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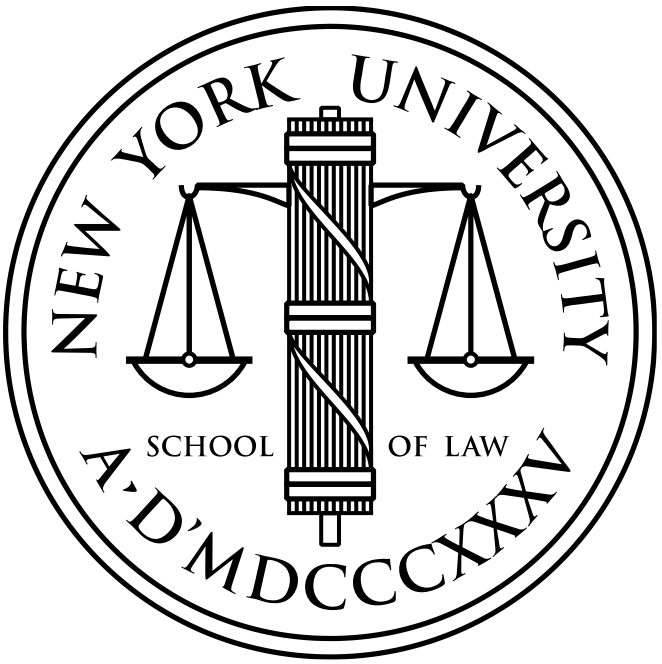

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PATENTS AND PRICE FIXING BY SERIAL COLLUDERS

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Antitrust law has long been mindful of the danger that firms may misuse their patents to facilitate price fixing. Courts and commentators addressing this danger have assumed that patent-facilitated price fixing occurs in a single market. In this Article, we extend conventional analysis to address firms' patent misuse to facilitate price fixing across multiple products lines. By doing so, we expose gaps in existing agency enforcement and scholarly proposals for reform. Important legal tests that make sense in the single market setting do not carry over to the context we call serial collusion, where certain offenders engage in repeat collusion across product lines. This Article argues that there is an urgent need to recast these tests to address serial collusion of the sort that prevails in the chemicals, auto parts and electronics industries. To support this argument, we develop empirical evidence consistent with the possibility that serial colluders in the chemical industry acquired and used patents to support their collusion, either directly to coordinate and monitor output and pricing or indirectly to deter new firm entry by erecting patent thickets as a barrier to entry. Throughout this Article, we describe the flaws of current antitrust doctrine when it comes to assessing patents and price fixing,

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suggest doctrinal improvements, and provide guidance to antitrust enforcers about how to better understand and combat serial collusion facilitated by patents.

INTRODUCTION

In the history of antitrust enforcement, patents have occupied center stage in a number of Supreme Court cases addressing horizontal price fixing and conspiracies to monopolize.[1] As one eminent economist has observed, "some of the worst price fixing schemes in American history were erected on a foundation of agreements to cross-license complementary and competing patents."[2] Over forty years ago, a formative study by George Priest identified the collusive potential of patent licenses. Priest described how a patent owner might, through licensing agreements with rivals, create a cartel:

> The Patent Act, as interpreted by the courts, has allowed persons granted or assigned patents broad authority to set licensee output, to allocate licensee territories, and even to fix minimum licensee prices. This has meant that a group of firms agreeing, in violation of the Sherman Act, either to fix prices or allocate output, could disguise its agreement by obtaining a patent on an unimportant process and executing licenses to previously competing members which incorporate the provisions of the illegal agreement.[3]

In essence, a patent holder, who can control output and thus affect prices for products that make use of its invention, could become a ring leader for a cartel under the cover of organizing a patent licensing scheme.

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[1] Notable examples include *United States v. Singer Manufacturing Co.*, 374 U.S. 174 (1963); *United States v. New Wrinkle, Inc.*, 342 U.S. 371 (1952); *United States v. Gypsum Co.*, 333 U.S. 364 (1948); *United States v. Line Material Co.*, 333 U.S. 287 (1948); *Hartford-Empire Co. v. United States*, 324 U.S. 570 (1945); *Standard Oil Co. (Indiana) v. United States*, 283 U.S. 163 (1931).

[2] FREDERIC M. SCHERER, INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE 452 (2d ed. 1980). *See also* Irene Till, *The Legal Monopoly*, *in* THE MONOPOLY MAKERS: RALPH NADER'S STUDY GROUP REPORT ON REGULATION AND COMPETITION 289, 307 (Mark J. Green ed., 1973) ("Harnessed to serve the ends of corporate enterprise, the patent has become a potent instrument for restraint of trade.").

[3] George L. Priest, *Cartels and Patent License Arrangements*, 20 J.L. & ECON. 309, 309 (1977). Other commentators from this period who identified the collusive possibilities posed by patent licensing agreements include LAWRENCE A. SULLIVAN, HANDBOOK OF THE LAW OF ANTITRUST 551–54 (1977) [hereinafter HANDBOOK OF THE LAW OF ANTITRUST]; Till, *supra* note 2, at 310 ("Licensing agreements have contained production and marketing quotas for licensees. Directly or indirectly they have served as vehicles for setting prices and establishing limited market territories . . . ."); William F. Baxter, *Legal Restrictions on Exploitation of the Patent Monopoly: An Economic Analysis*, 76 YALE L.J. 267, 336 (1966) (observing that price restrictions in patent licensing agreements can constitute "the backbone of a loose-knit cartel").

Early in the twentieth century, courts struggled to characterize patent licenses and pools that increased patent-based profits by restraining market competition. The recent *FTC v. Actavis, Inc.* decision recalled this body of law and noted: "[*United States v. Line Material Co.*] explained that 'the improper use of [a patent] monopoly,' is 'invalid' under the antitrust laws and resolved the antitrust question in that case by seeking an accommodation 'between the lawful restraint on trade of the patent monopoly and the illegal restraint prohibited broadly by the Sherman Act.'"[4] Courts were generally deferential to patent licensing schemes so long as they were confined to the duration of the patent agreement and did not involve products beyond the patented product.[5]

In the years between Line Material[6] and recent pay-for-delay cases, government antitrust agencies have detected and prosecuted several thousand price-fixing agreements.[7] Yet, judicial decisions, enforcement agency statements, and other accounts of these agreements rarely mention patents. This absence puzzles us. One possible reason is that judicial opinions and enforcement agency guidance, especially from the 1930s through the 1970s, discouraged price-fixers from using patents to advance their goals.[8] The wariness of antitrust policy concerning patent licensing practices crested in the late 1970s with the Department of Justice's (DOJ) issuance of what became known as the "Nine No-Nos"—a set of licensing practices that the Antitrust Division would regard as per se illegal violations of the Sherman Act.[9] In response, companies perhaps worried that restrictive patent license terms

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[4] 570 U.S. 136, 148 (2013) (citing *Line Material*, 333 U.S. at 310).

[5] *See* Brulotte v. Thys Co., 379 U.S. 29, 33–34 (1964) (ruling that a contract requiring the licensee to pay royalties to the licensor after the licensed patent had expired was patent misuse); *see also* Kimble v. Marvel Ent., LLC, 576 U.S. 446, 465 (2015) (reaffirming principle of *Brulotte*). The most contentious and often revisited issue in this period involved *United States v. General Electric, Co.*, 272 U.S. 476 (1926), where the Supreme Court validated a licensing term by which the licensor set the price of the licensee's output from the application of the licensed patent. *See infra* notes 97–101 (discussing judicial reconsideration of *General Electric*).

[6] 333 U.S. 287 (1948).

[7] The Workload Reports prepared by the Antitrust Division of the Department of Justice (DOJ) for fiscal years 1960 through 2019 indicate that the DOJ initiated nearly 2,800 criminal cases alleging violations of Section 1 of the Sherman Act. *See Division Operations*, DEP'T JUST., https://www.justice.gov/atr/division-operations (last accessed May 13, 2021) (providing downloadable workload statistics regarding agency enforcement actions by primary type of conduct at issue). Most of these matters involved horizontal price fixing or agreements among competitors to allocate customers or sales territories. *See id.*

[8] ANDREW I. GAVIL ET AL., ANTITRUST LAW IN PERSPECTIVE: CASES, CONCEPTS AND PROBLEMS IN COMPETITION POLICY 1111–22 (3d ed. 2017).

[9] *Id.* at 1112. In 1995, the federal antitrust agencies issued guidelines that retreated significantly from the positions staked out in the "Nine No-Nos." *Id.* at 1122–23.

would elicit enforcement agency scrutiny and avoided using patents for collusive ends. Few major antitrust cases involving price fixing and patents came before the Supreme Court from the 1970s to 2000s, until the eyes of the antitrust world turned to pay-for-delay agreements in the pharmaceutical context between makers of branded and generic drugs in Actavis.[10]

In this Article, we offer a different conjecture. Focusing on the rampant price fixing in the chemical industry from 1980 to present as a case study,[11] we contend that patents probably still do play a significant role in price fixing—a role that has gone unnoticed by enforcers. Our extensive examination of serial collusion in the chemical industry and our empirical evidence of patenting practices by collusive chemical firms leads us to this conclusion. Instead, patents are probably an important device to help manage and maintain cartels, especially among serial colluders, as described in greater detail below.

In a recent article on price fixing, we coined the term "serial colluder" to designate multi-product firms that have participated in many cartels, involving a range of participants, and initiated at different dates.[12] Several chemical firms meet this definition because of their participation in at least thirty different chemical cartels spanning at least three decades.[13] Our earlier article also addressed the business model of serial colluders and the failure of anti-cartel law to deter such behavior. In some cases, weak monitoring and high-powered incentive payments to product division managers may have fostered multiple cartels without encouragement from, or even contrary to the instructions of, upper management. This "rogue manager" explanation of serial collusion is often invoked by corporate directors seeking a story that deflects blame away from them. A more troubling explanation for serial collusion is that price fixing is an integral part of the business

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[10] Pay-for-delay cases involve agreements between producers of branded, patented pharmaceutical products and generic entrants that keep a competing—and allegedly infringing—generic product from entering the market. GAVIL ET AL., *supra* note 8, at 1161–79. These cases present difficult characterization questions, and courts have struggled to decide whether these agreements are per se illegal instances of price fixing, per se lawful and socially desirable uses of patents, or, as the Supreme Court recently concluded in *FTC v. Actavis*, something in a middle ground that should be evaluated under the rule of reason. 570 U.S. 136 (2013); Michael A. Carrier, *The Rule of Reason in the Post-*Actavis *World*, 2018 COLUM. BUS. L. REV. 25 (2018).

[11] William E. Kovacic et al., *Serial Collusion by Multi-Product Firms*, 6 J. ANTITRUST ENF'T 296 (2018) [hereinafter *Serial Collusion*]; Robert C. Marshall, *Unobserved Collusion: Warning Signs and Concerns*, 5 J. ANTITRUST ENF'T 329 (2017) [hereinafter *Unobserved Collusion*]. In this Article we refer to these works as our "prequel papers."

[12] Note that a firm could be a recidivist but not a serial colluder, and that a serial colluder does not need to be a recidivist.

[13] *Serial Collusion*, *supra* note 11, at 301–13.

model of certain firms, and high-level managers advocate for and assist with collusion throughout the firm. We believe serial colluders in certain industries have run "portfolios of cartels." In support of this "business model" explanation, in previous work we presented various kinds of indirect evidence that serial colluders in the chemical industry have indeed run a portfolio of cartels.[14] Unaddressed in that previous work is an examination of how serial colluders may use patents and patent licensing schemes to initiate or maintain a cartel.

In Section I of this paper, we find that serial colluders increased patenting during the duration of their cartels, which is consistent with the theory that these firms use new patents to support cartelization. The magnitude of this increase is above and beyond incremental increases in patenting over time. We also find that "core" serial colluders (but not other major serial colluding chemical firms) increased patenting on products that they did not produce but that were being cartelized by their fellow colluders, which is consistent with the view that serial colluders engage in reciprocal practices across distinct markets.[15] On the whole, our analysis of patenting practices for serial colluders in the chemical space suggests ongoing use of patents to initiate or maintain cartels, a practice that may apply to other industries with serial colluders as well.

Finding that the empirical data support our hypothesis of serial colluders using patents to create and maintain cartels, we next probe in Sections II and III reasons for why this conduct might evade agency enforcement and effectively help to coordinate cartels. Unlike the older cartels that openly used patents to directly restrain output, modern serial colluders running a portfolio of cartels potentially use patents in ways that are indirect and less likely to be noticed by private plaintiffs and government enforcers. We then explore how cartel participants in the modern era (excepting pay-for-delay cases like *Actavis*) appear to use patents to deter entry into cartelized markets, facilitate intrafirm communications and actions in support of collusive conduct, and communicate with other serial colluders about their portfolio of cartels under the guise of discussing their portfolio of patent licenses.

For the remainder of the Article, we discuss how the existing antitrust jurisprudence regarding patents and price fixing requires major upgrades to account for the dramatic modern improvements in our understanding of the economics of collusion. In older cases, judges recognized that firms could use patent licenses

[14] This evidence will be reviewed in Section III.B.

[15] A firm is identified as a non-producer if the relevant European Commission Prohibition Decision (EC decision) did not identify the firm as a producer. If the firm produced the product exclusively for internal consumption or made the product but only sold it outside of the European Union, then we would still label the firm as a non-producer.

directly to restrict output, raise prices, or boost competitors' marginal costs,[16] but they may not have appreciated the many indirect ways that patents can increase cartel stability and profitability. As discussed in greater detail below, patents provide an avenue for ongoing communication among rivals about output and pricing. Patent pools and cross-licensing arrangements are especially useful for organizing cartels across product types. Furthermore, licensing regimes may permit a firm to organize supportive resources within the firm without raising legal compliance concerns.

Anticipating these benefits to cartel formation and maintenance, this Article goes on to suggest that serial colluders may engage in strategic patenting. That is, they procure patents to advance cartel goals rather than to promote innovation. We present data on global patent procurement by price fixers in the chemical industry that is consistent with this view. Importantly, firms managing a portfolio of cartels can use patents in a reciprocal way to stabilize cartels across markets where not all firms participate as producers in each market. Within the network of chemical cartels, for example, we see evidence that certain firms use patents to promote cartels in markets for products they *do not* produce. Firms may use the threat of a patent lawsuit to punish deviators and discourage outsiders from attempting to enter a cartelized market. They may also use patent licenses to audit licensee sales and monitor compliance with cartel rules. One firm might perform such a service for other firms in the collusive network with the expectation that the non-participant would get similar help managing their own portfolio of cartels from other serial colluders in the future.

Further, in this Article, we probe deeply into the ways serial colluders can coordinate their patent practices to enhance cartel profits and stabilize their cartels. Our previous work on serial collusion documented that modern anti-collusion enforcement has not adequately deterred massive, prolonged multi-market price-fixing schemes.[17] We also explained how various forms of reciprocity among serial colluders increased their cartel profits and made cartels more resilient.[18] We expand on this topic with respect to the use of patents for cartelization, which we touched on only briefly in previous work.

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[16] See Section III.A's discussion of *Standard Oil Co. (Indiana) v. United States*, 238 U.S. 163 (1931), *Hartford-Empire Co. v. United States*, 323 U.S. 386 (1945), and *E. Bement and Sons v. National Harrow Co.*, 186 U.S. 70 (1902).

