 percent of the retail device price (or in one study, total handset revenues).[35] Moreover, these rates have held constant over an extended period—specifically, as found in one study, the average cumulative royalty fluctuated within a narrow range of 3 to 3.5 percent during 2007 to 2016.[36] Given the significant increases in functionality during this same period (which experienced the transition from feature phones to smartphones), this implies that aggregate royalty rates have been falling once adjusted for quality.

This body of empirical evidence poses a fundamental challenge to patent holdup and royalty stacking claims that continue to influence competition policy in wireless communications markets. In one notable antitrust litigation, a U.S. court relied on a variant of patent holdup theory as the basis for a liability finding and a dramatic intervention in SEP licensing agreements (later overturned on appeal).[37] Modest and declining royalty rates (when adjusted for quality and constant even if not adjusted) are simply inconsistent with assertions that SEP owners have the power to set "exorbitant" royalty rates, which in turn

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[32] On adoption rates of smartphone technology, see Michael DeGusta, 'Are Smart Phones Spreading Faster than Any Technology in Human History?' *MIT Technology Review* (9 May 2012) <https://www.technologyreview.com/2012/05/09/186160/are-smart-phones-spreading-faster-than-any-technology-in-human-history/>.

[33] Alexander Galetovic and Kirti Gupta, 'The case of the missing royalty stack in the world mobile wireless industry' (2020) 29 Industrial & Corporate Change 827; Alexander Galetovic, Stephen H Haber and Ross Levine, "An Empirical Examination of Patent Holdup' (2015) 11 Journal of Competition Law & Economics 549.

[34] Ann Armstrong, Joseph J. Mueller, and Timothy D. Syrett, 'The Smartphone Royalty Stack: Surveying Royalty Demands for the Components Within Modern Smartphones', *WilmerHale* (2014) <https://www.wilmerhale.com/-/media/ed1be413600634d1fa5c3ab08647e8ada.pdf>; Lemley and Shapiro (n 2) 2027.

[35] Galetovic and Gupta (n 36); Alexander Galetovic, Stephen H Haber and Lew Zaretski, 'An Estimate of the Average Cumulative Royalty Yield in the World Mobile Phone Industry: Theory, Measurement and Results' (2018) 42 Telecommunications Policy 263; Keith Mallinson, 'Don't Fix What Isn't Broken: The Extraordinary Record of Innovation and Success in the Cellular Industry under Existing Licensing Practices' (2016) 23 George Mason Law Review 967; and J. Gregory Sidak, 'What Aggregate Royalty Do Manufacturers of Mobile Phones Pay to License Standard-Essential Patents?' (2016) 1 Criterion Journal on Innovation 701.

[36] Alexander Galetovic and Stephen H Haber, 'SEP Royalties: What Theory of Value Should Courts Apply?' (2021) 17 Ohio State Technology Law Journal 189, 213-214.

[37] *Federal Trade Commission v. Qualcomm, Inc.,* 411 F.Supp.3d 658 (N.D. Cal. 2019), overturned by *Federal Trade Commission v. Qualcomm, Inc*., 969 F.3d 974 (9th Cir. 2020).

yields a royalty stack that discourages user adoption and stunts market growth. However, these findings *are* consistent with the fact that the market for mobile communications devices has exhibited robust output, widespread adoption, and declining quality-adjusted prices since the industry's inception. Put differently: available evidence strongly suggests that SEP-enabled industries have enjoyed market success, rather than suffering from market failure.

Re-understanding SEP licensing markets

It is instructive to consider why the patent holdup and royalty stacking hypotheses have apparently mispredicted real-world outcomes. The likely culprit lies in the fact that these models rely on a simplifying set of assumptions that fail to reflect key characteristics of more complex real-world environments. In particular, these models assume that licensors seek to maximize profits in a single technology generation and licensees never have any feasible alternative to the licensor's technology. Under those assumptions, it follows that any patent owner can set royalty rates at will and has incentives to exercise that power to capture the bulk of the economic surplus in the smartphone value chain.

Yet neither assumption tracks reality. SEP licensors are typically firms that have invested heavily in R&D expenditures *prior to* adoption of a technology standard (which is not certain given competing standards)[38], must secure adoption from a handful of large producers to earn a return on those expenditures, and seek to maximize profits on their R&D investments over multiple technology generations. Far from being powerless, the largest producers (which are among the world's largest companies by market capitalization) typically control the pathways that SEP owners must access to reach end-users. Once these real-world characteristics are taken into account, a SEP owner that demands "excessive" royalties would most likely be engaging in a self-defeating strategy that would discourage adoption in current or future technology generations and would endanger the firm's ability to earn a positive return on its R&D expenditures. This enriched theoretical framework correctly anticipates that licensors would offer relatively modest royalties to seed adoption and then would accumulate goodwill by holding royalties constant even after producers cannot easily migrate from the prevailing standard. This is precisely what is observed: it is estimated that IP licensors capture about five percent of the economic value in the smartphone value chain, while licensee-implementers capture between 34 to 42 percent.[39]

Market performance over more than three decades indicates that the likelihood that patent holdup and royalty stacking risks would materialize in real-world SEP licensing markets—as distinguished from stylized models that rely on simplifying assumptions—is low. Nonetheless some argue that this does not exclude the counterfactual possibility that the wireless markets would have performed even more efficiently during this period under a lower patent royalty burden.[40] This theoretical argument, however, falls prey to the "Nirvana

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[38] Kirti Gupta, 'Technology Standards and Competition in the Mobile Wireless Industry' (2015) 22 George Mason Law Review 865, 870-71.

[39] Jason Dedrick and Kenneth L Kraemer, 'Intangible Assets and Value Capture in Global Value Chains: The Smartphone Industry', World Intellectual Property Organization, Working Paper No. 41 (2017) 17-18. The data relates to the Apple iPhone 7, Samsung Galaxy S7, and Huawei P9 models.

[40] Carl Shapiro and Mark A Lemley, 'The Role of Antitrust in Preventing Patent Holdup' (2020) 168 University of Pennsylvania Law Review 2019, 2041-42; A Douglas Melamed and Carl Shapiro, 'How Antitrust Law Can Make FRAND Commitments More Effective' (2018) 27 Yale Law Journal 2110, 2117-18.

fallacy"[41] unless it can specify an alternative, and economically and technologically feasible, market structure that would have sustained incentives for firms to incur the same or greater level of R&D expenditures under reduced levels of patent protection and without any other offsetting social costs. No such alternative has been specified.

Even in a "second-best" scenario not contemplated by these commentators, innovators operating in a weak-IP environment may elect to fund and monetize R&D expenditures through vertically integrated supply chains that are less reliant on patent protections because commercialization is executed internally rather than externally through third parties. This may have been part of the rationale behind the proposed acquisition (withdrawn due to antitrust scrutiny) by Nvidia, an integrated chip manufacturer, of Arm[42], which licenses its foundational chip architecture to chip suppliers in the wireless communications market. As a matter of competition policy, however, vertically integrating (or being acquired by an integrated entity) to adapt to a weak-patent regime compares unfavorably with licensing-based structures that promote competition by providing device producers with access to the technology inputs required to enter the market. Unlike the merely hypothetical "could have been better" counterfactual, US innovation history shows that weakening patent protection (including constraints on patent licensing under antitrust law) has tended to lead firms in technology-intensive industries to shift toward increased vertical integration to capture returns on innovation.[43] As those historical tendencies suggest, weaker IP protections in SEP-intensive markets are likely either to discourage R&D investment or to induce market structures that are characterized by reduced technology access, increased vertical integration, and higher entry barriers. Either outcome represents a step backwards as a matter of competition policy.