[17] *Serial Collusion*, *supra* note 11, at 297–301.

[18] Serial colluders can respond to shocks that might destabilize their cartels by adjusting rewards to members via subcontracting agreements, sales of plants or divisions from one member to another, or even by coordinated entry into a market by one firm and exit by another. *Id.* at 330–34.

This Article also describes gaps in existing antitrust enforcement and scholarly analysis of patenting practices. Recognition of serial collusion helps us to identify further flaws in the conventional treatment of patent licenses that allegedly facilitate price fixing. As one example, case law favors vertical patent licenses by applying rule of reason analysis to restrictions that could earn per se condemnation if organized as horizontal licenses.[19] Such deference stems partly from worries that anti-collusion enforcement could weaken returns to patents and discourage research and innovation, as well as concerns that there may be legitimate reasons for suppliers, manufacturers, retailers to coordinate some activities. Yet, past practice of serial colluders show that firms can and do evade per se condemnation by simply organizing a middle man to stand as an upstream patent pool organizer. Thus, we reject such deference for vertically organized patent licenses in the context of serial colluders that are managing a portfolio of cartels, because what appears to be a vertical relationship is often part of the network of connections among serial colluders. Similarly, the leading scholarly commentary on patents and price fixing suggests that socially desirable licenses can be sorted from socially harmful licenses by determining whether significant rents flow to the licensor.[20] This test may be effective in the context of an isolated cartel affecting a single market.[21] As we explain in Section IV, this test has little or no value in the context of serial collusion where the firms are managing a portfolio of cartels.

Finally, in this Article, we provide additional policy recommendations tailored to the abuse of patents by serial colluders. Our earlier work lays out various reforms to anti-collusion policy that could mitigate the harms of serial collusion. In Section V, we go further and explain how certain patent-related behaviors by firms that do not participate directly in cartelizing a particular market can be used to infer collusion in that market (when the outsider is part of a network of serial colluders). We also discuss penalties and liability that antitrust and patent agencies should impose on firms that use their patents to facilitate collusion by others. Specifically, we argue for generous application of the patent misuse defense to render unenforceable patents used to facilitate price fixing.[22] Entry would be easier and

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[19] ABA SECTION OF ANTITRUST LAW, *Antitrust Issues Involving Intellectual Property,* ANTITRUST LAW DEVELOPMENTS, vol. 2, ch. 11, at 1107–10 (8th ed. 2017) [hereinafter ANTITRUST LAW DEVELOPMENTS] (discussing treatment of customer, territorial, and field of use restrictions).

[20] Priest, *supra* note 3.

[21] *Id.*

[22] *See infra* Section V; *see also* Daryl Lim, *Revisiting the Patent Misuse Doctrine: Its Potential Contribution to Maintaining Incentives for Innovation*, *in* INNOVATION SOC'Y & INTELL. PROP. 188 (Josef Drexl & Anselm Kamperman Sanders eds., 2019) [hereinafter *Revisiting Patent Misuse*] (setting out the patent misuse doctrine and discussing possible procompetitive applications in antitrust law).

patent-based cartel punishments would be eliminated if cartel patents are left unenforceable. Finally, we identify possible adjustments in the institutional arrangements by which the federal antitrust enforcement agencies address the use of patents and patent licensing to facilitate collusion.

This Article is organized as follows. Section I presents empirical evidence that serial collusion is a serious problem, that serial colluders in the chemical industry use the patent system intensively in ways that suggest strategic patenting, and that their patenting behavior is consistent with their use of patents to enhance multi-market price fixing. Section II considers the evolution of antitrust doctrine and policy related to patent assertion and licensing as collusive devices. Notwithstanding existing strictures, this section reviews how patent practices can facilitate cartelization. Section III turns to the role that patents can play in supporting serial collusion. Section IV discusses the modernization of doctrines related to patents and price fixing in response to the threat of serial collusion. Section V offers policy recommendations and additional concluding comments.

I
SERIAL COLLUSION AND PATENTS: CASE STUDY IN THE GLOBAL CHEMICAL INDUSTRY

Serial collusion in the chemical industry dates back to the 1880s and has reappeared in most decades since then.[23] German chemical firms have been prominent price-fixers and often cartel ring-leaders, but they have been joined by chemical firms from the United States, England, France, Belgium, the Netherlands, Canada, Switzerland, South Korea, and Japan.[24] Dozens of different chemical

[23] *Serial Collusion*, *supra* note 11, at 312–13. *See also* Diarmuid Jeffreys, HELL'S CARTEL: IG FARBEN AND THE MAKING OF HITLER'S WAR MACHINE (2010) (documenting the role that German chemical industry cartels played to support Nazi Germany's war mobilization efforts in the 1930s and German military production during World War II); Heinrich Kronstein, *The Dynamics of German Cartels and Patents. I*, 9 U. CHI. L. REV. 643 (1942) [hereinafter *Dynamics of German Cartels*] (discussing cartelization in Germany from late nineteenth century through mid-twentieth century and analyzing role of patents in facilitating cartelization).

[24] The firms listed in Figure 1, *infra*, were based in Germany, England, France, Belgium, and the Netherlands during the periods of collusion. American, South Korean, and Japanese firms participated in the lysine cartel; American, Swiss, German, Canadian, and Japanese firms participated in the vitamins cartel; American, Swiss, German, and Dutch firms participated in the citric acid cartel, Dutch, Japanese and French firms participated in the sodium gluconate cartel; and American, German, and Japanese firms participated in the sorbates cartel. DEP'T JUST., Appendix A: Antitrust Division Selected Criminal Cases, April 1, 1996 through September 30, 1999, https://www.justice.gov/atr/selected-criminal-cases-antitrust-division (last accessed June 8, 2021).

products have been affected by price fixing at some point.[25] Historically, some of these collusive agreements were regional; others were global. Some were short-lived; others spanned decades. This history, and the specific role of patents to instituting and maintaining cartels in the global chemicals market, is described below.

A. Historical and Modern Cartelization of the Global Chemical Industry

Patents played a significant role in chemical cartels during the first half of the twentieth century.[26] Margaret Levenstein observes that "[d]uring most of the 30 years preceding World War I, bromine producers in the United States and Europe colluded, pooling output, dividing up markets, and raising prices."[27] In the period leading up to World War II, German chemical firms engaged in a variety of practices that Heinrich Kronstein has called "monopolizing by patents."[28] One technique employed by the "combine" of chemical companies was to direct the research arm of each participant to procure as many patents as possible, to use them for strategic ends.[29] From his study of patents and cartelization in 1920s Germany, Kronstein reported that "[m]ore and more the chemical industry began to apply for patents on practically everything. The research laboratories of the few remaining chemical works, connected among themselves by cartel and working agreements, systematically studied entire fields and closed them by a large number of patents."[30] In fields such as plastics and pharmaceuticals, "[e]ach publication in any chemical review or each patent application of any applicant in any country was given to the staff of the research laboratory to find anything that could be patented, no matter if the patent was a patent of evasion or supplement or protection against other

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[25] *Serial Collusion*, *supra* note 11, at 308 fig.5, 312–13.

[26] WYATT WELLS, ANTITRUST AND THE FORMATION OF THE POSTWAR WORLD 12–26 (2002) [hereinafter FORMATION OF THE POSTWAR WORLD]. In discussing the durability of German cartels in the steel and chemicals sector from the 1880s to World War II, Wells observes that German cartel participants were also "adept at cloaking domestic and even international cartels in the guise of patent agreements, the violation of which also entailed considerable legal risks." *Id.* at 13. *See also* GEORGE W. STOCKING & MYRON W. WATKINS, CARTELS IN ACTION: CASE STUDIES IN INTERNATIONAL BUSINESS DIPLOMACY 363–517 (1946) [hereinafter CARTELS IN ACTION] (recounting the role that patent licensing practices played in the formation and operation of chemical industry cartels involving German firms and, in many instances, foreign producers).

[27] Margaret C. Levenstein, Do Price Wars Facilitate Collusion? A Study of the Bromine Cartel Before World War I, 33 EXPLS. ECON. HIST. 107, 107 (1996).

[28] *Dynamics of German Cartels*, *supra* note 23, at 664.

[29] Stocking and Watkins share this view with respect to the chemical patent practices of I.G. Farben. *See* CARTELS IN ACTION, *supra* note 26, at 373 n.16.

[30] *Dynamics of German Cartels*, *supra* note 23, at 664.

inventors."[31] This phenomenon Kronstein described resembles the pattern of recent patenting behavior in the chemical sector we document below—where patenting activity by cartel participants increases dramatically during the period of illegal collaboration for the purpose of consolidating market share for existing firms and keeping out entrants.[32]

A second method documented by Kronstein and other researchers involves the extensive use of patent licensing agreements among major U.S. and foreign chemical producers and their subsidiaries to establish effective networks for global cartelization.[33] Kronstein reports that in the decades leading up to World War II, "[t]he participation of an American enterprise in a world cartel chiefly through the device of patent exchange became very common."[34] In 1946, George Stocking and Myron Watkins reported "that a division of market territories for products coming within the scope of [cartel] patents and secret processes in a given field usually entail[ed] a complete division of territories for all related products."[35]

A third method of cartelization involved the use of multiple licensing arrangements to cartelize entire domestic markets. In the late 1930s, the DOJ successfully challenged Ethyl Gasoline Company for creating an elaborate system of licensing arrangements for the production and use of tetra-ethyl lead to stabilize prices for motor fuel.[36] In another prominent American example of the technique applied outside the chemical sector, in the 1940s, the DOJ prosecuted United States Gypsum for using minimum price terms in patent licenses to cartelize the gypsum wallboard industry.[37] For about a decade, Gypsum had granted licenses with largely

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[31] *Id.* Kronstein used the term "patent of evasion" to describe patents that sought to work around an existing patent to "accomplish[] the same result as a previous patent of another patentee without infringing it." *Id.* at 664 n.65.

[32] *See id.*

[33] *Dynamics of German Cartels*, *supra* note 23, at 668–71.

[34] *Id.* at 669.

[35] CARTELS IN ACTION, *supra* note 26, at 428. American firms in the dyestuffs cartel used patent licenses to stabilize their cartel. *Id.* at 509. Dupont and Nobel used patent licenses to facilitate the explosives cartel. *Id.* at 439. General Electric engaged its foreign counterparts in similar agreements to cartelize the production of light bulbs, as did Standard Oil of New Jersey in the hydrogenation of coal into petroleum. *Dynamics of German Cartels*, *supra* note 23, at 669–70.

[36] Ethyl Gasoline Co. v. United States, 309 U.S. 436 (1940). The Supreme Court observed that Ethyl "has established the marketing of the patented fuel in vast amounts on a nationwide scale through the 11,000 jobbers and, at the same time, by the leverage of its licensing contracts resting on the fulcrum of its patents, it has built up a combination capable of use, and actually used, as a means of controlling jobbers' prices and suppressing competition among them." *Id.* at 457.

[37] United States v. U.S. Gypsum Co., 333 U.S. 364 (1948).

identical price restrictions to nearly all of the industry's numerous firms.[38] In upholding the government's challenge to Gypsum's licensing terms, the Supreme Court observed, "the industry is completely regimented, the production of competitive unpatented products suppressed, a class of distributors squeezed out, and prices on unpatented products stabilized."[39]

The rash of chemical industry cartelization has continued to modern times. In the three decades since 1980, the European Commission (EC) prosecuted chemical producers for collusion in 32 separate markets.[40] Notable American antitrust cases brought against chemical producers during this period ended cartels in the markets for lysine, citric acid, and vitamin C.[41] Since 2010, the Korean Fair Trade Commission (KFTC) fined participants in a chemical additives cartel.[42] Today, the EC is investigating an ethylene cartel,[43] and a massive investigation of serial collusion by generic drug companies is ongoing in the United States.[44] Whereas the

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[38] *Id.* at 371–86.

[39] *Id.* at 400. In later years, the DOJ twice prosecuted firms in the U.S. gypsum industry of price fixing. In *United States v. United States Gypsum Co.*, 438 U.S. 422 (1978), the defendants defeated charges of price fixing based on price information exchanges within the industry. More recently, three American drywall manufacturers settled charges of price fixing in 2012 and 2013. *See* Press Release, Berger & Montague, P.C., $125 Million Settlement Reached in Drywall Price-Fixing Lawsuit, MKTS. INSIDER (Jan. 3, 2018, 4:40 PM), https://markets.businessinsider.com/news/stocks/125-million-settlement-reached-in-drywall-price-fixing-lawsuit-1012446943.

[40] The chemical industry is a good candidate for stable price-fixing agreements. In many markets there few producers, products are usually homogeneous, and the long history of cooperative pricing fosters trust among colluding firms.

[41] The citric acid cartel is discussed in John M. Connor, *What Can We Learn from the ADM Global Price Conspiracies?* (Purdue Univ. Dep't Agri. Econ., Staff Paper #98-14, Aug. 1998), https://www.researchgate.net/publication/227645450. The lysine cartel is discussed in John M. Connor, *"Our Customers are Our Enemies": The Lysine Cartel of 1992–1995*, 18 REV. IND. ORG. 5, 10 (2001) [hereinafter *Lysine Cartel*]. The Vitamin C cartel is discussed in Mitsuru Igami & Takuo Sugaya, MEASURING THE INCENTIVE TO COLLUDE: THE VITAMIN CARTELS, 1990-1999 (Mar. 7, 2017), http://economics.mit.edu/files/12734.

[42] *See, e.g.*, *2014 Year-End Criminal Antitrust and Competition Law Update*, GIBSON DUNN (Jan. 8, 2015), https://www.gibsondunn.com/2014-year-end-criminal-antitrust-and-competition-law-update/#_ftnref431 (imposing sanctions and fines against five producers of chemical additives for plastic products due to price and quantity collusion between 2002 and 2013).

[43] Margaret Volkova, *Celanese Reserves USD88 Million Related to European Commission Ethylene Cartel Investigation*, MKT. REP. CO. (Dec. 26, 2019), http://www.mrcplast.com/news-news_open-363613.html.

[44] DEP'T JUST., *Antitrust Division Update 2020: Generic Drugs*, https://www.justice.gov/atr/division-operations/antitrust-division-update-2020/generic-drugs (last updated June 23, 2020).

scope of these investigations has *not* focused on what role patents may have played in helping to facilitate these cartels, we suspect that patents did play a role.[45] We explore this conjecture by examining the patenting behavior of colluding firms before, during, and after agency enforcement to explore whether these firms may have pursued patents for strategic ends.

B. Empirical Analysis of Serial Collusion in the Global Chemical Markets, 1980s to Present: The Role of Strategic Patenting to Facilitate Cartelization

Our analysis of strategic patenting in the global chemicals markets starts with the information on serial collusion in chemical markets displayed in Figures 1 and 2. The companies listed in the rows are all European chemical producers,[46] except for the Swiss consulting firm Fides/AC Treuhand. The columns list the different chemicals that the EC found to be cartelized in the period 1980 to present, from EC Prohibition Decisions (EC decisions) listed in Appendix A. Subsequent graphs replace the chemical names with the number listed below each chemical, as identified in Appendix A. The grey color in a box indicates that the firm participated in a cartel for that chemical market, as determined from EC decisions as well. All of these decisions are listed in Appendix A by chemical name. These cartels had different start dates, end dates, and durations; some cartels operated for as long as 30 years.[47] The duration of each cartel is displayed in Figure 2.[48]

Next, for each of the chemical producers subject to EC decisions listed in Figure 1, we studied patenting activity near to the time of the relevant cartel.[49] We

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[45] One exception is lysine. *Lysine Cartel*, *supra* note 41, at 10. Archer Daniels Midland (ADM) entered the lysine market even though Ajinomoto held patents on manufacturing techniques. Connor's account of testimony at the ADM price fixing trial indicates that "Ajinomoto believed that ADM had stolen its patented lysine microorganisms, and the trial transcript makes clear that ADM did attempt to steal lysine secrets from Ajinomoto." *Id*. He adds that "Ajinomoto had filed a patent-infringement suit against ADM concerning the amino acid threonine (which Ajinomoto won)." *Id.* at 12 n.10.

[46] American, Japanese, and Korean chemical firms also were involved in price fixing during this period. *See Lysine Cartel*, *supra* note 41, at 7–12 (discussing membership of lysine cartel).

[47] An EC decision might not always reveal the true start date of a cartel. When firms admit to guilt as part of negotiations with the EC, they have an incentive to bargain to shorten the reported cartel duration so as to reduce fines and damages from follow-on civil litigation. Thus, the start date reported in an EC decision may be the result of a negotiation between the Commission and the cartelists.

[48] This figure is reproduced from *Serial* Collusion, *supra* note 11, at 308 fig.5.

[49] In 2017, one of us (Marshall) acknowledged the difficulties of analyzing unobserved, explicit collusion:

first counted global patent applications[50] that were ultimately granted for each of the firm-participants to a cartel during that cartel's active period,[51] determined from the relevant EC decision and labeled as the "plea period." We then tallied patenting in the 10 years before and after the plea period in order to analyze trends in patenting for these firms. Since the length of the plea periods varied, the patent applications during the plea period were rescaled to ten-year periods.[52] The results of these patent tallies—"pre-plea," "plea," and "post-plea"—are reflected in three columns in Figure 3. Further explanation of how these patents were tallied and organized appears in Appendix B.

> Before moving forward, allow me to note that we do not know the extent and scope of unobserved explicit collusion. At one extreme, all previously existing explicit collusion may have been detected and no continuing or new explicit collusion may exist. At another extreme, detected explicit collusion may be just the tip of the iceberg. Namely, there may be vast amounts [of collusion] continuing and newly forming throughout the world. Unlike some other illegal activities, measuring the scope and magnitude of unobserved explicit collusion suffers from truncation, which creates classically difficult inference problems.

Unobserved Collusion, *supra* note 11, at 330.

[50] We counted patent applications as opposed to granted patents because there is a significant delay between patent applications and grants. The count of applications that matured into grants helps us identify the immediate response of firms to the formation of a cartel.

[51] Appendix B provides a detailed description of how we assembled these numbers. This appendix should enable the reader to fully reproduce everything we report here.

[52] For example, if a plea period was 5 years, then the patent applications for each firm were multiplied by two. If the plea period ran for 30 years, the patent applications for the plea period were multiplied by one-third.

Figure 1: European Chemical Firm Cartel Involvement by Product Market, from EC Decisions 1980 to Present

Company \ Product Market	Bitumen	Butadiene Rubber	Calcium Carbide	Candle Waxes	Cartonboard	Chloroprene Rubber	Choline Chloride	Citric Acid	Fatty Acids	Food Flavour Enhancers	Heat Stabilizers	Hydrogen Peroxide 1984	Hydrogen Peroxide 2006	Lysine	Methacrylates	Methionine	Methylglucamine	Monochloroacetic Acid	Organic Peroxides	Polyethylene	Polypropylene	Potash	PVC	Rubber Chemicals	Soda Ash	Sodium Chlorate	Sodium Gluconate	Sorbates	Synthetic Fibers	Vitamins	Woodpulp	Nitrile Butadiene Rubber	Row Sum
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
Akzo Nobel			■				■				■		■					■	■					■		■	■						9
Fides/Treuhand					■				■		■							■	■	■	■		■								■		9
BASF							■													■	■	■	■		■					■			7
Bayer		■				■		■												■				■					■			■	7
Solvay												■	■								■	■	■		■					■				7
Arkema/ Atofina											■		■		■			■	■							■								6
Degussa			■									■	■		■	■			■															6
Hoechst																		■		■	■		■						■	■				6
Shell	■	■		■																■	■		■											6
Elf Aquitaine											■		■		■			■								■								5
ICI															■					■	■		■						■					5
Rhone Poulenc/Aventis																■	■												■	■				5
Atochem												■								■	■		■											4

Figure 2: European Chemical Firm Cartel Involvement by Firm, from EC Decisions 1980 to Present

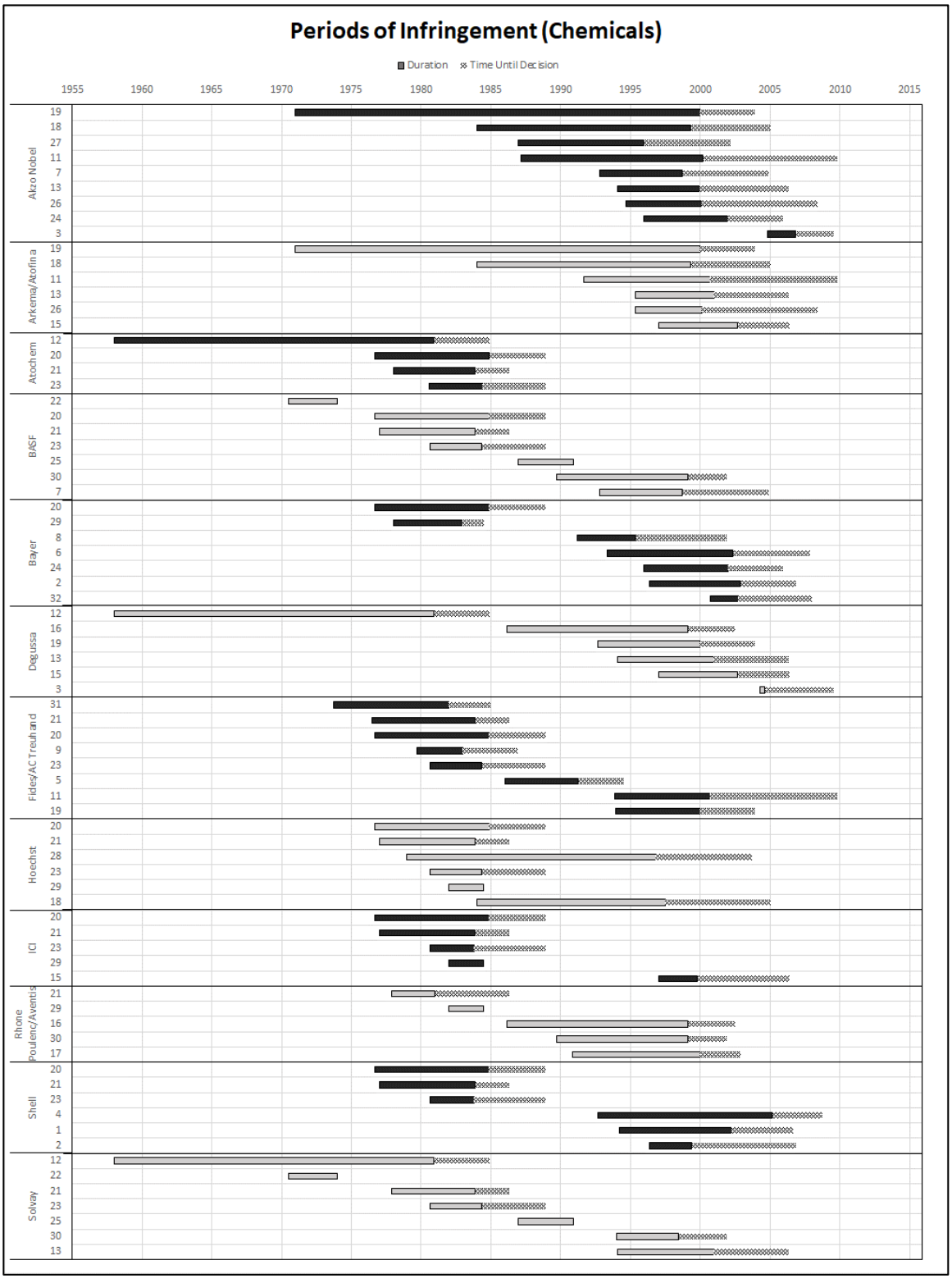

Figure 3: Empirical Findings Regarding Patenting by Large Multi-Product Chemical Firms that Regularly Participate in Cartels

	Producers of Cartel Chemical			*Non-producers of Cartel Chemical*		
Firm	Pre-plea	Plea	Post-plea	Pre-plea	Plea	Post-plea
Akzo	105	158	128	207	414	389
BASF	246	523	824	1037	1639	1527
Bayer	490	610	541	523	753	653
Solvay	157	223	303	107	175	267
Degussa	189	280	461	109	190	331
Shell	154	262	416	289	185	153
ICI	283	257	214	119	74	41
Arkema (AAA)	291	326	586	119	115	149
Hoechst	168	458	891	557	439	131
RP	23	89	38	277	276	253
Aventis	4	62	36	55	148	246
Total	**2110**	**3248**	**4438**	**3399**	**4408**	**4140**
% Change, Pre-plea to Plea		54%			30%	
% Change, Plea to Post-plea			37%			-6%

Figure 4: Patenting Practices of "Core" Serial Colluders, as Compared to "Non-core" Serial Colluders

	Producers of Cartel Chemical			*Non-producers of Cartel Chemical*		
Firm	Pre-plea	Plea	Post plea	Pre-plea	Plea	Post-plea
"Core" Serial Producers	1187	1794	2257	1983	3171	3167
% Change, Pre-plea to Plea		51%			60%	
% Change, Plea to Post-plea			26%			0%
"Non-core" Serial Colluders	923	1454	2181	1416	1237	973
% change pre-plea to plea		58%			-13%	
% change plea to post-plea			50%			-21%

As noted above, Figure 3 displays the tallies of the number of patents that firms applied for in three time periods: "pre-plea," "plea," and "post-plea." Patents were organized by filing date and only tallied if a patent was ultimately granted. For each firm, patents awarded in these periods were sorted into two groups: on the left side, chemical patents awarded to cartel members, aggregated across enforcement actions ("Producers of Cartel Chemical"); on the right side, patents associated with a firm who was not party to the cartel or a producer of the cartel product, as adjudged by review of the same enforcement actions ("Non-producers of Cartel Chemical"). We relied on EC reports to determine if a firm was a seller of a chemical and was not prosecuted as a member of the cartel for that chemical.[53] The bottom of Figure 3 displays totals of patents awarded across the three relevant time periods for each firm. We also calculated the percentage changes in patenting for each firm and overall across the pre-plea to plea time frames and plea to post-plea time frames. The trends that this data reveal is analyzed in greater detail below.

Figure 4 reorganizes the same data from Figure 3, sorting firms into two buckets: "core" serial colluders and "non-core" serial colluders.[54] "Core" serial colluders include Akzo, BASF, Bayer, Solvay, and Degussa (ABBSD). The remaining six firms (Shell, ICI, Arkema, Hoechst, RP, and Aventis) were marked as "non-core" serial colluders.

From review of the data in Figure 3, we find that there was a surge in patenting by cartel members on chemicals covered by the cartel *during the plea period*. In the plea-period, the adjusted total number of patent applications by the chemical firms which the EC deemed to have participated in a cartel for a given product was over 3,200 patents, as compared to close to 2,100 patents in the pre-plea period. The total number of patent applications was 54% higher for serial colluders in the plea period than in the pre-plea period, reflecting a surge in patenting activity. This trend continued in the post-plea period, where the number of patent applications by serial colluders rose to close to 4,400 patents, 37% higher in the post-plea period than in

[53] More precisely, we have no information that these firms are producers. The EC prohibition decisions do not name them—an omission that may only mean that the firm had no sales for the product in the European Union. A "non-producer" could make the product entirely for internal consumption. In addition, a "non-producer" could be making the product and not selling any of its output in the Europe Union. We address some of these classification distinctions in Section III.C.

[54] We call Akzo, BASF, Bayer, Solvay, and Degussa the "core" serial colluders because they are the only serial colluders who engaged in the anomalous behavior of increased patenting of products that they did not produce but which were cartelized by others. Also, these are the most frequent colluders, active in at least seven cartels, except for Degussa, which was active in six. Finally, BASF and Bayer are the two main descendants of the I.G. Farben conglomerate of Germany.

the plea period. Appendix B provides firm-specific details corroborating these results.

Is a 54% increase in patenting activity between the pre-plea and plea periods large enough to raise suspicions about suspect motivations for patenting? Finding a good benchmark for patenting activity is quite difficult. Trying to benchmark cartel participant patenting activity against others in the industry is not a perfect solution, as other chemical firms are potentially involved in collusion across other product types or their behavior may be influenced by the cartel firms, even if they are not formal members of the cartel. For example, patenting activity by Japanese chemical firms does not appear to be very different than that of the European producers listed in Figure 1, but that could simply reflect the use of patents by Japanese and European firms to define exclusive territories as part of coordinated conduct.[55] Nevertheless, the fact that patenting for serial colluders increased more across the pre-plea to the plea periods as compared to the plea to post-plea periods may be a good indicator of suspect motivations for patenting. If innovation was accelerating at an increasing rate, then we would expect for the results to be the opposite. Further, it is important to remember that the plea periods for these cartels all differ in time; thus, a surge in innovation over some specific time period is very unlikely to explain the results. Rather, it seems that serial colluders deliberately increased patenting during plea periods at a rate untethered to innovation improvements, for reasons further discussed below.

Another interesting trend emerges from review of producer versus non-producer patenting during the relevant pre-plea, plea and post-plea periods. If there was no coordinated activity among non-cartel and cartel members, one would not expect any spike in patenting for non-producers in the relevant periods above and beyond innovation improvements. And yet, the data suggest that non-producer firms to some degree may strategically be seeking patents during the relevant time periods as well. The "core" serial colluders, Akzo, BASF, Bayer, Degussa, and Solvay (ABBDS), generated over 4,400 patents related to chemical products that they themselves did not make but that their other regular co-conspirators did make and cartelized markets for. Notably, core serial colluder patent applications for cartelized products that they did not make increased by 60% from the pre-plea to the plea period; a spike in patenting similar to that for producing firms actually party to the

[55] Another potential benchmark might be university patent applications. That possibility is diminished by the Bayh-Dole Act of 1980, 35 U.S.C. §§ 200-212 (1980), which created great incentives for universities and others receiving federal grants to seek patent applications. Enactment of Bayh-Dole means that the rapid increase for these institutions is almost surely just a result of the change in the regulatory environment.

cartel at issue. By contrast, as shown in Figure 4, patent applications for non-core serial colluders in cartelized products that they did not make fell by 13% from the pre-plea to plea periods and fell by 21% from the plea to post-plea periods. This suggests the ABBDS firms garnered patents that could be used in a reciprocal fashion to support cartels operated by their compatriots.