IV. ARE LICENSING NEGOTIATION GROUPS LIKELY TO ENHANCE OR DEGRADE SEP LICENSING MARKETS?

In this Part, I examine the merits of the proposal to relax competition laws to permit the formation of LNGs in 5G SEP licensing markets for purposes of precluding some combination of patent holdup, royalty stacking, and transaction-cost inefficiencies. First, I review the standard economic understanding of the competitive effects of collective buying groups. Second, I assess whether there is sufficient evidence to support the view that 5G SEP licensing markets are likely to suffer from market failure that warrants intervention as a matter of competition policy. Third, I assess whether there is a reasonable case for adopting LNGs as a mechanism to counteract any pricing power or other competitive harms that might be reasonably attributable to 5G SEP licensors. Fourth, I assess whether there is a reasonable case for adopting LNGs as a mechanism to reduce transaction costs in 5G SEP licensing markets, taking into account patent pools and similar arrangements that pursue the same objective.

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[41] The "Nirvana fallacy" refers to economic analysis that evaluates an existing imperfect institutional arrangement as compared to a hypothetical idealized environment that is not technically feasible. See Harold Demsetz, 'Information and Efficiency: Another Viewpoint' (1969) 12 Journal of Law & Economics 1.

[42] NVIDIA, 'NVIDIA to Acquire Arm for $40 Billion, Creating World's Premier Computing Company for the Age of AI' (13 September 2020) <https://www.nvidianews.nvidia.com/news/nvidia-to-acquire-arm-for-40-billion-creating-worlds-premier-computing-company->.

[43] Barnett (n 18).

The competitive effects of collective buying groups

It is elementary that cooperative action among actual or potential competitors poses a high risk of anticompetitive effects. This is true both of sell-side and buy-side collusion, whether involving price, price-related inputs, or output.[44] In either case, collusion inefficiently drives pricing away from the levels that would arise in a competitive market. In the more familiar case of sell-side collusion, prices are pushed above the levels that would prevail in a competitive market. If successful, this enables the colluding firms to constrain output and capture supra-competitive profits, resulting in deadweight losses for consumers. In the case of buy-side collusion, pricing is pushed below the levels that would prevail in a competitive market, resulting in a distortion relative to the equilibrium that would otherwise have prevailed.[45] Nonetheless this is sometimes interpreted as a net competitive gain on the assumption that the colluding buyers, who are typically wholesalers or retailers negotiating collectively with producers, pass on the cost-savings to consumers.

This interpretation suffers from two deficiencies.[46]

First, there is no assurance that the cost-savings secured by the collective buying group will be passed on to consumers. Suppose a substantial percentage of retailers in a certain geographic and product market collectively negotiate wholesale prices with suppliers. If the retailers in the buying group enjoy pricing power in the consumer market, they will likely pocket the cost-savings from reduced wholesale prices, in which case this collusive mechanism would simply redistribute wealth from suppliers to retailers with no benefit for consumers. Relatedly, collective buying activities can worsen competitive conditions in the retail market by promoting information exchange, homogenizing input costs, and facilitating collusion among retailers on the prices charged to consumers. Illustrating this risk, the LNG proposal in the 2021 SEP Experts Report commissioned by the European Commission contemplates that LNG members would agree on the licensed product, the "level" at which licensing would take place, and the maximum royalty rate.[47] The competitive risks posed by this granular level of coordination among device manufacturers are self-evident.

Second, even if pricing discipline in the consumer market is strong and retailers in a collective buying group pass on at least a portion of the cost-savings to consumers, this nonetheless reflects a net harm to competitive conditions since the buying group likely would have pushed wholesale prices below the levels that would prevail in a non-collusive bargaining environment. Given reduced expected returns, suppliers are likely to respond by reducing output, yielding deadweight losses just as in the case of sell-side collusion. If suppliers are innovators as in wireless communications markets, output reductions will encompass reductions in R&D expenditures. This can impose especially high social costs since the business ecosystem is deprived not only of innovative output but also the "market multiplier" effect through which innovation gives rise to a stream of newly enabled products

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[44] Blair and Harrison (n 9) 41-48.

[45] ibid

[46] Much of the following discussion is informed by Blair and Harrison (n 9) 41-104, who provide the most comprehensive economic analysis of the net competitive effects of monopsony and oligopsony structures in a variety of scenarios. For an analysis of the net competitive effects of joint purchasing agreements from an EU law perspective, see Geradin et al. (n 11) ¶¶ 7.97-7.119.

[47] Group of Experts on Licensing and Valuation of Standard Essential Patents (n 8) 169. On the competitive risks posed by information exchanges among LNG members, see Nikolic (n 5).

and services across a wide range of industries. Whereas sell-side collusion only gives rise to static efficiency losses in the form of supracompetitive pricing of existing goods and services, buy-side collusion also gives rise to dynamic efficiency losses in the form of suppressed innovation that might have resulted in new goods and services.

Given the high risk of substantial harm posed by collective buying groups to competitive conditions, it is generally recognized that there are only limited circumstances in which this mechanism is likely to result in net competitive gains that would warrant relaxing the presumptive ban on coordination on price or output among horizontal competitors. Those circumstances arise most typically in the case of a retailers' buying group that has an insufficient market share to exert pricing power over suppliers, which enhances the likelihood that the buying group can achieve transaction-cost efficiencies (typically, in negotiation, storage and distribution functions) without inducing material distortions in suppliers' output and pricing decisions. (Note that these transaction-cost efficiencies are most applicable to tangible-goods markets and therefore may not have relevance in intangible-goods environments such as wireless technologies.)[48] Even in this limited case, however, it is necessary to assess whether comparable transaction-cost savings can be achieved through an alternative mechanism that avoids the risks of competitive harm inherent to collective buying groups. If such an alternative mechanism can be identified (or, even more persuasively, already exists and operates successfully), then the policy rationale for relaxing the presumptive ban on direct or indirect coordination among horizontal competitors on price, price-related inputs, or output is unlikely to survive.

Is 5G different?

Based on the observed performance of SEP licensing arrangements for 2G, 3G and 4G/LTE standards in wireless communications, there appears to be little factual basis for the view that SEP licensing is prone to market failure. Contrary to theoretical assertions that SEP-intensive markets are inherently exposed to patent holdup and royalty stacking, which would translate into inflated prices and slow adoption, real-world wireless technology markets have exhibited declining quality-adjusted prices and rapid adoption over several decades.[49] Given this mismatch between theory and evidence in the 2G, 3G and 4G/LTE wireless generations, any reasonable case for policy intervention in the emergent 5G wireless market must identify characteristics that are both unique to 5G-enabled IoT environments *and* give rise to an elevated risk of competitive harm.

There are two potentially qualifying characteristics.