Of course, we cannot entirely reject the possibility that these patterns of patenting are due to non-collusive motivations. As noted above, alternative explanations are industry-wide or firm-specific innovation improvements. Some jumps or falls in patenting could also be random occurrences. Yet, several facts cast doubt upon such explanations. First, the firms at issue regularly participate in cartels with one another across a broad array of chemical products.[56] Second, as described in greater detail below, patents are very useful tools to facilitate cartel conduct.[57] Third, the fact that the increase in patent applications by cartel members from the pre-plea to the plea period is greater than the increase from the plea to the post-plea period strongly suggests an incremental value of patents for these firms above and beyond protecting intellectual property. Fourth, a surge in patent applications by the core serial colluder firms on products that they do not make but for which their frequent co-conspirators are engaged in a cartel strongly suggests that at least this subset of core serial colluders use patents to facilitate cartel conduct across products. Finally, it is noteworthy that the plea periods for the 32 cartels that we analyze have different start and end dates. Thus, the data we report across Figures 3 and 4 are unlikely to be driven by some industry-wide innovation surge over a specific time period. Also, the finding of a patent surge for non-producers from the pre-plea to the plea period pertains to only the five most active cartel firms and not the other six. This implies that surges in patenting are not being driven by some industry-wide phenomenon.

Having identified certain suspect patenting practices by serial colluders in the chemical industry, we next explain that this behavior is rationally related to instituting and maintaining a cartel. Before doing so, we lay some groundwork for how antitrust law approaches collusive schemes involving patents and patent licensing. Then, we describe competitive pressures that might drive firms to seek out patents as a means to institute and maintain a cartel.

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[56] *See* Section III.B.

[57] *See* Section II.A.

II
PATENTS, COMPETITION, AND COLLUSION: THE EVOLUTION OF ANTITRUST DOCTRINE AND POLICY

Most antitrust scholars agree that the patent system has procompetitive effects when it works as intended.[58] Patents give inventors incentives to create new technology by strengthening their ability to earn profits that cover the cost of inventing.[59] Patents achieve this end by giving their owners the right to exclude others from making, using, and selling the patented technology during the patent term. In return, patent owners must disclose their invention to the public; thus, sharing the knowledge that they created.[60] This knowledge will enter the public domain at the end of the patent period.

The right to exclude—the patent's vital legal trait—is not an unmixed social blessing. This right may slow the diffusion of new technology and sometimes leads to market power in a patented product. These social costs must be balanced against the social gains arising from patents' innovation incentives and knowledge disclosure function. Moreover, patents do not completely bar other firms from using the patented technology. Importantly, these firms are free to utilize the invention if they obtain a license from the patent owner. When patent owners and other inventors or manufacturers can come to an agreement to license the patented technology during the patent term, society gains doubly from the speedy diffusion of new technology and royalty payments that reward inventors.

As a general matter, patent owners enjoy considerable discretion to draft patent licensing agreements that they desire. Antitrust law usually allows said license agreements to restrict licensees' output, fields of use, or freedom to market covered products.[61] Antitrust law also tolerates license royalty provisions that raise the

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[58] FED. TRADE COMM'N, TO PROMOTE INNOVATION: THE PROPER BALANCE OF COMPETITION AND PATENT LAW AND POLICY, ch. 1 (Oct. 2003) [hereinafter TO PROMOTE INNOVATION].

[59] FREDERIC M. SCHERER & DAVID R. ROSS, INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE 621–30 (3d ed. 1990); Stanley M. Besen & Leo J. Raskind, *An Introduction to the Law and Economics of Intellectual Property*, 5 J. ECON. PERSPS. 3 (1991).

[60] This bargain—exclusivity in return for disclosure—is a basic foundation for the U.S. process through which patent rights are granted. CHRISTINA BOHANNAN & HERBERT HOVENKAMP, CREATION WITHOUT RESTRAINT: PROMOTING LIBERTY AND RIVALRY IN INNOVATION 62–67 (2012); ROBERT P. MERGES, PATENT LAW AND POLICY: CASES AND MATERIALS 247–302 (7th ed. 2017).

[61] Weimin Wu, *Managing Cartels Through Patent Pools*, 64 ANTITRUST BULL. 457, 457–73 (2019). *See also*, Priest, *supra* note 3, at 314 ("Under the guise of patent license, a cartel can gain supracompetitive profits without employing any detectable restriction on price. A cartel can agree on some other aspect of the sale of the product to achieve the same result.").

marginal cost of licensees.[62] Relative to the absence of licensing, these restraints on competition during the patent's term are tolerated on the ground that such restrictions tend to promote technology diffusion and more competitive markets after patent expiration.[63]

In some instances, antitrust law also permits agreements among actual or potential rivals to determine collectively how a group of firms will exploit their patent rights. The creation of the Manufacturers' Aircraft Association in the early twentieth century provides an example of a socially beneficial use of cross-licensing agreements and a patent pool to coordinate patent licensing covering complementary patented technologies. At the advent of airplane technology, Orville and Wilbur Wright, i.e., the Wright brothers, and, separately, Glenn Curtiss, had patent rights covering fundamental airplane technology.[64] No one, including the Wright Brothers and Curtiss, could avoid patent infringement when making a commercial airplane unless they had permission from the three patent owners.[65] For years, Curtiss and the Wrights were locked in patent litigation that held up knowledge transfer and caused the American airplane industry to lag behind developments in Europe. Eventually, the patent owners resolved their dispute in response to pressure from Franklin D. Roosevelt, then the Assistant Secretary of the Navy, to expedite preparation for the United States's entry into World War I.[66] As a result, Curtiss and the Wright brothers' fundamental patents (and many improvement patents) were contributed to a patent pool called the Manufacturer's Aircraft Association. The pool became a vehicle for airplane patent owners to coordinate their patent licensing, but in this case, cooperation improved social welfare as compared to no licensing at all.[67]

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[62] ANTITRUST LAW DEVELOPMENTS, *supra* note 19, at 1094–118.

[63] HANDBOOK OF THE LAW OF ANTITRUST, *supra* note 3, at 525–28.

[64] DAVID MCCULLOUGH, THE WRIGHT BROTHERS 249–53 (2015) (describing patent litigation between the Wright brothers and Glenn Curtiss, all early aviation pioneers); LAWRENCE GOLDSTONE, BIRDMEN: THE WRIGHT BROTHERS, GLENN CURTISS, AND THE BATTLE TO CONTROL THE SKIES (2014) (same).

[65] Robert P. Merges, *Contracting into Liability Rules: Intellectual Property Rights and Collective Rights Organizations*, 84 CAL. L. REV. 1293, 1341 (1996) ("[W]here different firms hold patents on the basic building blocks of the industry's products, they will have to cross-license to produce at all.").

[66] *Id.* at 1356–57 ("In several cases where the government was concerned that technology useful to the military was not being developed because of a logjam of conflicting property rights, the lurking threat of the eminent domain power contributed to the formation of patent pools.").

[67] G. R. Simonson, *The Demand for Aircraft and the Aircraft Industry, 1907-1958*, 20 J. ECON. HIST. 361, 363–64 n.9 (1960).

However, patent license terms that maximize value to the licensor and licensee may also cause unacceptable harm to third parties.[68] For example, antitrust may block a patent license agreement that diminishes competition in markets for technology outside the scope of the patent.[69] Antitrust may also block license agreements aimed at thwarting entry to challenge patents that are likely invalid, or the use of such patents to divide a market among competitors.[70] Both of these results are discussed in greater detail in Section II.A below.

The tricky question raised in the following section is how courts should distinguish legitimate restrictions on competition that appropriately award inventors for their efforts from illegitimate restrictions that harm competition without significantly promoting invention. To address this inquiry, we sketch the evolution of antitrust enforcement policy as it has applied to patent-related practices that could support collusive arrangements. In doing so, we present some of the principal scenarios of alleged collusion that have appeared in antitrust decisions involving patents, especially in cases that present complex patent enforcement and licensing practices. We later propose some ways for settling this line-drawing question in Section IV.

A. Patents and Collusion in Antitrust Policy

From the earliest decades of antitrust law, antitrust policy in some eras has viewed the patent system warily and has given careful attention to the possibility that patent licensing and pools could facilitate collusion and the monopolization of entire industries.[71] Perhaps more than at any time in American history, these concerns crystalized during the proceedings in the late 1930s and early 1940s of the

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[68] TO PROMOTE INNOVATION, *supra* note 58.

[69] DEP'T JUST. & FED. TRADE COMM'N, ANTITRUST GUIDELINES FOR THE LICENSING OF INTELLECTUAL PROPERTY 8–9 (Jan. 12, 2017), https://www.justice.gov/atr/IPguidelines/download [hereinafter DOJ/FTC IP GUIDELINES].

[70] *Id.*

[71] Walton Hamilton's monograph on "Patents and Free Enterprise" for the Temporary National Economic Committee in 1941 recounts the longstanding concern among antitrust specialists that patent rights, unless properly constrained, would undermine competition. TEMP. NAT'L ECON. COMM., 76TH CONG., INVESTIGATION OF CONCENTRATION OF ECONOMIC POWER: PATENTS AND FREE ENTERPRISE (Comm. Print 1940) (Walter Hamilton) [hereinafter Hamilton, PATENTS AND FREE ENTERPRISE]. In a section titled "The Peril to Free Enterprise," Hamilton observed that, "[i]n their concern with trade practices, the Federal Trade Commission and the Department of Justice have been plagued with a legalistic conception of a patent as a sacrosanct area in the economic realm." *Id.* at 159. Hamilton cautioned that a rebalancing of the interests of the patent system and the antitrust regime was necessary: "If presently the patent is not brought into accord, free enterprise can survive only on the fringes of a closed economy." *Id.* at 163.

Temporary National Economic Committee (TNEC) and its "Investigation of Concentration of Economic Power."[72] The final TNEC report described the patent system and its operation in scathing terms:

> No one can read the testimony developed before this committee on patents without coming to a realization that in many important segments of our economy the privilege accorded by the patent monopoly has been shamefully abused. . . . It [patenting] has been used as a device to control whole industries to suppress competition, to restrict output to enhance prices, to suppress innovation, and to discourage inventiveness.[73]

The TNEC report reflected the work of researchers who had documented how patent licensing arrangements had facilitated the cartelization of global markets.[74] The acute suspicion with which U.S. antitrust policy sometimes has treated patent licensing arrangements almost surely flows out of findings in law enforcement initiatives and academic studies from this era that patent licensing helped to cartelize sectors critical to the World War II mobilization effort.[75] The TNEC proceedings also lent support to existing efforts by Thurman Arnold, then the Assistant Attorney General for Antitrust, to challenge domestic and international cartels that used patent licenses as coordination mechanisms.[76] Much of what we know about the early use

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[72] TEMP. NAT'L ECON. COMM., 77TH CONG., INVESTIGATION OF CONCENTRATION OF ECONOMIC POWER: FINAL REPORT AND RECOMMENDATIONS OF THE TEMPORARY NATIONAL ECONOMIC COMMITTEE (Comm. Print 1941) [hereinafter TNEC FINAL REPORT]. On April 29, 1938, President Franklin D. Roosevelt asked Congress to conduct a study of economic concentration in the United States. *Id.* at 11–20. In June of 1938, the President approved a joint resolution of Congress establishing a Temporary National Economic Committee to conduct the inquiry. *Id.* at 691–93. The significance of the TNEC proceedings is examined in Albert A. Foer, *Putting the Antitrust Modernization Commission into Perspective*, 51 Buff. L. Rev. 1029, 1032–36 (2003).

[73] TNEC FINAL REPORT, *supra* note 72, at 36.

[74] *See* Hamilton, PATENTS AND FREE ENTERPRISE, *supra* note 71, at 165 ("In peace or at war the international cartel poses its problem. A corporation barricades its monopoly by securing grants in all the dominant nations. If concerns here and abroad lay claim to rival technologies, the conflict is usually resolved by a private understanding. . . . The consumer is denied the protection of competition; and an agreement between gentlemen which vaults over frontiers becomes the actual regulation of commerce with foreign nations.").

[75] FORMATION OF THE POSTWAR PERIOD, *supra* note 26, at 96–107.

[76] *Id.* at 83–89. By the late 1930s, the DOJ had given high priority to investigating the use of patents as collusive and exclusionary mechanisms. ELLIS W. HAWLEY, THE NEW DEAL AND THE PROBLEM OF MONOPOLY 368–70 (1966) (describing DOJ efforts to scrutinize "the use of patent laws to create and perpetuate monopolistic strongholds."). Arnold testified on behalf of the DOJ Antitrust Division before the TNEC body at the close of its proceedings. TNEC FINAL REPORT,

of patent licensing as a collusive device comes from government cases initiated in the 1930s and from the TNEC proceedings.

In addition to agency reports and congressional hearings, government litigation in the mid-twentieth century reflected a larger effort to bring antitrust law to bear on collusive, patent-based schemes. During this time period, the DOJ prosecuted a variety of antitrust cases in which patent practices provided crucial means for executing improper collusive schemes.[77] We highlight three factual scenarios involving allegations of illegal concerted action involving patents in litigated cases: patent pools, cross-licenses, and price restrictions.[78] The illustrative cases below do not expressly address the special anticompetitive possibilities presented by patenting activity and patent practices in the context of serial collusion by multi-product firms, yet their fact patterns and analysis are consistent with some of the serial collusion concerns we address in Sections III and IV.

Scenario 1: Patent Pools and Cross-Licensing

Some antitrust cases have challenged patent pools on the ground that the contested pooling arrangements facilitated industry-wide coordination of output and pricing. One notable illustration is *Standard Oil Co. (Indiana) v. United States*.[79] In the case, several petroleum refiners held patents on a new catalytic cracking process that enabled refiners to extract a larger amount of higher valued products (e.g., gasoline) from a barrel of crude oil.[80] To avoid litigation over their competing claims,

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supra note 72, at 98–138. At several points, he emphasized how the DOJ was working to prosecute cartels in sectors that supplied vital means for the wartime mobilization. *Id.* at 99 (testimony of Thurman Arnold stating that "expenditures for national defense have imposed the immediate task on the Antitrust Division of breaking up combinations which are restricting production in national-defense industries or which are causing the Government to pay artificial prices for its defense materials.").

[77] For notable examples of government antitrust cases in this period that attacked patent practices as illegal agreements under Section 1 of the Sherman Act, 15 U.S.C. § 1 (1980), or as conspiracies to monopolize under Section 2 of the Sherman Act, 15 U.S.C. § 2 (1980), *see infra* notes 82–88, 97–101, 121–22 and accompanying text.

[78] A separate body of cases, not treated in this paper, has focused on patenting behavior as a form of illegal, single-firm misconduct. The leading patent-antitrust cases of this category are analyzed in F. M. Scherer, *Technological Innovation and Monopolization* (John F. Kennedy Sch. of Gov't, Harvard Univ., Faculty Research Working Papers Series, No. RWP07-043, Oct. 2007) [hereinafter *Technological Innovation and Monopolization*].

[79] 283 U.S. 163 (1931).