First, 5G technology enables a greater range of products and services within the IoT, which encompasses not only person-to-person and business-to-person communications but person-to-machine and machine-to-machine communications that can extend beyond mobile communications devices to markets such as transportation, health care, industrial production,

[48] This analytical step corresponds to the last step in a fully implemented rule-of-reason analysis under U.S. antitrust law, which provides the plaintiff with the opportunity to show that any efficiencies attributed to the defendant's contested practice could be feasibly achieved through a "less restrictive alternative"—that is, through an alternative practice that achieves comparable efficiencies at a lower risk of competitive harm. For further explanation, see Herbert Hovenkamp, 'The Rule of Reason' (2018) 70 Florida Law Review 81, 103-104.

[49] See nn 33-36 and accompanying discussion.

and other areas.[50] This expanded scope of application implies a greater volume and complexity of licensing transactions but the magnitude of those differences is difficult to predict at present. Second, it has been asserted that this broader range of 5G-enabled markets will encompass a significant number of small and medium-sized enterprises (SMEs) that may lack the resources or sophistication to feasibly negotiate licenses with SEP holders.[51] By contrast, the licensee population in 3G and 4G-enabled wireless communications markets principally comprises a relatively small number of large and sophisticated device producers that can feasibly identify SEP owners and undertake licensing negotiations.

In light of the potentially increased volume and heterogeneity of licensing transactions and licensees, some commentators have returned to the assertion that 5G-related SEP licensing is prone to market failure due to some combination of patent holdup, royalty stacking, or transaction-cost inefficiencies. Despite providing no specific examples, a National Bureau of Economic Research publication states that "the 'Internet of Things' is a new and growing area where royalty stacking and patent holdup appear to be very real dangers."[52] Notwithstanding these conjectural assertions, there are already indications of robust 5G SEP licensing activity between SEP owners and licensees in various 5G-enabled markets. As of October 2020, Nokia had announced 180 "commercial 5G deals," Ericsson had announced 146 "commercial 5G engagements," and Qualcomm had announced "over 150 licensing deals."[53] At the same time, there is evidence that private industry is investing exceptionally large amounts in the adoption and implementation of 5G technology (estimated to reach $1 trillion worldwide by 2025)[54], which tentatively suggests that licensing-related costs are not impeding market growth.

The likelihood that the rollout of 5G technology across the IoT will be advanced by SEP licensing relationships or, alternatively, will be impeded by SEP licensing costs can be tentatively evaluated based on existing evidence concerning both past licensing practices in

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[50] McKinsey Global Institute, Connected world: An evolution in connectivity beyond the 5G revolution (2020); McKinsey Global Institute, The Internet of Things; Mapping the Value Beyond the Hype (2015); GSMA, The 5G Guide: A Reference for Operators (2019).

[51] On these concerns, see Group of Experts on Licensing and Valuation of Standard Essential Patents (n 8) 42; Igor Nikolic and Niccolo Galli, 'SEP Expert Group Report: A Look into the IoT Future of SEP Licensing' (2021) CPI Columns: Intellectual Property; Joachim Henkel, 'How to license SEPs to promote innovation and entrepreneurship in the IoT' (2021), <https://www.ssrn.com/sol3/papers/cfm?abstract_id=3808987>. As observed by Harris Tsilikas and Claudia Tapia, 'SMEs and Standard Essential Patents: Licensing Efficiently in the Internet of Things' (2017) 42 Les Nouvelles 170, SMEs that hold 5G patents and invest significantly in innovation would be *dis*advantaged by policy interventions that push royalty rates below levels that would prevail absent such intervention. Relatedly, Kirti Gupta, 'The role of SMEs and Startups in Standards Development' (2017) <https://www.ssrn.com/sol3/papers/cfm?abstract_id=3001513>, shows that, during 2000-2014, SMEs and startups were active contributors in the standard-development process at 3GPP, representing 15% of all participants. Additionally, SME technical contributions to the standard-development process at 3GPP during this period exhibited a higher likelihood of acceptance (34%) than large firms (29%). These findings suggest that SMEs represent a nontrivial portion of the innovator population in wireless technology markets.

[52] Fiona Scott Morton and Carl Shapiro, 'Patent Assertions: Are We Any Closer to Aligning Reward to Contribution?' in William R Kerr, Josh Lerner, and Scott Stern (eds), *Innovation Policy and the Economy,* vol 16 (University of Chicago Press 2016) 124.

[53] Sources: <https://www.nokia.com/networks/5g/5g-contracts>; <https://www.ericsson.com/en/5g/contracts>; <https://www.nokia.com/about-us/news/releases/2020/10/02/nokia-reaches-100-5g-deals-and-160-commercial-5g-engagements>.

[54] World Economic Forum, The Impact of 5G: Creating New Value across Industries and Society (2020) 10.

2G, 3G and 4G/LTE wireless communications and other information technology markets and emergent licensing relationships in 5G-enabled wireless communications, automotive, and other industries. While this evidence is inherently preliminary, there does not currently appear to be grounds to believe that SEP licensing practices in 5G-enabled environments will depart substantially from the efficient outcomes observed in previous wireless generations.

Wireless communications

In wireless communications device markets, there is currently no indication that there will be a significantly increased volume, or heterogeneity in the types, of device producers following the integration of 5G-enabled technologies in mobile communications devices. Based on past wireless generations, we can expect to observe a relatively small but changing set of leading handset producers in the global market that rely on licensing relationships with a small group of lead innovators. The Table below shows the global market share of handset producers from April 2010 through August 2021, which encompasses 3G, 4G/LTE, and 5G wireless generations. As can be observed, the number of leading firms at any point in time is relatively small but there are substantial changes in global market share over the period as a whole. Additionally, since at least 2017, there has been robust entry into the global market of additional producers (each of which is likely to hold larger shares in specific national or regional markets).

[INSERT FIGURE 1]

The historical turnover in market share suggests that SEP licensing has not erected barriers to entry into device production markets. To the contrary: SEP owners that monetize R&D investment through licensing-based business models most likely have lowered entry barriers by making available a substantial portion of the technology inputs required to enter the market. This reduces significantly the technical and capital requirements that might otherwise pose an insuperable barrier to entry for firms that lack sufficient R&D capacities and technical know-how or the financial resources to acquire those assets. Early indications show that 5G SEP licenses in the wireless device industry have followed the existing practice of granting whole-portfolio SEP licenses at the device level and announced royalty rates (which may sometimes be higher than negotiated rates) are approximately the same as, or in some cases lower than, the rates announced in the past for 4G/LTE SEP licenses.[55] Given that leading SEP owners are apparently maintaining this licensing-based business model in 5G wireless communications and have not announced any material increases in royalty rates, it should be expected that SEP licensing will continue to have the same favorable effects on entry costs and competitive conditions as in the industry's past three decades under previous generations of wireless technology.

Automotive

The automotive industry is the first significant market outside mobile communications in which 3G, 4G/LTE and 5G wireless technology have been substantially deployed. The

[55] Eric Stasik and David L Cohen, 'Royalty Rates and Licensing Strategies for Essential Patents on 5G Telecommunications Standards: What To Expect', *Les Nouvelles* (September 2020).

deployment of cellular communications in the automotive market will transform the industry by improving safety, enabling autonomous driving, facilitating remote upgrades and repairs, and other applications.[56] As such, the automotive industry provides the best available "test case" for assessing preliminarily whether SEP licensing in markets outside wireless communications are likely to exhibit characteristics that increase the likelihood of market failure that would warrant regulatory intervention. At present, there is no indication that licensing relationships in the automotive market exhibit material differences relative to existing relationships between SEP owners and users in wireless communications markets. Like the wireless communications markets, SEP licensing negotiations have principally taken place between the small group of leading SEP owners and a larger but still relatively small group of leading vehicle manufacturers (equivalent to original equipment manufacturers (OEMs) in mobile device markets). Given that the automotive market appears to exhibit relatively "small-number" properties on both the licensor and licensee side of the market, which tends to limit transaction costs and support reputation effects that discourage opportunistic licensing practices, the automotive market does not appear to exhibit any unique characteristics that would render it prone to an elevated risk of market failure as compared to the mobile handset market in which SEP licensing has principally taken place during previous wireless generations.