[80] Catalytic cracking represented an important advance in refining technology. Before cracking became commonplace, refineries relied mainly on distillation units that separated hydrocarbons by boiling crude oil and using fractionation towers to separate components of different densities and boiling points. *The Petroleum Industry: Hearings on S. 2387 and related bills Before the*

the firms pooled their patents, cross-licensed to each other, and agreed to share royalties received from licenses under the patents in a fixed proportion. The DOJ claimed the arrangement enabled the refiners to eliminate competition among the patentees over royalty rates. Applying a rule of reason test, the Supreme Court upheld the participants' cross-licensing and royalty division practices. The Court wrote that the challenged practices often are necessary to prevent infringement litigation from blocking technical progress and concluded that the royalty division mechanism could not adversely affect prices because gasoline produced from the use of the patented cracking technology constituted only 26 percent of all gasoline output.[81]

Two features of the *Standard Oil (Indiana)* decision are interesting for our purposes. First, the Court took an expansive view of the benefits of the settlements that supported the patent pool and seemed less sensitive to, or unaware of, their anticompetitive possibilities, including their tendency to suppress challenges to the validity of weak patents. For serial colluders, the aura of legitimacy that surrounds patent settlements might increase the attractiveness of such agreements as a means to create or reinforce the structures vital to cartel success. Second, the *Standard (Indiana)* decision notes that pooling and settlements may be inevitable and essential to achieving economic progress where many firms engage in patenting related to a specific technology. This raises the question, which we discuss below, of whether cartel members might strategically strive to obtain as many patents as possible as one way to create a nexus of conflicting rights that only can be resolved by agreement among rivals who own these rights. In other words, intensive patenting can create the condition that necessitates pooling and related settlements, and these arrangements can provide useful cartel administration infrastructure.

Hartford-Empire Co. v. United States provides a second, important illustration of the competitive concerns that can arise in pooling and cross-licensing arrangements.[82] This case dealt with the use of patents to implement price fixing by glass manufacturers. In the first half of the twentieth century, glass manufacturing was a competitive and technologically progressive industry. Process innovation

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Subcomm. on Antitrust and Monopoly of the S. Comm. on the Judiciary, 94th Cong., Part 3, at 2143–44 (1975) (testimony of Frederic M. Scherer regarding vertical integration in the petroleum industry).

[81] By treating distillation and cracking as fungible, the Court underestimated the significance of cracking. Because it gave refiners important cost advantages, cracking likely constituted a distinct relevant market. Seen that way, the share of output covered by the challenged patent arrangements would have been over 50 percent (instead of a 26 percent share of all gasoline output).

[82] 323 U.S. 386 (1945).

during this period allowed for automation of most manufacturing activities. However, the industry moved toward collusion when two key players, Hartford and a Corning subsidiary named Empire, settled patent litigation and reached a cross-license agreement in 1916. Subsequently, Hartford and Owens (another glass manufacturer) settled patent litigation in 1924, then jointly bought up most remaining glassmaking patents from other manufacturers. With Corning, Hartford and Owens at the core of the patent cross-licensing agreements, most manufacturers were organized into a cartel that relied on product market division. Corning enjoyed an exclusive license to make certain kinds of blown glass, Owens-Illinois had the exclusive right to make pressed glass using the suction process, and Thatcher held the exclusive right to make milk bottles.[83] The licenses for fruit jars went to Ball and Owens-Illinois, and eventually to Hazel-Atlas. Hazel-Atlas resisted the manufacturers' cartel for several years but joined in 1932 to settle patent litigation.

Making its case, the DOJ accused the several glass manufacturer defendants of conspiring to fix prices and monopolize the market for glass making. At the time of the suit, 96% of U.S. glass output was made using glass machinery licenses: Hartford owned more than 600 patents, Corning owned more than 100, Hazel owned more than 70, Owens owned more than 60, and Lynch owned 12.[84] All of these patents were merged into a pool that effectively permitted defendants to control industry output and pricing.[85] On certiorari, the Supreme Court upheld the district court's ruling that the patent licensing agreements violated the Sherman Act.[86] The remedy required the defendants to offer a reasonable royalty on their patents going forward and blocked future use of patent license terms that could facilitate collusion.[87]

Analyzing the result in *Hartford-Empire,* it is easy to see the risk of collusion created by aggressive patent acquisition and enforcement coupled with licensing terms that allocate product markets. This result also differs from that of the aircraft manufacturing patent pool, described in the Curtiss and the Wright brothers example above. Whereas the glass patent pool and airplane patents both tied up a significant portion of the relevant industry, the airplane patents covered fundamental technologies and represented blocking patents as to each other. By contrast, the glass patent pool covered relatively pedestrian inventions. Thus, the Court's finding of anticompetitive effect and imposition of required licensing at reasonable rates is a

[83] *Id.* at 396–400
[84] *Id.*
[85] *Id.* at 398.
[86] *Id.* at 401–02.
[87] *Id.* at 413–14.

sensible result in *Hartford-Empire*. Our assessment of *Hartford-Empire* would be different if we were convinced that key patents in the pool were technologically significant and mutually blocking.[88]

The *Hartford-Empire* case facts also suggest ways in which the benefits of patent licenses to cartels are magnified when the colluding firms pool their patents and establish an independent entity to administer the pool. A vertical licensor-licensee relationship between an upstream and downstream firm is less likely to be subjected to antitrust scrutiny[89] because vertical agreements are subject to a more permissive standard of review that considers procompetitive justifications from firm coordination.[90] By contrast, agreements among horizontal competitors to fix prices, set output levels, divide territories, or allocate customers are generally treated as per se illegal, as they are thought to have a greater potential to cause social harm.[91] Yet, the disparate treatment of vertical and horizontal agreements can be questionable

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[88] Our sentiment here parallels recent policy in the DOJ and FTC that looks favorably at pools containing only "standard essential patents." By definition, such patents cover significant and complementary technology related to computers and communications. The DOJ issued business review letters "that endorse a policy of *ex ante* price disclosure at VITA (an SSO that promotes the VMEbus computer architecture) and the IEEE. The VITA policy requires IP holders to commit to a 'price cap' (i.e. a maximum royalty rate and most restrictive set of licensing terms), which can be amended downwards, while the IEEE policy allows firms to disclose their most restrictive licensing terms on a voluntary basis." Timothy Simcoe, *Can Standard Setting Organizations Address Patent Hold-up? Comments for The Federal Trade Commission* 13 (2011) (internal citation omitted), http://people.bu.edu/tsimcoe/documents/working/Simcoe-FTC-SSO-Comments-v2.pdf (prepared comment for 2011 FTC conference on the topic of tools to prevent "hold-up" issues created by patents. *See also Tools to Prevent Patent "Hold-up": IP Rights in Standard Setting*, FED. TRADE COMM'N, https://www.ftc.gov/news-events/events-calendar/2011/06/tools-prevent-patent-hold-ip-rights-standard-setting (last accessed May 15, 2021) (with links to download all submitted comments at the 2011 FTC conference, including that of Timothy Simcoe).

[89] Herbert Hovenkamp & Christopher R. Leslie, *The Firm as Cartel Manager*, 64 VAND. L. REV. 813, 842 (2011) [hereinafter *Cartel Manager*] (noting that vertical communication is less likely to attract the attention of anti-cartel enforcers).

[90] Douglas H. Ginsburg et al., *Antitrust and Intellectual Property in the United States and the European Union*, *in* THE INTERPLAY BETWEEN COMPETITION LAW AND INTELLECTUAL PROPERTY—AN INTERNATIONAL PERSPECTIVE 99, 103 (Gariella Muscolo & Marina Tavassi eds., 2019); *see also* Leegin Creative Leather Products, Inc. v. PSKS, Inc., 551 U.S. 877, 907 (2007) ("Vertical price restraints are to be judged according to the rule of reason.").

[91] Ginsburg et al., *supra* note 90, at 105–06; *see also* United States v. U.S. Gypsum Co., 333 U.S. 364, 388–89 (1948) (condemning arrangement by which rivals pooled patents to produce gypsum and agreed to take a license setting royalties by a common formula and fixing the downstream price of gypsum products); United States v. Nat'l Lead Co., 332 U.S. 319, 325–28 (1947) (banning patent cross-licensing scheme that divided global markets).

when the upstream pool manager is working for the downstream licensees who hope to achieve a cartel in their market. In these cases, the upstream actor may merely be coordinating horizontal dealing in a "hub-and-spoke" arrangement without providing procompetitive benefits to the market.[92] Nevertheless, it is hard for courts and enforcers to distinguish desirable pool managers who offer one-stop licensing of a vast portfolio of patents from those who simply work to promote a licensees' cartel.[93]

There are several other ways that patent pools can facilitate cartels. These are not directly addressed in the *Hartford-Empire* decision, but they emerge as implications that cartel members—especially serial colluders—might derive from

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[92] Federal antitrust agencies have challenged a number of these hub-and-spoke arrangements in settings that did not involve patents. Interstate Circuit, Inc. v. United States, 306 U.S. 208 (1939); United States v. Apple Inc., 791 F.3d 290 (2d Cir. 2015); Toys "R" Us, Inc. v. FTC, 221 F.3d 928 (7th Cir. 2000).

[93] The Organization for Economic Cooperation and Development (OECD) Competition Committee has identified this concern when describing FTC enforcement experience in the 1990s:

> The main concern regarding cross-licensing and pooling arrangements is that they can be used to cover up a collusive agreement by mechanisms such as the joint marketing of pooled intellectual property rights with collective price setting or coordinated output restrictions that do not contribute to an efficiency-enhancing integration of economic activity among the participants. Such anticompetitive effects are more likely to occur when the IP rights being cross-licensed or pooled comprise substitute technologies, i.e. the IP rights' holders are potential competitors in a horizontal relationship. . . . A contemporaneous example can be observed in the [United States], where the FTC challenged a pool of patents relating to the manufacture and use of lasers employed in performing eye surgeries in 1998. The two companies comprising the pool were the only firms whose laser equipment had obtained the marketing approval from the U.S. Food and Drug Administration for performing the surgery. Through the pool, Summit and VISX relinquished the right to license their patents unilaterally, but each received the right to prohibit the pool from licensing [to] any third party. The pool issued no third-party licences [sic] over its six-year existence. In addition, the pool agreement required the payment of a minimum fee for each procedure performed with its laser equipment, i.e. the pool set a price floor for the "per-procedure fee" that each company charged ophthalmologists using its equipment. The FTC alleged that the pool eliminated competition between the pool members in the sale or leasing of the laser equipment and in the licensing of related technology. The FTC's allegations concerning the pool were settled through consent orders that dissolved the agreement.

OECD, DIRECTORATE FOR FINANCIAL AND ENTERPRISE AFFAIRS COMPETITION COMMITTEE, *Licensing of IP Rights and Competition Law* 25–26 (June 6, 2019), https://one.oecd.org/document/DAF/COMP(2019)3/en/pdf [hereinafter *Licensing of IP Rights*].

the glass cartel experience. One benefit is that combining the patent portfolios of the members creates a bigger stick to punish deviators and deter entry.[94] A second advantage is that buyer resistance to higher cartel prices may be reduced if sellers in the cartel can deceive buyers and attribute price increases to the royalties imposed by the pool, which supposedly are out of sellers' control.

Scenario 2: Price Restrictions

A second distinct category of antitrust case law has wrestled with the question of whether a patentee may control the price at which its licensees can sell a product making use of the patented technology. In the early years of the Sherman Act, the Supreme Court in *E. Bement & Sons v. National Harrow Co.* took the position that a patentee may enforce minimum price clauses in its licenses.[95] The Court reasoned that because it had no obligation to license its patent, the patentee had the right to condition the grant of a license upon the licensee's agreement to sell the patented good at or above a designated price. Thus, the Court permitted an explicit price restraint so long as it was incorporated into a patent licensing agreement.

In *United States v. General Electric Co*., the Supreme Court rejected a DOJ challenge to a patent licensing agreement between General Electric (GE) and Westinghouse that enabled Westinghouse to produce and sell incandescent lamps covered by GE's patents.[96] The DOJ attacked a licensing provision that required Westinghouse to set prices for its lamps at the same levels that GE set for its own distributors. The Court reasoned that the restriction was a reasonable method for GE to achieve an appropriate return on its investment in developing its lamp technology. The Court did not consider other less benign motivations, such as the use of the licensing provision to support coordination between the two firms. And, if GE's patents were infirm, the license could help ensure that the company's chief rival (Westinghouse) would not contest their validity. The pricing term thus could assist the two companies in coordinating the output and pricing of electric lamps.

On many subsequent occasions, the DOJ has brought cases to challenge the rule of *General Electric*.[97] The agency has succeeded in limiting the rule; however, it has not convinced the Supreme Court to repudiate it. In *United States v. Masonite*

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[94] About 15% of chemical patents are traded. Carlos J. Serrano, *The Dynamics of the Transfer and Renewal of Patents*, 41 RAND J. ECON. 686, 693 (2010).

[95] 186 U.S. 70 (1902).

[96] 272 U.S. 476 (1926).

[97] These efforts are recounted in HANDBOOK OF THE LAW OF ANTITRUST, *supra* note 3, at 541–54; UNITED STATES, REPORT OF THE ATTORNEY GENERAL'S NATIONAL COMMITTEE TO STUDY THE ANTITRUST LAWS 233–36 (Mar. 31, 1955).

Corp.,[98] the DOJ persuaded the Supreme Court to strike down licenses where the patentee had set the price at which its licensees sold products making use of its patent. The Court treated the arrangement as a traditional horizontal price-fixing conspiracy and emphasized that, unlike the circumstances of *General Electric*, Masonite did all of the manufacturing for its licensees, which distributed the patented product at the price set by Masonite. Later in the same decade as *Masonite*, the DOJ again invited the Supreme Court to overrule *General Electric*. In *United States v. Line Material*,[99] the DOJ challenged a cross-licensing agreement where the holders of a "basic patent" and an "improvement patent" licensed their technologies to each other and imposed a price limitation of the type that the Court had approved in *General Electric*. The defendants argued that the cross-licensing arrangement was necessary to overcome a commonplace patent blocking problem. In upholding the DOJ's complaint, the Court distinguished *General Electric* on the ground that the two patentees had engaged in a "combination" and that such combinations violated Section 1 of the Sherman Act.[100] The erosion of *General Electric* continued in *United States v. New Wrinkle, Inc.*,[101] where the Supreme Court barred a price restraint contained in the license of pooled patents assigned to a holding company. Unlike in *Line Material*, the patents in questions were substitutes and not complements. The Court distinguished *General Electric* on the ground that the licensing mechanism was a holding company that acted on behalf of the contributors to the patent pool.

In sum, patent holders remain able to set prices for their licensees' products making use of the patent, but they are mostly limited to the facts of *General Electric* if they try to do so. This provides uncertain protection to firms seeking to invoke the shelter of *General Electric*.[102] That said, patent holders remain able to set royalty rates in their licensing agreements that functionally allow them to retain a good deal of control over market output and pricing.

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[98] 316 U.S. 265 (1942).

[99] 333 U.S. 287 (1948).

[100] This distinction has mystified generations of commentators. *See, e.g.*, WARD S. BOWMAN, JR., PATENT AND ANTITRUST LAW: A LEGAL AND ECONOMIC APPRAISAL 195 (1973) (critiquing the Court's efforts in *Line Material* to distinguish *General Electric*, stating "A more arbitrary and unprincipled per se rule would be difficult to construct.").

[101] 342 U.S. 371 (1952).

[102] *See* HANDBOOK OF THE LAW OF ANTITRUST, *supra* note 3, at 543 ("Analytically deficient, as it is, it is not surprising that the status of *General Electric* is clouded by the criticism which it has evoked and the stinginess with which it has been construed. Though in some sense the case remains law, one cannot rely on it in counseling . . . . The alacrity with which courts have distinguished *General Electric* and the fact that since 1926 no majority of the Supreme Court has been ready to affirm it serve warning that even narrowly read, the case provides no basis for planning a licensing program.").

B. Patent Practices as Sources of Cartel Stability Though Not Always a Total Solution for Cartel Coordination

The government's investigation of patent practices and the records of prosecuted cases illuminate the capacity of licensing terms to enhance cartel stability. In many historical cases, patents played a simple role in price-fixing agreements: licenses set caps on or restricted output by means of territorial, customer, or field-of-use restrictions. In some cases, the licenses specified prices or restricted price-setting.[103] In these examples, patents were helpful tools to enable firms to form and maintain a cartel, although they were often also violative of antitrust law.

Unexplained, however, is why prosecuted cartels would put in place pricing, allocation, and enforcement structures with co-conspirators if they can suppress rivalry through legally enforceable patent licenses alone. Presumably, it could be the case that many unobserved cartels are run only or mainly with patent licenses. Thus, enforcement cases might be skewed toward fact sets where firms adopt more explicit coordinating conduct. But this still begs the question as to why we see so many prosecuted colluders implement cartel structures with measures that extend well beyond patent licenses. We offer three possible explanations below.

First, agreements that are designed to encumber interfirm rivalry will be inherently incomplete. Specifically, many unanticipated circumstances will arise that will cause colluding firms to enter into discussions to reaffirm cartel structures and ensure compliance with the agreement. Incomplete contracts are not unique to cartel agreements,[104] but said agreements are not legally enforceable. Thus, the incompleteness issues that arise are likely to be more extensive than for a legally enforceable contract. Because patent licenses are legally enforceable, they would seem to be a partial solution to this problem. This may explain, at least in part, their prevalence in cartel agreements. Yet, like any other contract, the incompleteness of even patent license agreements requires discussion by cartel members regarding unforeseen circumstances.

Second, patent licenses in mature product markets or industries are probably best used for coarse components of the cartel structures. For example, European and Japanese chemical firms may license to each other with the intent of creating a geographic division across their two markets. But patent license agreements are unlikely to have enough specificity to, say, delineate price increases twice a year by

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[103] *See also* Christopher R. Leslie, *Trust, Distrust, and Antitrust*, 82 TEX. L. REV. 515, 604–05 (2004) (describing the use of patent licenses to stabilize price-fixing agreements).

[104] Jean Tirole, *Incomplete Contracts: Where Do We Stand?*, 67 ECONOMETRICA 741 (1999).

licensees as well as articulate the rationale that will be offered to buyers regarding the justifications for these price increases.

Third, diffusing buyer resistance is crucial to the success of a cartel. For example, as cartel participants restrain output and drive up prices, buyers will attempt to lure cartel members into offering lower prices for a greater volume of business. This may lead to cheating on the cartel agreement. In this and many other ways, buyers can resist price increases, and it would be a difficult task to write a fully contingent license agreement that anticipated all such attempts. In practice, many communications between cartel members are about thwarting buyer resistance.

Overall, patents can facilitate cartel formation and stability. In some cases, however, cartel meetings and structures may still be necessary. In other cases, it is possible that experienced colluders, who make nearly the entirety of industry output for a product, can accomplish the suppression of rivalry primarily through use of patent licenses where ongoing discussions about license terms are nothing more than disguised cartel meetings.

C. Patents and the Evasion of Antitrust Scrutiny

As introduced above, past enforcement experience suggests a number of ways in which patent practices can assist cartel members in avoiding detection and prosecution. In general, patent licenses provide a cloak of apparent legitimacy to the interaction of competitors that otherwise would raise regulators' suspicions. Patent licensing also presents an opportunity for cartel members to speak frankly about inputs and prices, create cartel evasion penalties, and pass off coordinating conduct to internal actors as legitimate business activity.

In a non-collusive setting, the owner of a patent on a valuable invention ordinarily can refuse to license its new technology.[105] To avoid this holdup problem, the law gives the patent owner a measure of protection from antitrust law to encourage licensing.[106] Certain field-of-use, territorial, or customer exclusivity

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[105] Ginsburg et al., *supra* note 90, at 107–08.

[106] A policy paper prepared by the OECD Competition Committee Secretariat has identified the competitively ambiguous nature of such licensing practices:

> Field-of-use, territorial or customer exclusivity raise antitrust concerns mainly if there is a horizontal relationship among licensors, among licensees, or between the licensor and its licensee(s). At the same time, . . . it is widely accepted that such restraints may serve procompetitive ends. It follows that a finding of whether such

provisions that might raise regulatory flags outside of the patent licensing context may be permitted. Yet, colluding firms can mimic the practices of non-collusive patent licensors to achieve their anticompetitive goals.[107] Even outside of the patent context, these types of restraints on trade may have been the goal of collusive firms. Seeking licensing arrangements to achieve these ends, then, provides protection from antitrust enforcement without societal benefit.

Further, the processes for negotiating and enforcing licensing agreements can afford valuable advantages to cartel members. In order to reach an agreement on licensing terms, parties may be willing to share information about input costs and pricing that would otherwise be impermissible for rivals to share.[108] The meetings in which parties negotiate licensing terms are facially legitimate and thus do not have to be kept secret, though the terms agreed upon usually are kept secret.[109]

Patent licensing schemes may also be part of a larger cartel maintenance strategy. Licensors often impose audit provisions to ensure licensees cannot evade

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> clauses infringe competition law depends on the balancing of pro- and anticompetitive effects.

OECD, *Licensing of IP*, *supra* note 93, at 19.

[107] The same OECD policy paper observes:

> Licensing arrangements can nonetheless pose competitive risks. Foremost among these is the risk of cartelisation [sic], which can arise whenever the agreement is between actual or potential competitors in a given market. Collusion can take place in the market for products manufactured using the licensed technology or in the market for the licensed technology itself. In the market for products manufactured using the licensed technology, cartel agreements between licensees can be implemented by ostensibly vertical distribution agreements, e.g. by inducing licensors to impose resale price maintenance and thus fixing prices at the licensee level. Vertical price fixing may also contribute to the stability of a cartel arrangement at the licensor level by making the licensors' retail prices more transparent and stable.

Id. at 15.

[108] As Professor Priest noted in his groundbreaking paper on patent licensing as a means for collusion, U.S. patent laws have been interpreted to give licensors "broad authority to set licensee output, to allocate licensee territories, and even to fix minimum licensee prices." Priest, *supra* note 3, at 309. These interpretations give actual or potential rivals a legitimate reason to exchange sensitive information that could raise serious antitrust concerns outside the setting of patent licensing.

[109] *Cartel Manager*, *supra* note 89, at 842 (suggesting that the risk of cartel detection increases as communication between competitors increases).

paying royalties that are sometimes calculated as a percentage of sales or a fee based on output.[110] A collusive patent licensor can use this audit mechanism to detect and discourage cheating on cartel rules. Licenses may also have termination or penalty provisions that could be invoked by a licensor to punish a firm that deviated from cartel rules.[111]

In addition to the benefit of having output restrictions that are legally enforceable, patent licenses may serve a valuable internal function to avoid raising compliance concerns with in-house counsel or a firm's board of directors. Specifically, each cartel firm can "explain" to counsel and its sales force that restrictions on where to sell, how much to sell, and pricing are part of patent license agreements with rivals as opposed to revealing a cartel.[112] Clever cartel managers have the opportunity to coordinate multiple licenses with fellow colluders to induce

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[110] *See* RUSSELL L. PARR, ROYALTY RATES FOR INTELLECTUAL PROPERTY 187–96 (2007) (describing mechanisms for auditing and monitoring of fulfillment of royalty terms in licensing agreements for patents and other forms of intellectual property).

[111] *See* Ian Ayres, *How Cartels Punish: A Structural Theory of Self-Enforcing Collusion*, 87 COLUM. L. REV. 295, 318 (1987). Professor Ayres analyzes the behavior of General Electric and Westinghouse in the early twentieth century light bulb industry and describes:

> [C]onsider the opportunities for including binding punishment threats in sham patent licenses. Such opportunities are illustrated in the General Electric/Westinghouse light bulb license. In 1912, General Electric granted to Westinghouse patent licenses for the manufacture and sale of light bulbs. The license required Westinghouse to maintain the price that General Electric charged for bulbs and to pay a royalty of two per cent [sic] of net sales—which rose, however, to 10 per cent [sic] if Westinghouse's net sales exceeded 15 percent of General Electric-Westinghouse total net sales.
>
> George Priest has suggested that the license agreement might have been used to fix price: "A royalty of 2 per cent indicates either that the patent was trivial and the parties were simply price-fixers, or that General Electric was distributing patent rents in return for an agreement to fix price and limit output." The increasing royalty is especially relevant to the issue of punishment. For if General Electric's patent were invalid and the license agreement were entered solely to facilitate collusion, then the escalating royalty would punish price-chiseling. Westinghouse would be deterred from giving secret price cuts in order to increase its output beyond the 15 percent market share that triggered the punishment royalty, which was five times higher.

Id. at 318.

[112] Aggressive sales representatives often cause fights within cartels, as through making excess sales, they can cause a firm to cheat on cartel rules. Absent the patent license, evidence that a firm openly punished an aggressive sales force could be used as evidence of price fixing.

desired output restrictions while hiding the operation of the cartel in plain sight, even from fellow employees. Outside counsel can be used to draft the licenses without raising ethical concerns, as they are less likely to know the industry well enough to recognize the collusive purpose of these agreements. And the board of directors will avoid knowledge of illegal activity that would typically require a board's response.

III
ECONOMICS OF EXPLICIT COLLUSION WITH EXTENSION TO SERIAL COLLUDERS' PATENT ACTIVITY[113]

In the previous section, we suggested that past antitrust enforcement experience yields insights about how patent licensing practices can provide valuable means for effective cartel management—for example, by providing instruments to formulate and adjust collusive agreements, by increasing opportunities for communication in contexts that generally do not attract suspicion, and making the punishment of cheaters and deterrence of entrants more credible. In the following sections, we take care to distinguish how encounters across multiple markets makes collusion easier and more effective as compared to single market collusion. In particular, we lay out how patents play new roles or are more effective in facilitating cartelization in the serial collusion context as compared to the single market setting. First, we review the economics of explicit collusion, starting with the basics and recalling our analysis from our earlier work regarding serial colluders, and then extend that analysis to include the use of patents by serial colluders.

A. Basics of the Economics of Explicit Collusion

Under what circumstances does an industry have a proclivity for explicit collusion?[114] A proclivity for collusion indicates that there are characteristics of the industry that result in a potential substantial payoff from explicit collusion by participant firms. Michael Porter's Five Forces Model (PFF) provides a compelling way to understand this proclivity.

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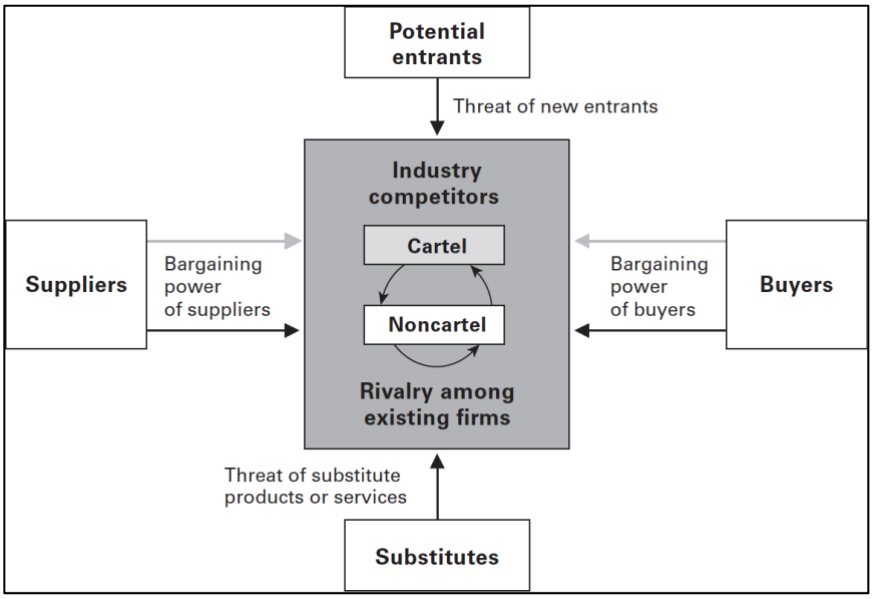
[113] The arguments and analyses in this section are largely drawn from George J. Stigler, *A Theory of Oligopoly*, 72 J. POL. ECON. 44 (1964) and ROBERT C. MARSHALL & LESLIE M. MARX, THE ECONOMICS OF COLLUSION: CARTELS AND BIDDING RINGS (2012) [hereinafter ECONOMICS OF COLLUSION].

[114] A definition of "industry" offered by Michael Porter in 1979 is a "group of competitors producing substitutes that are close enough that the behavior of any firm affects each of the others either directly or indirectly." Michael E. Porter, *The Structure within Industries and Companies' Performance*, 61 REV. ECON. & STATISTICS 214, 215 (1979).

Figure 5: Adapted Graphic of Michael Porter's Five Forces[115]



PFF identifies the forces that impact the profitability of an industry. The center force is interfirm rivalry. Going clockwise from the top, other forces include the threat of new entry, bargaining power of buyers, possibility of substitute products, and bargaining power of suppliers. The following conditions imply that the perimeter forces are conducive to high profits for the industry: little threat of entry, limited bargaining power of buyers, few close substitute goods, and limited bargaining power of suppliers. If these conditions are met, then the primary detriment to the profits of the industry will be interfirm rivalry. This implies that an agreement among producers to suppress interfirm rivalry can be quite profitable, provided that the agreement anticipates the primary challenges of explicit collusion: members cheating on the cartel scheme and external actors making adjustments to cartelization of the market.[116]

First, for explicit collusion to be effective, the agreement must mitigate secret deviations by the cartel members. Each member will want to cheat on the agreement by secretly selling to buyers at prices that somewhat undercut the cartel and at a greater volume than they would otherwise sell. To avoid this difficulty, the cartel firms must adopt structures addressing challenges on three fronts: pricing, allocation, and enforcement.[117] A pricing structure provides for the coordinated elevation of

[115] ECONOMICS OF COLLUSION, *supra* note 113, at 94 fig.5.1. Reprinted with permission of MIT Press.

[116] *Id.* at 5–22.

[117] ECONOMICS OF COLLUSION, *supra* note 113, at 105–138.

prices or restriction in quantities by the members of the cartel. An allocation structure provides for an agreed upon division of the collusive gain. An enforcement structure provides for the accurate monitoring of prices and/or quantities by the members of the cartel as well as the specification of the negative consequence for intentionally cheating on the cartel agreement.