Some commentators have expressed concern that the larger population of "Tier 1", "Tier 2", and other upstream component suppliers in the automotive supply chain may be dissuaded from adopting 5G-enabled technologies due to the transaction costs and royalty burdens involved in securing licenses from multiple patent owners.[57] This assertion appears to reflect the assumption that the industry would retain the existing practice that component suppliers indemnify OEMs for IP-related liabilities. Yet this is only one of many possible arrangements. Nascent licensing practices involving 4G/LTE and 5G technologies in the automotive industry indicate a "trial and error" process in which licensors and licensees are experimenting with different licensing arrangements that take into account the economic and technological characteristics of the still-developing market in wireless-enabled automotive applications. The Table below lists reported bilateral licensing deals in 2020 and 2021 between SEP owners and licensees in the automotive industry and involving 3G, 4G or 5G wireless technology.

[INSERT TABLE 1]

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[56] McKinsey Global Institute (2020, n 50) 33-40; McKinsey & Company, Development in the mobility technology ecosystem—how can 5G help? (2019). For additional discussion, see Sunil Arya, 'The Value of Standardized Technology to Connected Cars' (2020) 69 GRUR International 365; Bowman Heiden, 'The Value of Connectivity in the Automotive Sector—A First Look' (2019), <https://www.ssrn.com/sol3/papers.cfm?abstract_id=3521488>.

[57] On this point, see Damien Geradin, 'SEP Licensing After Two Decades of Legal Wrangling: Some Issues Solved, Many Still to Address' (2020) <https://www.ssrn.com/sol3/papers/cfm?abstract_id=3547891>, Ropes & Gray, '*Continental Automotive v. Avanci*: Wireless SEP Licensing Presents Challenges for Automotive Industry' (June 2019) <https://www.ropesgray.com/en/newsroom/alerts/2019/06/Continental-v-Avanci-Wireless-SEP-Licensing-Presents-Challenges-to-Automotive-Industry>.

As the Table indicates, variants of OEM-level licensing (encompassing "OEM-specific" Tier 1 licenses) appear to be the dominant structure in SEP licensing activity at this early stage of deploying connectivity technologies in the automotive industry. This tendency is even more pronounced in light of the multi-lateral licensing relationships for 2G, 3G, and 4G wireless technology secured through the Avanci platform (discussed subsequently[58]), which provides a collective mechanism for SEP licensing at the OEM level. It is important to appreciate that market adoption of an OEM-level licensing convention would not preclude participation by upstream suppliers due to exposure to infringement liability. There are two reasons. First, OE-licensees have incentives to request, and SEP licensors have incentives to grant, "have made" rights in licensing agreements, which, as in the mobile device industry, would then limit the infringement liability exposure of the OEM's suppliers.[59] Second, an OEM-level licensing convention effectively shields upstream suppliers from infringement suits as a result of the patent exhaustion doctrines that apply in various jurisdictions.[60] Under those doctrines, a SEP owner has no incentive to bring an infringement suit against a supplier since doing so could preclude the SEP owner from securing more lucrative licensing revenues at a downstream point on the supply chain.[61] Reflecting these considerations, a US appellate court recently held that a component supplier in the automotive industry is not entitled to a FRAND license from a SEP owner because the SEP owner has no incentive "to require redundant licensing of" component suppliers so long as the OEM enters into a license.[62] This reasoning is not theoretical: component suppliers in the wireless communications markets have operated successfully under the legal umbrella of OEM-level contractual arrangements for several decades, which suggests that this state of affairs provides sufficient protection from potential liability to sustain supplier investment.

SME licensing markets

As noted[63], some commentators have asserted that certain 5G-enabled markets in the IoT will comprise large numbers of SMEs that will face especially high obstacles in securing licenses from SEP owners. Recent remarks by a Federal Trade Commissioner raises similar

[58] See below Part IV, "Avanci licensing platform."

[59] Bowman Heiden, Jorge Padilla and Ruud Peters, 'The Value of Standard Essential Patents and the Level of Licensing' (2020) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3717570>. There is apparently a difference of opinion concerning the extent to which "have made" rights under the laws of certain EU member states provide suppliers with sufficient protection against potential infringement claims. See Geradin (n 57) (identifying limitations to the enforceability of "have made" rights); Richard Vary, 'The case for the defence: Access for all v. license to all' (April 2020) <https://www.twobirds.com/en/news/articles/2020/global/the-case-for-the-defence-access-for-all-v-license-to-all> and Heiden et al. (n 59) (expressing confidence that "have made" rights are typically not contested as a legal matter).

[60] Patent exhaustion doctrines typically provide that, upon the first sale of a product that "embodies" a patented technology, the patent owner loses any legal exclusivity over the use or distribution of that product.

[61] For similar views, see Jean-Sebastien Borghetti, Igor Nikolic and Nicolas Petit, 'SEP holders are under no obligation to license to all under EU law', *IAM* (30 April 2020) <https://www.iam-media.com/frandseps/sep-eu-law-licensing>.

[62] *Continental Automotive Systems v. Avanci LLC,* No. 20-11032 (5th Cir., Feb. 28, 2022) 11.

[63] See n 51.

concerns.[64] This assertion has not yet been supported by empirical evidence[65] and, as described above, is not consistent with preliminary indications in the two industries (wireless communications and automotive) in which 5G technology is being substantially licensed so far. Even if this assertion ultimately has empirical relevance in other 5G-enabled industries that comprise substantial numbers of potential SME-licensees, it is still not clear that this would necessarily give rise to transaction-cost difficulties that would impede or block mutually profitable licensing opportunities and the resulting dissemination of 5G technology in enterprise and consumer markets. In fact, empirical evidence on licensing practices covering more than a century of historical experience in patent-intensive technology markets suggests that this outcome is unlikely.

It is common to *assume* that large numbers of patents, licensors, and licensees inherently give rise to "patent thickets" that block transactions, discourage technology adoption, and suppress market growth.[66] The rationale is intuitive: transaction costs involved in matching licensors and licensees, negotiating licensing terms, and collecting payments would be so large that a significant portion of licensing transactions would not be worthwhile to execute, resulting in a chilling effect that impedes technology access and inhibits innovation. Yet there is little evidence showing that this outcome typically is realized in patent-intensive environments. A growing and underdiscussed body of historical research has carefully assessed the factual support for alleged patent thickets in the sewing machine industry in the late 19th-century, radio communications and aircraft industries in the early 20th-cenutry, and biotechnology and information technology industries in the late 20th and early 21st-centuries.[67] Remarkably, these studies all found that these patent-intensive markets exhibited robust capacities to develop contractual and other solutions that preempted or unraveled transaction-cost obstacles attributable to intensive patenting, allowing the market to proceed without any material impediment. That is: the prospect of a patent thicket simply induced transactional innovation to preempt or unwind it.

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64 Federal Trade Commission, SEPs, Antitrust, and the FTC, Remarks of Commissioner Rebecca Kelly Slaughter as Prepared for Delivery at ANSI Standards Week: Intellectual Property Advisory Group Meeting (29 October 2021) <https://www.ftc.gov/system/files/documents/public_statements/1598103/commissioner_slaughter_ansi_102921_final_to_pdf>.

65 A limited exception is Henkel (n 51), who provides qualitative evidence of small firms in IoT-related industries that report facing difficulties in securing SEP licenses, mostly due to reported lack of knowledge. These findings are based solely on interviews with six small firms, which raises doubts whether the study's results would generalize across a broader firm and industry sample.

66 For the most widely cited source for this proposition, see Michael A Heller and Rebecca S Eisenberg, 'Can Patents Deter Innovation? The Anticommons in Biomedical Research' (1998) 280 Science 698.

67 On aircraft and radio, see Jonathan M Barnett, 'The Anti-Commons Revisited' (2015) 29 Harvard Journal of Law & Technology 127; on aircraft, see Ron D Katznelson and John Howells, 'The myth of the early aviation patent holdup—how a US government monopsony commandeered pioneer airplane patents' (2015) 24 Industrial & Corporate Change 1; on radio, see John Howells and Ron D Katznelson, 'The Coordination of Independently-Owned Vacuum Tube Patents in the Early Radio Alleged Patent Thicket' (2014), <https://www.ssrn.com/sol3/papers/cfm?abstract_id=2450025>; on sewing machines, see Adam Mossoff, 'The Rise and Fall of the First American Patent Thicket: The Sewing Machine War of the 1850s' (2011) 53 Arizona Law Review 165; on biotechnology markets, see David E Adelman and Kathryn L DeAngelis, 'Patent Metrics: The Mismeasure of Innovation in the Biotech Patent Debate' (2007) 85 Texas Law Review 1677; on information technology markets, see Jonathan M Barnett, 'From Patent Thickets to Patent Networks: The Legal Infrastructure of the Digital Economy' (2014) 55 Jurimetrics 1 (Barnett 2014).

Consistent with these historical and contemporary trends, patent licensing practices in the wireless communications markets show that patent owners have capacities to anticipate and minimize transactional obstacles through an adaptive combination of bilateral licensing, cross-licensing, and patent pooling arrangements. In 3G and 4G/LTE wireless technology markets, the common practice of OEM-level licensing in the consumer electronics markets, combined with "have made" rights for component suppliers, has substantially mitigated exposure to potential infringement liability for all players in the smartphone supply chain.[68] It is often overlooked that SEP licensors have rational incentives to allay such concerns in order to maximize adoption by producers and other implementers, without which the SEP-protected technology cannot generate returns. While the OEM is protected by the license, its higher-level suppliers are protected both by "have made" rights set forth in the OEM-level license[69] and the fact that the OEM-level license exhausts the SEP owner's rights with respect to all other users in the supply chain.[70] If this practice persists in 5G-enabled markets, as appears tentatively to be the case in the automotive market, then it would generally be unnecessary for SMEs who are component suppliers to negotiate a license directly with SEP owners, who will contract only with OEMs at the end of the supply chain.

Just as it is insightful to consider why the patent holdup and royalty stacking theories have failed to find support in real-world SEP licensing markets, so too it is insightful to consider why the "patent thicket" theory has similarly failed to track actual outcomes in patent-intensive markets. That theory relies on an assumption that patent owners will typically be unable to overcome coordination obstacles to reaching agreement with potential licensees, leaving the market in an unproductive standstill. Yet this assumption overlooks the fact that a patent owner has incentives to avoid any such standstill and secure a return on its patent-protected assets that have a limited economic and legal lifespan. Those incentives are especially strong in the case of a firm that has significant R&D investments at stake, operates under a business model in which those investments are principally monetized through licensing transactions, and is a repeat player with long-term incentives to accrue reputational goodwill among the licensee population. Avoiding a patent thicket by offering "reasonable" royalty rates accelerates adoption of the technology standard and maximizes the base of products and services from which the patent owner can extract royalty streams that monetize past, and fund current, R&D investment. These alternative assumptions are consistent with the fact that patent owners in a diverse range of markets exhibit capacities to negotiate contractual arrangements that preempt or mitigate coordination-cost obstacles to licensing transactions. While future market evolution cannot be predicted with certainty, there is currently no apparent reason to anticipate that the 5G SEP licensing market, including sub-markets that may involve significant numbers of SMEs, is likely to reach a different outcome.

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[68] On historical licensing practices in the wireless industry, see Heiden et al. (n 59); Marvin Blecker, Tom Sanchez and Eric Stasik, 'An Experience-Based Look at the Licensing Practices That Drive the Cellular Communications Industry: Whole Portfolio/Whole Device Licensing' (2017) 41 Les Nouvelles 221.

[69] On the legal enforceability of "have made" rights under EU law, see n 59.

[70] For similar views, see Jean-Sebastien Borghetti, Igor Nikolic, and Nicolas Petit, 'SEP holders are under no obligation to license to all under EU law' *IAM* (30 April 2020) <https://www.iam-media.com/frandseps/sep-eu-law-licensing>.

Are LNGs Necessary to Offset Licensors' Purported Market Power?

It is sometimes argued that 5G SEP licensing markets are prone to suffer from pricing distortions attributable to the market power purportedly enjoyed by licensors. Based on this market power assumption, it is asserted that formation of a LNG would enhance competitive conditions by counteracting SEP licensors' pricing power, driving royalty rates closer to efficient levels and minimizing deadweight losses.

The fragility of the market power assumption

This argument rests on the assumption that SEPs confer market power since SEPs cover technology inputs that are required to implement the relevant standard. The economic characteristics of wireless communications markets do not support making any such broad assumption about SEP holders. To see why this is the case, it is important to appreciate that lead innovators in the wireless industry (which are typically also the lead SEP owners[71]) operate in an overlapping-generations technology market. For example, as 3G wireless technology is being adopted by producers and other implementers, lead innovator-firms are concurrently investing in R&D relating to 4G wireless technology.[72] This model of continuous technology development depends on the availability of a steady stream of royalties from the deployment of each technology generation to fund R&D investment in the next technology generation. This iterative framework incentivizes innovator firms to accrue and maintain reputational goodwill among the implementer-licensee population by *not* demanding an "exorbitant" premium on use of their technology, even if it is critical to the currently dominant standard.[73]

At two critical stages in the lifecycle of a technology standard, a SEP holder is likely to lack either the capacity or incentives to exercise pricing power in "setting" the royalty rate or other terms of access to its technology. At the first stage, when the standard has not yet been adopted and must therefore compete for users with legacy standards (persuading implementers to migrate from 3G to 4G) or other new standards (for example, persuading implementers who are moving from 3G to 4G to select LTE over WiMax[74]), SEP owners must offer modest royalty rates to secure a sufficient producer and end-user base to unleash the network effects that generate economic value. If it fails in this objective, the SEP owner faces the prospect of a loss on its R&D investment, especially if it has no independent production or distribution capacity and therefore relies on licensing as its principal monetization strategy. At the second stage, when a standard has achieved adoption, a repeat-play SEP owner retains an interest in maintaining modest royalty rates insofar as doing so

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71 On the technological contributions of leading innovators in the wireless communications industry, based on an analysis of each firm's patent portfolio, see US Patent & Trademark Office, Patenting activity by companies developing 5G (February 2022).