Second—external actor adjustment. Let's return to PFF and consider what effects a successful cartel will have on the market. Even if the perimeter forces in PFF were not a threat to the profitability of the relevant market before explicit collusion, as a cartel elevates profits, perimeter forces may place a greater strain on cartel participants: increased profits will lure new entrants, spur buyers to be more aggressive in bargaining on price, and induce buyers to seek out substitute products. Increased industry profits may also induce suppliers with bargaining power to use that power to extract some of the incremental profits of the cartel through higher factor input prices.[118] In addition, if the cartel is not all-inclusive of firms in the market, then the non-cartel firms will seek to undercut cartel pricing and increase their own market shares, thereby freeriding on the protective pricing umbrella of the cartel and cutting away at its price stability.

B. The Comparative Advantage of Serial Colluders in Cartel Management

All effective cartels confront these internal challenges. First-time colluders lack experience on how to deal with these issues and thus may settle for only modest profit elevation from their cartels. Further, cartel firms that make only a single product or that are only colluding in a single product market will be forced to address these issues within the stovepipe of that single market cartel. However, large multi-product firms that are, and have been, managing a portfolio of cartels are in a fundamentally better position to implement and maintain their cartel. There are several reasons that serial colluders stand at an advantage:

- Serial colluders are experienced at initiating and managing cartels. This experience matters in terms of the effectiveness of any cartel, as well as keeping it clandestine from buyers and avoiding detection by enforcement authorities.[119]

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[118] *Id.* at 151.

[119] Modern antitrust policy relies heavily on leniency and other innovations in detection. Antitrust enforcement authorities seem to perceive that such measures have greatly impaired explicit collusion. In our view, the enforcement community's confidence in the effectiveness of leniency underestimates the adaptability and ingenuity of cartel firms. In particular, we find serial colluders to be enormously creative in addressing a myriad of cartel issues and using enforcement

- Serial colluders have lots of cartel-specific internal human capital embodied in senior managers who have run successful cartels in the earlier parts of their careers. Senior managers who are experienced at initiating and managing cartels are familiar with how to address the issues associated with the consequent relative weakening of the perimeter forces from effective explicit collusion. Senior managers with cartel-specific human capital have existing relationships with their counterparts at other serial colluders.

- Serial colluders have gained an understanding about which firms are likely to be reliable, trustworthy partners in collusive schemes, thus can choose effective cartel partners with limited risk of cartel defection.

- Serial colluders may have acquired experience by virtue of past law enforcement inquiries about how to anticipate and respond to antitrust investigations and lawsuits, thereby lessening the threat of agency enforcement.

By contrast, first time colluders, and/or smaller firms that are managing a single cartel do not enjoy these advantages.

In support of the comparative advantage that serial colluders enjoy when architecting or enforcing a cartel, we present three strands of evidence from the chemical industry. First, serial colluders in the chemical industry are familiar with common facilitating practices, such as organizing cartel activity through a neutral middleman. Each of the serial colluders in the chemical industry has used the services of Fides/AC Treuhand to facilitate the explicit collusion structures in at least one of the cartels that they participated in. Knowledge of the cartel facilitation services provided by Fides/AC Treuhand, and the ability to access those services, is inconsistent with the rogue division manager scenario and consistent with the portfolio of cartels/business model scenario. First-time cartel participants might not be aware of market actors like Fides/AC Treuhand, thus may take on excess costs and risks to stand up a cartel.

Second, serial colluders in the chemical industry are familiar with cartel exit and re-alignment strategies. In the midst of several chemical industry cartel periods, some firms exited by selling their product division to another firm that would continue to participate in the cartel. To exit a cartel when high profits are being earned and antitrust liability already exists is inconsistent with the rogue division

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"innovations" to their advantage, if it is at all possible to do so. *See, e.g.*, Leslie M. Marx et al., *Antitrust Leniency with Multiproduct Colluders*, 7 AM. ECON. J. 205 (2015).

manager scenario and consistent with the management of a portfolio of cartels. In particular, this conduct suggests that firms may be exiting one cartel and having their entry into other cartels accommodated.

Third, serial colluders in the chemical industry are familiar with mechanisms to punish troubling fringe parties in order to preserve cartel profits. Firms have applied for amnesty to signal to smaller cartel participants across their portfolio of cartels that they will not tolerate deviant conduct.[120] Again, this is inconsistent with a rogue division manager scenario and consistent with a serial colluder running a portfolio of cartels.

In sum, the chemical industry example suggests that serial colluders stand at an advantage to their peers when it comes to maintaining and managing a cartel. This advantage is only magnified in the multi-product context. Next, we discuss how patents and patent licensing fit into cartel maintenance.

C. Serial Colluders Using Patents to Manage Their Portfolio of Cartels

How do patents and patent licensing help a serial colluder manage a portfolio of cartels? When viewed solely in the context of a single cartel, a surge in patent activity from the pre-plea to the plea period can create a substantial entry barrier for non-cartel firms regardless of whether the cartel firm is a serial colluder. By comparison, the surge in patent activity by non-producing serial colluders is a phenomenon that may play a unique role in the context of serial collusion. At a high level, patent licensing strategies can assist cartels in making investments that sustain the structures necessary for the success of a collusive scheme. The investments that serial colluders might make to enhance industry-wide profits are likely to occur to a much fuller extent when serial colluders generate patents and patent licenses across a range of products. By contrast, firms might underinvest in such activities if they treat each cartel as a stovepipe. Thus, where serial colluders are managing a portfolio of cartels, we would expect that there will be much more investment in these profit enhancing actions.[121]

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[120] If firms A and B participate in cartels in both markets 1 and 2, and if firm B defected from the cartel agreement in market 2, then firm A could punish firm B, by disclosing the market 1 cartel to enforcement authorities and applying for amnesty. Firm B would likely suffer from sanctions resulting from enforcement in market 1. Firm A might take this step if collusive profit in market 1 is small compared to collusive profit in market 2, especially if firm A thinks firm B and other potential defectors will be deterred from further cheating in market 2. *Serial Collusion*, *supra* note 11, at 334–36.

[121] Our analysis on this point is informed in part by review of judicial decisions that describe how successful, long-lived, single object collusive schemes have used patent licenses to establish

Additionally, serial colluders, being experienced at cartel activity and wanting to facilitate the management of a portfolio of cartels, likely see other advantages from a surge in patent activity in products that they make. These potential advantages are best understood when viewed through the lens of PFF and the three cartel structures:

- *Serial colluders can use patents and patent licenses to keep smaller cartel participants "in line."* A smaller cartel participant will often chisel on the cartel's allocation structure as it tries to incrementally increase its share of the collusive gain. Serial colluders can restrain this conduct by generating a large number of patents, licensing to the smaller cartel firm, and then controlling it through the terms of that license agreement. Note that the smaller firm may be colluding with the serial colluders in a few other products, and the license agreement could cover a range of products where the serial colluders have leverage over the smaller cartel firm.

- *Serial colluders can use patents and patent licenses to coerce non-cartel rivals to join a cartel or to drive them out of the market*. A smaller firm that does not want to join a cartel can be a substantial irritant to serial colluders. Serial colluders can surge patents in a number of products made by the smaller firm, where membership in the cartel is essential for the smaller firm to obtain the relevant patent license agreements. Note that for serial colluders, leverage may come from patents obtained in products made by the smaller firm but not a product in which the serial colluders have a cartel.

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broad, durable control over an industry, and thus motivated cartel participants to invest more heavily in activities that increase the effectiveness of their illegal collaboration. One sees a breadth of vision and ambition that is missing in one-shot collusion scenarios. For example, in 1943, the DOJ brought civil charges against National Lead and DuPont for conspiring to restrain trade and monopolize the market for titanium dioxide. In *United States v. National Lead Co.*, the Supreme Court upheld the trial court's finding that the defendants "have utilized their patents which relate to the manufacture and use of titanium pigments and compounds to control and regulate the manufacture and sale of titanium pigments and compounds in the United States [and] . . . have done so throughout the rest of the world." 332 U.S. 319, 328 (1947). The Court endorsed the trial court's conclusion that the defendants' patents "through the agreements in which they are enmeshed and the manner in which they have been used, have, in fact, been forged into instruments of domination of an entire industry." *Id.* The Court also endorsed the trial court's additional finding that the exchange of patents between National Lead and DuPont "bec[ame] an instrument of restraint, available for use and used, to continue the mastery of the market" which the two firms "achieved by means of the illegal international agreement." *Id.*

- *Serial colluders can use patents and patent licenses to encumber entry and thwart capacity expansion by non-cartel firms*. In contrast to single product colluders, serial colluders can attack a potential entrant on several different product fronts.[122] Serial colluders may also bar expansion for existing firms looking to implement a new technology or process as part of its expansion strategy.

- *Serial colluders can use patents and patent licenses to create a fictitious competitor, leading buyers to believe that the competitive process is policing the market*. A serial colluder may invite a frequent co-conspirator to enter a product market so that production in that market now appears to be a duopoly. To do so, the original monopolist could offer to license its patent technology to the "new entrant." This entry may put the minds of regulators and buyers at ease, because now there appears to be "competition." And, new entrants may stay out of the market instead of trying to compete for smaller portions of market share.

- *Serial colluders can use patents related to substitute goods to limit the proliferation of these goods*. Serial colluders can potentially identify substitute products and generate a large number of patents that relate to these products in order to prevent substitute product manufacturers from being effective competitors. Serial colluders can also use patents to stymie expansion in the substitute product space.

- *Serial colluders can use patents on the processes to make factor inputs for a cartelized product to thwart the bargaining power of suppliers, regardless of any intent to manufacture or sell upstream inputs*. Serial colluders can generate patents on factor inputs and use these patents as leverage to secure better terms from suppliers. In this way, serial colluders can mitigate supplier bargaining power and deter new entry.

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[122] A number of cases involving single-object colluders have identified how cartel members use patent infringement cases to deter entry. For example, in *United States v. Singer Manufacturing Co.*, 374 U.S. 174 (1963), a Swiss firm assigned its American patent to an American licensee (Singer) to facilitate a lawsuit against an alleged infringing Japanese producer. The DOJ contended that the licensing agreement between the Swiss and American firm sought to prevent Japanese imports from entering the United States. *Id.* at 176–78, 189. The Supreme Court agreed and concluded that it was unreasonable for Singer and its Swiss counterpart to cooperate in seeking to forestall a rival's entry into the U.S. market. *Id.* at 195–97.

- *Serial colluders can use patent licenses to implement intrafirm cartel restrictions by, for example, each cartel firm instructing its sales force to emphasize "price before volume" so as to be in compliance with the terms of patent license agreements*. How does a cartel firm comply with the cartel structures while not broadly informing its employees that the firm is a member of a cartel? Patent license agreements with other cartel firms provide a marvelous avenue for alleviating this issue. Consider for example the change in incentives for the sales force of a cartel firm from the pursuit of market share strategy before entering the cartel to a "price before volume" strategy at the inception of the cartel. Through adopting a "price before volume" term in a patent licensing agreement, managers responsible for running a cartel do not have to disclose the cartel to other employees. Instead, they can simply inform the sales force that new patent licensing agreement mandates incremental constraints on what the sales force can do to pitch new accounts. Other constraints can be similarly adopted through patent agreements, such as terms that state specific territories or customers are off limits to a sales force. Simply put, new incremental patent licensing agreements can be used to solve intrafirm communication issues without raising internal compliance red flags.

- *Serial colluders can use their patent portfolios to facilitate discussions regarding cartel issues*. It ordinarily would be highly risky for senior managers at rival firms to meet to discuss cartel issues like output, pricing, or cheating by other cartel participants. However, there is at least a pretense of legality when managers at rival firms meet to discuss their patents and patent licensing agreements, permitting colluders to use these negotiations to facilitate cartel communications. Further, as a given firm looks over its portfolio of cartels, it might be having issues with a specific firm that is a member of several of their cartels, but this firm's involvement is not as ubiquitous as that of their serial colluding co-conspirators. Resolving the cartel issues associated with this smaller cartel participant can potentially be addressed across a number of cartels. For example, a serial colluder may want to suggest that another serial colluder exit a specific cartel by ceasing production of the product, allowing the expansion of the smaller cartel firm, and compensate the exiting serial colluding firm by accommodating their entry or expansion in another cartelized product. The discussion of this kind of reorganization of cartel conduct within the cartel portfolio of each firm can be done with apparent legality through the discussion of patent licenses as well.

- *Non-producing serial colluders can use patent license agreements to reduce the price they pay for the cartel product of other serial colluders*. Serial colluding non-producers are likely aware of the portfolio of cartels that other serial colluders are operating. A non-producer may be a purchaser of the product made by the cartel firms, but the non-producer wants to pay non-cartel prices for the product. It may be difficult for cartel firms to justify within their firm, as well as to third parties, why a specific firm received special pricing on a product when others were paying a considerably higher price. Patent licenses by the non-producer can resolve this issue. Specifically, the non-producer will nominally pay the cartel firms the higher cartel price, but their net price will be a non-cartel price as a consequence of the licensing payments made by the cartel firms to the serial colluder non-producer.

- *Serial colluders can use patents to redirect potential entrants by surging patents in some cartel products but not others*. Although patents can be used as an entry deterrent by almost any cartel firm, serial colluders can surge patents in a number of products that redirect entry ambitions of smaller firms in a direction that better suits the collusive profits of the serial colluders. Suppose a smaller potential entrant has the potential capacity to enter the market for products 1, 2, 3, 4, and 5 and believes ex ante that entry is equally profitable in each of these products. Suppose serial colluders have all of these products in the portfolio of cartels, but the serial colluders realize that entry would have the most serious negative impact on cartel profits for products 1, 2, 3, and 4. Then the serial colluding firms would surge patents in products 1, 2, 3, and 4, while leaving product 5 without a surge of patent activity. Essentially, the serial colluders are inviting the entry effort to be directed at product 5.[123] This kind of activity by serial colluders that are managing a portfolio of cartels can be undertaken with apparent legality as part of discussions regarding patent activity and patent licensing. Note that if the cartel had issues managing product 5 because of a difficult, smaller cartel member who was regularly cheating on the cartel agreement, then leaving product 5 relatively exposed to a threat of entry might be an effective punishment for that firm.

- *Serial colluders can use patent licenses to organize coordination via a neutral third party, like several chemical industry participants did with Fides/AC*

[123] The scenario described is consistent with the behavior of German chemical companies in the 1920s and 1930s, as described in Kronstein's study of cartelization in Germany before World War II. *Dynamics of German Cartels*, *supra* note 23, at 664–71.

Treuhand. Although we have already noted that patent licensing is unlikely to replace the myriad of communications and actions needed to manage a given cartel on a regular basis, patent licensing does have the potential to implement cartel structures. Suppose two serial colluders are the sole makers of a product. The two cartel firms recognize the need to monitor one another but neither firm wants the other in their production facility, talking to their employees, and potentially trying to recruit away top talent. A serial colluder non-producer with patent license agreements with each firm, where the license agreements contain audit provisions, may provide a solution to the monitoring dilemma. The two cartel firms would thus benefit from an outside facilitator to assist with a number of cartel activities, in much the same way that Fides/AC Treuhand provided such assistance to many cartels.