72 Gupta (n 38) 869-71.

73 This proposition is a special case of the more general proposition that repeat-play holders of even fundamental technologies typically have neither the incentives nor, in the presence of sophisticated and far-sighted users, the capacities to demand "exorbitant" premia on use of their technology. See Jonathan M Barnett, 'The Host's Dilemma: Strategic Forfeiture in Platform Markets for Informational Goods' (2011) 124 Harvard Law Review 1861.

74 On the competition between the LTE and WiMax standards, see Zakhia Abichar, J Morris Chang, and Chau-Yun Hsu, 'WiMAX v. LTE: Who Will Lead the Broadband Mobile Internet?' (2010) 12 IEEE IT Professional 26.

yields a stock of goodwill that the SEP owner can use to secure adoption of future technologies in which it is making significant R&D investments.

This virtuous cycle of constrained royalty rates and continuous R&D investment runs counter to the standard model in which dominant SEP licensors face no pricing discipline and extract "excessive" royalties from producers and other licensees. Yet this overlapping-generations model conforms closely to real-world wireless markets, which do *not* consist of a sequence of "one-off" investments by non-repeat-player firms. The major innovators and SEP owners in the wireless market (which includes Ericsson, Huawei, LG, Nokia, Qualcomm, and Samsung[75]) have been in the market for several technology generations and are repeat-players that have rational incentives to maximize returns over time. Additionally, this model, in which future reputational effects constrain current licensing strategy, can account for evidence showing that licensors offer and maintain aggregate royalty rates that represent modest percentages of retail device prices.[76] In turn, these consistently modest royalty rates account for the rapid adoption rates and declining quality-adjusted device prices exhibited by the wireless device industry since inception.

Devaluation risk

For the sake of argument, I will nonetheless adopt the assumption that a SEP owner at least sometimes enjoys pricing power in negotiating licensing rates with prospective licensees. If that is the case, it might be objected that formation of LNGs would have favorable competitive effects by counteracting SEP owners' pricing power and driving royalty rates closer to competitive conditions, which may then result in lower device prices for end-users. However, even this apparently favorable outcome is likely to have adverse consequences on net as a matter of competition policy. The reason is straightforward. If LNG members constitute a significant portion of total SEP licensing revenues, the LNG would have incentives to "hold out" for a significant reduction in royalty rates from a SEP licensor, who faces the prospect of a net loss on its R&D investment or, at least, a rate of return that does not adequately reflects the risks and costs of its underlying R&D investment.[77] To the extent the LNG is successful in achieving this objective, SEP licensors will respond either by shifting capital away from R&D investment, which represents a welfare loss in the form of reduced innovation, or, as discussed previously[78], maintaining R&D investment but adopting vertically integrated monetization structures (or entering into acquisitions with firms that are vertically integrated), which represents a welfare loss in the form of increased concentration.

This scenario is far from a theoretical possibility. Legal and licensing practitioners widely report that device producers (and, especially, the most well-resourced producers) regularly elect to ignore licensing demands and compel SEP owners to initiate protracted infringement litigation to secure a settlement or damages award, at risk of potential invalidation of the

[75] For further information on these firms' SEP holdings and the relative quality of those holdings, see US Patent & Trademark Office (n 71).

[76] See n 36 and accompanying discussion.

[77] For a formal analysis showing how joint negotiations by licensees over royalty rates are likely to reach this result under a broad range of circumstances, see Anne Layne-Farrar, Gerard Llobet, and A. Jorge Padilla, 'Preventing Patent Hold Up: An Economic Assessment of Ex Ante Licensing Negotiations in Standard Setting' (2009) 37 AIPLA Quarterly Journal 445.

[78] See nn 18 and 42 and accompanying text.

patents at issue.[79] This tactic has even been recognized by the former head of patent licensing at one of the world's largest handset producers.[80] Case studies of SEP infringement litigations find that alleged infringers deploy resources to drag out litigations over several years in multiple judicial venues, forcing the SEP owner to bear significant costs and delays until settlement or final adjudication.[81] Given the prevailing legal understanding of the "FRAND" commitment that governs SEP licensing (and, in the US context, other legal changes that have increased the difficulty of defending a patent against validity challenges[82]), infringers' behavior is perfectly rational. Since the SEP owner cannot secure an injunction under European, UK or US law outside of a clear case of an "unwilling licensee"[83], the infringer can rest assured that it will be able to extract revenues from use of the SEP owners' technology while effectively negotiating the royalty rate through the litigation and settlement process. It is important to note that LNGs in SEP licensing markets differ from collective buying groups in physical goods markets, who must negotiate the terms of access with sellers *before* securing the goods being purchased. In the SEP context, the buyers (licensees) already have the goods and the sellers (licensors) have almost no legal ability to deny access, which favors the buyer (licensee) in negotiating the terms of use, whether through bargaining or settlement of litigation. Even if the parties do not settle and the SEP owner prevails in litigation, the infringer's liability is typically limited to a damages award designed to approximate the royalty rate that would be negotiated in a market transaction.[84]

In a ruling by the International Trade Commission, the administrative law judge observed that "[t]here is no risk to the exploiter of the technology in not taking a license before they exhaust their litigation options if the only risk to them for violating the agreement is to pay a FRAND based royalty or fee. This puts the risks of loss entirely on the side of the patent

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79 David Kappos, Richard Ludwin, and Marc Ehrlich, 'From Efficient Licensing to Efficient Infringement', *New York Law Journal* (4 April 2016) <https://www.cravath.com/a/web/393/3597162_1.pdf; Michael T Renaud, James M Wodarski, and Sandra J Badin, 'Efficient infringement and the undervaluation of standard-essential patents', *Intellectual Asset Management* (September/October 2016) <https://www.mintz.com/sites/default/files/media/documents/2018-04-09/Efficient%20infringement%20and%20the%20ur>.

80 'The trouble with patent-troll-hunting', *The Economist* (14 December 2019) <https://www.economist.com/2019/12/14/the-trouble-with-patent-troll-hunting> (reporting that Apple's "former patent chief" stated that "'efficient infringement', where the benefits outweigh the legal costs of defending against a suit could almost be viewed as a 'fiduciary responsibility', at least for cash-rich firms that can afford to litigate without end").

81 Jonathan M Barnett and David J Kappos, 'Restoring Deterrence: The Case for Enhanced Damages in a No-Injunction Patent System', in Jonathan M Barnett and Sean M O'Connor (eds), *5G and Beyond: Intellectual Property and Competition Policy in the Internet of Things* (Cambridge University Press, forthcoming 2022).

82 See n 79.

83 Under judicial decisions in the EU, UK, and US, a SEP owner can seek an injunction only if it can show that the infringer had rejected a licensing offer that a court determined to be a "fair, reasonable and nondiscriminatory" offer or, in some cases, has otherwise acted in bad faith. Given the uncertainty concerning any particular court's understanding of the FRAND-compliant royalty range, the availability of this exception to the "no-injunction" principle for SEPs probably does not appreciably increase the likelihood that a SEP owner will be able to secure an injunction against an infringing user. For leading decisions, see *Unwired Planet Int'l Ltd. v. Huawei Techs. Co. Ltd*. [2020] UKSC 37 [61], aff'g [2018] EWCA (Civ) 2344 (Eng.); Case C-170/13, *Huawei Techs. Co. Ltd. v. ZTE Corp*., ECLI:EU:C:2015:477, ¶ 71 (July 16, 2015); *Apple, Inc. v. Motorola, Inc*., 757 F.3d 1286 (Fed. Cir. 2014).

84 Barnett and Kappos (n 81).

holder, and encourages patent hold-out . . ."[85] LNGs would simply magnify infringing users' inherent incentives to engage in hold-up under a patent regime in which there is no material threat of injunctive relief. So long as injunctions remain a low-probability outcome, licensees have sufficient litigation resources, and courts do not typically award enhanced damages, collective bargaining through LNGs is likely to induce collective infringement by licensees in an attempt to negotiate lower royalty rates from licensors through the costly process of litigation and settlement. Executed on an industry-wide scale, this generalized strategy of "efficient" infringement would devalue IP assets in wireless markets, distorting royalty rates and redistributing economic value away from the innovators without which the technology ecosystem would not function.

Even if implementers face competitive forces that induce them to pass on some of this wealth transfer to consumers in the form of reduced device prices, consumers are likely to suffer far more significant harms in the long term due to adverse effects on licensors' innovation choices. If LNGs reduce royalty rates significantly, SEP owners must adopt one of two strategies in response, each of which would have adverse effects as a matter of innovation and competition policy.

First, as discussed previously[86], SEP owners may abandon a licensing-based business model in favor of vertically integrated structures to undertake and fund innovation, which can limit technology dissemination among device producers and consequently raise entry costs into the production market. Second, licensors may reduce R&D expenditures. This follows standard economic analysis: buy-side collusion induces suppliers to restrict output—in this case, innovative output. Unlike physical goods markets, however, reductions in innovative output can have especially high social costs since it suppresses other products or services that may have been developed using that "missing" output.[87] Put differently: reductions in output in response to buy-side collusion yield not only static inefficiencies (fewer existing goods) but, of greater concern, dynamic inefficiencies (fewer new goods). As has been observed since Joseph Schumpeter's groundbreaking economic analysis of innovation (1942)[88], it is generally agreed that gains in social wealth attributable to new technologies far outweigh gains in social wealth attributable to reduced prices on existing technologies.[89] Permitting licensees to bargain collectively with licensors is almost certainly a short-sighted policy that risks forfeiting major welfare gains in the future for minor (or nonexistent) welfare gains in the present.

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85 In the Matter of Certain Wireless Devices with 3G and/or 4G Capabilities and Components Thereof, 337-TA- 868, U.S. International Trade Commission (December 2018) 114.

86 See nn 18 and 42 and accompanying text.

87 For further discussion of the social costs of oligoposonistic collusion on SEP royalty rates, see Barnett (2019 n 2), J Gregory Sidak, 'Patent Holdup and Oligopsonistic Collusion in Standard-Setting Organizations' (2011) 5 Journal of Competition Law & Economics 123.

88 Joseph Schumpeter, *Capitalism, Socialism and Democracy* (Harper 1942). In a famous passage, Schumpeter writes: "The fundamental impulse that keeps the capitalist engine in motion comes from the *new* consumers' goods, the *new* methods of production or transportation, the *new* markets, the *new* forms of industrial organization that capitalist enterprise creates" (emphasis in original) (ibid, 18).

89 Rudolph J R Peritz, 'Dynamic Efficiency and US Antitrust Policy', in Antonio Cucinotta, Roberto Pardolesi and Roger van der Bergh (eds), *Post-Chicago Developments in Antitrust Law* (Edward Elgar 2002) 109.

V. ARE LICENSING NEGOTIATION GROUPS NECESSARY TO REDUCE TRANSACTION COSTS?

LNGs might improve the efficiency of SEP licensing markets by replacing tens to hundreds of licensor-licensee negotiations with a substantially smaller number of negotiations between licensors and the LNG, acting on behalf of its licensee-members. Given the collusion risk and related competitive harms inherent to LNGs, however, it is necessary to assess whether LNGs deliver not only a competitive gain *net* of those competitive harms, but a higher net competitive gain compared to other mechanisms for reducing transaction costs in patent-intensive markets. The prospect of high transaction costs in patent-intensive technology markets is hardly unique to the 5G SEP licensing environment. It characterizes consumer electronics markets in general, which generally exhibit large numbers of patents, licensors, and potential licensees.[90] Contrary to standard commentary, which often assumes that patent-intensive markets are impeded by a "web" of overlapping patent rights, empirical evidence shows that information technology markets have generally anticipated and avoided this outcome by developing pooling structures and related arrangements that reduce significantly the transaction costs associated with large-number licensing environments.[91] These structures, which have been deployed to a certain extent in the 2G, 3G, and 4G/LTE environments, reduce transaction costs and do so at a significantly lower risk of competitive harm as compared to LNGs.

Why patent pools outperform LNGs

Since the late 1990s, when the US Department of Justice issued a favorable "business review" letter with respect to several patent pools[92], third-party intermediaries have entered various information technology markets to form and administer tens of patent pools that have secured significant coverage of the licensor and licensee populations relating to a particular standard.[93] These pools typically encompass tens of licensors, hundreds to thousands of licensees, and thousands of patents[94], effectively converting potential sources of patent thickets into members in patent pools. The Table below shows some of the most successful pools in the electronics industries.

[INSERT TABLE 2]

Like a LNG, a pool provides a "one-stop shopping" venue that reduces transaction costs by substituting a small number of pool-licensee negotiations for tens to potentially hundreds of licensor-licensee negotiations. However, there is far less risk that a pool can be used to

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90 Barnett (2014 n 67) 4.

91 ibid 2.

92 A favorable "business review letter" indicates that the regulator does not currently believe the proposed arrangement raises material concerns under US antitrust laws.

93 Barnett (2014 n 67) 15.

94 For a list of all pools formed in information technology markets during 1995-2014, see Barnett (2014 n 67) 48-51. For more recent information, see Group of Experts on Licensing and Valuation of Standard Essential Patents (n 8) 227 Annex 10; Robert P. Merges and Michael Mattioli, 'Measuring the Costs and Benefits of Patent Pools' (2017) 78 Ohio State Law Journal 281.

facilitate collusion on royalty rates. This is for several reasons.[95] First, a pool is typically administered by an independent third party that has no economic stake in any downstream product market and therefore has no incentive to push royalty rates above or below efficient levels. Rather, the administrator seeks to maximize licensor and licensee participation in the pool by offering a rate that is sufficiently high to attract licensors while sufficiently low to attract licensees. Second, the administrator seeks to form additional pools in the future and therefore has an incentive to accrue a reputation for assessing royalties that are deemed to be reasonable on the part of both licensors and licensees. Third, licensors in the pool are often also licensees and hence, like the administrator, have no interest in elevating royalty rates, which, in the case of a pool member that is a net licensee, would operate to its competitive disadvantage. At least in the case of one prominent pool administrator in the information technology industry, patent pools include a provision that all parties pay the same royalty rate, even if a licensee is also a licensor.[96] All these factors reduce the risk that the pooling entity could be used as a mechanism for elevating royalty rates and causing adverse competitive effects on entry conditions and retail prices in associated device markets.

Avanci licensing platform

Some pools in the information technology sector have been unable to achieve broad coverage of the patents relating to a particular standard, usually due to resistance from prospective licensors that hold especially high-value patent portfolios. To minimize transaction costs, pools typically allocate the royalty stream from the end-user market among licensors based on the percentage that each licensor's contributed patents represent out of the total pool. Given the absence of any adjustment for patent quality, this allocation formula undervalues higher-quality patents, which discourages the owners of those patents from joining the pool and explains why attempts to form pools in the 3G and 4G/LTE markets failed.[97]

Yet this obstacle is not insurmountable. Launched in 2016, the Avanci licensing platform has enabled one-stop licensing transactions between automotive manufacturers and SEP licensors of the 2G, 3G, and 4G/LTE wireless standards. Licensors that participate in the platform include most of the leading wireless SEP owners, such as Ericsson, Interdigital, LG, Nokia, and Qualcomm. Licensees include major automotive manufacturers such as Audi, BMW Group, Daimler, Jaguar LandRover, Volkswagen, and Volvo.[98] It has been estimated that subscribing licensors on the platform represent approximately 75% of SEPs declared as essential to the 4G/LTE wireless standard (as of March 2022)[99] and approximately 75% of

[95] Many of these reasons were set forth in the favorable business review letter issued by the US Department of Justice concerning the MPEG-2 standard patent pool, see Letter from Joel I. Klein, Assistant Attorney General, US Department of Justice, Antitrust Division, to Gerrard R Beeney, Sullivan & Cromwell (26 June 1997) <https://www.justice/gov/archive/atr/public/busreview/215742.htm>.

[96] Barnett (2014 n 67) 36.

[97] On this point, see Barnett (2014 n 67), Anne Layne-Farrar and Josh Lerner, 'To Join or Not To Join: Examining Patent Pool Participation and Rent-Sharing Rules' (2011) 29 International Journal of Industrial Organization 294.

[98] For a complete list of licensors and licensees, see <https//www.avanci.com>.

[99] Florian Mueller, 'LG Electronics joins the Avanci patent pool; contributing one of the industry's largest 4G standard-essential patent portfolios', *FOSS Patents* (10 February 2022) <https://www.fosspatents.com/2022/02/lg-electronics-joins-avanci-patent-pool.html>

SEPs declared as essential to the 3G wireless standard (as of August 2020).[100] In July 2020, Avanci launched a new platform for licensing 5G SEPs in the IoT, after having received a favorable business review letter from the US Department of Justice.[101]

Avanci's success in securing significant adoption by SEP licensors and automotive OEMs for the 2G, 3G, and 4G/LTE wireless standards derives from the royalty rates it offers prospective licensees and the royalty allocation policies it offers prospective licensors. To secure participation from owners of high-value SEP portfolios, Avanci abandoned the simple numerical allocation formula used in most patent pools in favor of a more complex formula that incorporates various factors to adjust for the quality of each licensor's patent portfolio.[102] To secure participation by licensees, Avanci commits to a flat royalty for the life of the relevant standard, which allays concerns that the pool administrator may have incentives to "hold up" licensees as the standard develops or as more SEP owners subscribe to the platform. With royalties ranging from $3 to $15 per vehicle (for the full package of 2G, 3G, 4G and "e-call" technology), irrespective of the vehicle model, even the highest possible royalty rate represents a nominal percentage (less than 0.1%) of the average sale price of a new vehicle[103] and an even smaller percentage of the total economic value generated by connectivity technologies in the automotive ecosystem.[104] Consistent with market practice in the mobile device industry, the Avanci license is offered only to vehicle manufacturers (the automotive equivalent of device producers) but includes "have made" rights to mitigate infringement liability exposure for Tier 1 and other component suppliers. To mitigate collusion risk and royalty stacking, any licensor-member in the Avanci pool is free to negotiate individual agreements with licensees outside the pool, subject to the condition that any such agreement provides the licensee with an "offset" for any royalties it already pays to the Avanci pool.

Market-driven arrangements such as the Avanci patent pool, and the multi-decade record of successful pool formation in information technology markets, suggest that pools offer an effective tool to mitigate transaction costs in licensing markets, while incorporating elements that substantially mitigate collusion risk compared to an LNG structure. Given the demonstrated capacity of patent-intensive markets to devise organizational structures that reduce transaction costs, and the incentives of patent owners or intermediaries to assemble such structures, there does not appear to be any sufficiently compelling justification to incur the collusion risk and other competitive harms that are inherent to LNGs.

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[100] Matthew Noble and Richard Vary, 'Avanci's share of mobile SEPs far higher than previously reported', *IAM Media* (10 August 2020) <https://www.iam-media.com/frandseps/avanci-market-share-3g-and-4g>

[101] Letter from Makan Delrahim, Assistant Attorney General, US Department of Justice, Antitrust Division, to Mark H. Hamer, Baker & McKenzie (28 July 2020) <https://www.justice.gov/atr/page/file/1298626/download>.

[102] The description of the Avanci license is based on information found in Avanci, Accelerating IoT Connectivity (2020) 7-8 <https://www.avanci.com/wp-content/uploads/2020/03/Avanci-White-Paper.pdf>; Letter of Request for Business Review of Avanci's Proposed 5G Patent Platform for Connected Transportation Vehicles (21 November 2019) <https://www.justice.gov/atr/page/file/1298631/download>.

[103] Keith Mallinson, 'Right-pricing cellular patent licensing in 4G and 5G connected vehicles' *RCRWirelessNews* (2020) <https://www.rcrwireless.com/20201009/5g/right-pricing-cellular-patent-licensing-in-4G-and-5G-connected-vehicles>. This calculation is based on an average sale price of a new car of $37,000 in the US and $27,400 globally.

[104] Arya (n 56), Heiden (n 56).

V. CONCLUSION

It has been argued periodically that the formation of LNGs is necessary to preserve competitive conditions in SEP licensing markets in which producers are purportedly burdened by onerous royalty payments to SEP owners. This argument has resurfaced with the deployment of the 5G standard. This proposal has no compelling basis in empirical evidence or, when revisited in light of such evidence, economic theory. Multiple empirical studies have failed to find support for theoretical conjectures of "patent holdup" or "royalty stacking" in previous wireless generations. These empirical results are consistent with expanding output and declining quality-adjusted prices in the handset market and reflect the repeat-play effects that constrain SEP licensors that seek to maximize profits from R&D investments over multiple overlapping technology generations. There is currently no apparent reason to believe these efficient outcomes would not persist in the wireless communications, automotive, and other IoT industries in which 5G technology will be deployed. Given the absence of any material risk of market failure in 5G SEP licensing, the formation of LNGs merely advances implementers' private interest in reduced input costs at the expense of the public interest in robust innovation markets. In particular, formation of LNGs would redistribute value from innovators to implementers while endangering licensing-based monetization models that have sustained R&D investment, promoted technology dissemination, facilitated entry into the device production market, and enabled transformative business models across a wide range of industries since the inception of the mobile communications industry. While LNGs may reduce the transaction costs of SEP licensing, the historical record shows that this objective can be achieved through pooling structures at a substantially lower risk of competitive harm. In short: both evidence and theory indicate that the formation of LNGs in 5G SEP licensing markets cannot be reconciled with the sound application of competition policy.