IV
MODERNIZING ANTITRUST DOCTRINE RELATED TO PATENTS AND PRICE FIXING IN RESPONSE TO THE THREAT OF SERIAL COLLUSION

In this Section, we describe how antitrust law, outside of the pay-for-delay context, handles allegations of price fixing when patents are involved. A core objective of antitrust law is to deter and punish price-fixing cartels to allow for market output and prices to be set via competition. As we explained above, the label "price fixing" applies to naked agreements to set minimum prices; restrict output; and divide markets by customer, product, or territory. A per se rule against price fixing was advanced early in the twentieth century and solidified by the middle of the century in its current form.[124] The logic of per se condemnation for horizontal restraints—such as price fixing, output restrictions, and the allocation of geographic sales territories or customers—is that these types of behavior harm competition in the vast majority of cases without offering redeeming procompetitive benefits.[125] The threshold inquiry for courts in analyzing agreements challenged as illegal trade

[124] William E. Kovacic, *The Future Adaptation of the Per Se Rule of Illegality in U.S. Antitrust Law*, 2021 COLUM. BUS. L. REV. (forthcoming 2021) [hereinafter *Future Adaptation*]. The principal landmark case defining this development in the courts is *Socony-Vacuum Oil Co. v. United States*, 310 U.S. 150 (1940), which held that agreements to set prices were subject to summary condemnation without regard to their actual market effects. *Id.* at 223–24 & n.59.

[125] *Future Adaptation*, *supra* note 124. *See also* N. Pac. Ry. Co. v. United States, 356 U.S. 1, 5 (1958) ("This principle of per se condemnation not only makes the type of restraints which are proscribed by the Sherman Act more certain to the benefit of everyone concerned, but it also avoids the necessity for an incredibly complicated and prolonged economic investigation into the entire history of the industry involved, as well as related industries, in an effort to determine at large whether a particular restraint has been unreasonable—an inquiry so often wholly fruitless when undertaken.").

restraints is to characterize the conduct as either suitable for summary condemnation or worthy of a more elaborate reasonableness assessment.[126] However, because patent licensing often serves benign or procompetitive purposes, the characterization process can be more difficult when patent licenses are inserted into the fact pattern.[127]

From 1900 to 1950, a number of cases challenging patent licensing arrangements as horizontal price fixing came before the courts. Some treated the contested arrangements leniently.[128] In 1926, in an extreme decision recounted above,[129] the Supreme Court permitted General Electric to use a patent license to impose price limitations on its rival (Westinghouse) for the sale of light bulbs making use of its patented technology.[130] Some scholars describe the *General Electric* rule as approaching total immunity from per se illegality: "*GE* does not authorize rule of reason treatment for price-fixing arrangements. Rather, it creates what amounts to an immunity for restraints that fall within its domain, and generally leaves naked price fixing falling outside that domain to per se condemnation."[131]

Over time, the Supreme Court developed a more nuanced approach as it gained more experience with questionable patent licenses and apparent price fixing not closely related to innovation. Courts have tended to accord fuller rule of reason treatment to restrictions imposed by individual licensors upon individual licensees, even though the restrictions set the licensee's prices or output levels, or limit the licensee's sales territories or customers to which it can sell.[132] It appears that patent

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[126] *Future Adaptation*, *supra* note 124. *See also* Broad. Music, Inc. v. Columbia Broad. Sys., Inc., 441 U.S. 1, 19–21 (1979).

[127] Behavior with cognizable, plausible efficiency justifications ordinarily receives a more elaborate inquiry, as part of a "quick look" or fuller rule of reason analysis, to test its actual or likely competitive effects. *Future Adaptation*, *supra* note 124. *See also* Calif. Dental Assoc. v. Fed. Trade Comm'n, 526 U.S. 758, 769–71, 779–81 (1999). Despite the complexities of some patent licensing scenarios, the courts have indicated that the presence of patent licenses does not preclude per se condemnation for efforts by rivals to set prices or output levels, or to allocate sales territories or customers. Ginsburg et al., *supra* note 90, at 105–06; DOJ/FTC IP GUIDELINES, *supra* note 69, at 17.

[128] *See supra* Section II.A (describing Supreme Court decisions that gave permissive treatment to licensing arrangements with arguably horizontal price-fixing effects).

[129] United States v. Gen. Elec. Co., 272 U.S. 476 (1926).

[130] Some commentators have concluded that the Court treated GE's behavior as "essentially unilateral." HERBERT HOVENKAMP ET AL., IP AND ANTITRUST: AN ANALYSIS OF THE APPLICATION OF ANTITRUST PRINCIPLES TO INTELLECTUAL PROPERTY LAW 31–39 (3d ed. 2019) [hereinafter IP AND ANTITRUST].

[131] *Id.*

[132] *See supra* Section III.A (describing the narrowed interpretation of *General Electric* in subsequent Supreme Court decisions).

owners have the most leniency to create licensing agreements that may restrain competition when they appear to be acting individually to advance their own self-interest to recover their investment costs, and not as part of a larger plan with multiple rivals to cartelize a sector. Hovenkamp and his colleagues observe that, "the courts have generally been tolerant of horizontal output limitations in intellectual property licenses, at least when the restriction was imposed by the licensor on each licensee individually and there was no proof of an output limitation agreement among the licensees themselves."[133] Firms lose the protection of *General Electric*, and per se condemnation is more likely, where multiple rival firms have imposed the licensing restriction or participated in pooling arrangements,[134] or the patent license is determined to be a pretense for collusion—e.g., if the patent covers minor or irrelevant technology, the patent is invalid, or there is a cheap and easy substitute technology not covered by the patent.[135] This imprecise set of rules governing the patent license and antitrust intersection creates two major analytical challenges for courts in cartel enforcement cases: (1) when should a license be characterized as mainly horizontal, and (2) how does an antitrust court know if licensed patents are weak and the license is a pretense?

A. Priest's Approach to Evaluating Competitive Effects in Patent Licensing: A Patentee / Licensee Rents Analysis

George Priest's still-influential commentary on patent licensing, published 40 years ago, recounted the intricate pattern of how industries sometimes shift away from healthy competition in prices and innovation toward collusion.[136] It may be hard to detect this transition because patent licenses provide good cover for collusive agreement. Priest responded to this challenge by developing a test rooted in economic theory to determine whether a patent license is pro or anticompetitive, through analyzing relative rents in patent licensing agreements. Priest also criticized some of the alternative tests that had been used by courts, which focused on intent information and patent strength. While Priest's approach is attractive for offering a unified treatment of liability and may be useful in the single market context, his

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[133] IP AND ANTITRUST, *supra* note 130, at 32–33.

[134] In cases such as *Hartford Empire*, the courts have found output restrictions illegal in the context of patent pools, or cross-licenses, and in cases in which it appeared that the licensees sought the restrictions. *See* Section II.A.

[135] *Id.* "*GE* is limited to cases where the patentee licenses [to] a manufacturer to manufacture the patented product and the patent covers all or a 'significant' proportion of the resulting product." IP AND ANTITRUST, *supra* note 130, at 31–35.

[136] Priest, *supra* note 3.

analysis did not account for the properties of serial collusion. As demonstrated below, the approach is unlikely to be useful in the serial collusion context.

Priest approached the two questions posed above regarding antitrust enforcement in the patent license context by focusing on the flow of patent-based rents and designing what we call a "rents test."[137] Priest reasoned that if a patent is strong and the patent owner acts in his own self-interest, then he likely captures most of the value from his patent licenses. On the other hand, if the patent is weak and the patent owner acts in part at the behest of the licensees to help them organize a cartel, then the flow of licensing rents to the licensor would be relatively modest.[138] When subject to antitrust review, Priest argued that the former type of agreements should be permitted but the latter should be struck down. Priest discounted the use of intent information in more traditional analysis undertaken by courts for being unreliable, and information about the importance of the patented technology, i.e., patent "strength," as too costly and difficult for courts to evaluate.

Yet, while Priest's approach is useful for evaluating collusion in a single market context, his proposed framework fails to consider the competitive dynamics and collusive schemes of serial colluders. We argue that when the focus shifts to

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[137] Priest also looked at price changes in response to the introduction of the patent license. Eswaran explains that Priest "proposes that if the cross-licensing of competing patents ends up raising the prices of the products, the arrangement should be rendered illegal." Mukesh Eswaran, *Cross-Licensing of Competing Patents as a Facilitating Device,* 27 CAN. J. ECON. 689, 704 (1994). Eswaran adds "[This test] is unlikely to be effective in practice. Firms contemplating cross-licensing could easily contrive a drastic but temporary increase in prices prior to the agreement and lower [them] slightly after the agreement becomes formal . . . ." *Id.*

[138] Professors Joseph F. Brodley and Maureen A. O'Rourke offer this interpretation of Priest's approach:

> Priest would confirm the cartel diagnosis by examining changes in price, output, and market share, particularly in response to variations in manufacturing costs. Stability of market shares, output, and price tend to indicate a cartel. A cartel manager would try to hold prices and market shares stable, and maintain a price umbrella over less efficient firms to avoid the disruptions and shocks that can undermine the cartel. On the other hand, a patent monopolist will seek to induce competition at the licensee level, which leads to changing market shares, fluctuations in price as manufacturing costs increase or decrease, and exit of less efficient firms.

Joseph F. Brodley & Maureen A. O'Rourke, *Patent Settlement Agreements*, 16 ANTITRUST 53, 56 (2002) [hereinafter *Patent Settlement Agreements*].

serial collusion, Priest's rents test fails, and other possible frameworks that consider patentee and licensee intent and patent strength deserve more consideration.

We illustrate the general approach suggested by Priest with the following hypothetical. Suppose firms A and B compete vigorously in market 1, enjoying equal market share and equal efficiency, but neither is reaping any economic profit. Suppose now firm A achieves a drastic invention and gets a patent that would allow it to drive firm B out of market 1.[139] Firm A, acting as a monopolist, can sell to half of the original market for a profit of 5 or sell to the entire market for a profit of 8.[140] Alternatively, firm A could cooperate with firm B and boost the total profit to 10.[141] Suppose the firms agree to both use the new invention and continue selling to their current customers, and firm B agrees to pay a lump sum patent royalty of 4 to firm A. Then, firm A gets a profit of 5 from selling to its half of the market plus 4 from the royalty, and firm B gets a profit of 5 from selling to its half of the market minus 4 from the royalty. The relatively large royalty payment from B to A reflects the market power created by A's patent.

Now consider a similar hypothetical in which firm A's invention is trivial and the patent license is simply a tool to divide the market. By assumption, firm A derives no market power from the patent because it has no ability to exclude firm B. That said, through use of a patent licensing agreement, the firms could divide the market with each firm limiting their sales to their current customers. Let's assume the total monopoly profit with the old technology is 6 and thus each firm gets a profit of 3 from the collusive agreement.[142] Now, however, the license payment would be trivial, and each firm would earn half of the monopoly profit in market 1.

Comparing the two hypotheticals, Priest would note that a license associated with a legitimate patent leads to a significantly higher royalty payment of 4, and dissimilar profits of 9 and 1 for firms A and B, respectively. By contrast, when the license is used purely for collusion, the royalty payment from B to A is trivial, and the profits of the two firms are the same at 3. Priest describes this sort of investigation into the rent split across patent licensing participants as a valuable test for

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[139] Economists use the term "drastic" for process innovations that reduce marginal cost so much that a firm using a drastic innovation can cut its price low enough to drive out competitors, and in some cases still enjoy the benefits of a monopoly price. *See* JEAN TIROLE, THE THEORY OF INDUSTRIAL ORGANIZATION 390–92 (1988).

[140] Here, we are assuming that firm A's cost of production jumps up if its output rises above 5.

[141] We assume total cost is lower and profit is greater if A and B share production and A's facilities are not strained by an increase in output above 5.

[142] We assume that the joint monopoly profit of 6 is less than the joint monopoly profit of 10 that flowed from the drastic process innovation.

distinguishing "good" from "bad" patent licenses in terms of their likely competitive effects and social utility.

While Priest's approach makes sense if we consider one market in isolation, it fails when firms compete in more than one market and use patent licenses to control both markets. We start with a hypothetical similar to our first, in which firm A achieves a drastic invention in market 1, but now firm B also achieves a drastic invention in market 2. Firm A and firm B compete in both markets. Once again, we assume that the inventors can use their patents to achieve a monopoly in their respective markets, but in the multi-market context, it would be more efficient for the two firms to license to their competitor and share the markets equally.[143] As before, firm B could make a license payment of 4 to firm A for the invention it needs in market 1. Similarly, firm A could make a license payment of 4 to firm B to use the invention it needs to compete in market 2. Of course, since the two license payments are a wash, the firms could instead simply grant royalty-free cross licenses to each other. So, this result already looks quite dissimilar to the single market context, as the rent split across patent participants appears de minimis but actually reflects a mutual exchange for value. By contrast, if we suppose instead that the two inventions are both trivial and the firms are simply using the patents to implement a collusive cross-license, they could also set the royalties at zero, divide the markets, and equally share in the monopoly profit in markets 1 and 2. This result on the surface looks the same as the mutual exchange for value, but the competitive effects and social benefits of the two exchanges are starkly different.

In sum, while Priest's rents test may be a valuable tool for evaluating patent licensing in the single market context, it is less helpful in the serial colluder context. When two markets or products are involved, we can no longer look to the amount of patent royalties or the resulting profitability of the two firms from a licensing agreement to determine whether the license is likely to be procompetitive or collusive. Instead, mutual exchanges for value and collusive dealing may look very similar; small exchanges in royalties may reflect a mutual exchange or a pretextual, sham deal to divide a market or customers.[144]

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[143] As before, we assume that sharing the market equally leads to more efficient production because firms avoid straining their production capacity.

[144] Moreover, the Priest approach may induce enforcement agencies and courts to mistakenly characterize a horizontal licensing agreement as vertical. Suppose firm B offers a patent license that facilitates collusion in market 1 by firms A and C, while A and B rely on a patent license from C to help them collude in market 2, and B and C rely on a patent license from A to help them collude in market 3. When there is a risk of serial collusion, it may be dangerous to accept at face

B. Reevaluating the Traditional Approach to Analyzing Competitive Effects in Patent Licensing: An Intent-Based Analysis or Analysis of Patent Strength

The traditional approach used by courts to rein in the anticompetitive effect of licensing deals often relies on evidence of downstream licensees' intent to control license terms, or evidence that the patent covers a minor technology or is likely invalid or uninfringed.[145] Courts may also try to analyze the strength of a patent from objective information about the patented technology, such as through testimony from expert witnesses and other sources. As previously noted, Priest distrusts intent evidence because he considers it unreliable,[146] and he disapproves of an inquiry into the merits of a patent in the context of an antitrust trial—he argues this inquiry is too difficult.[147] Subsequent commentators, especially in the *Actavis* context, also worry about error costs from undertaking this analysis. They fear that aggressive enforcement against cartels implemented via patent licenses will chill research and development, and that those costs are greater than the social costs of under-deterred collusion.[148]

It is certainly true that intent evidence is noisy and that courts and parties will face increased costs in terms of time and resources from placing greater reliance on whether defendants had knowledge of patent weakness or undertaking an on the merits inquiry into the strength of patents. Yet, we perceive that courts and commentators have exaggerated the potential harm of chilling research and development from these inquiries and ignored their value in identifying price

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value the claim that a patent license is vertical just because the licensor does not produce the product made by the licensees.

[145] *See* IP AND ANTITRUST, *supra* note 130, at §§ 31.21, 31.26, 33.15, and 33.38; MacGregor v. Westinghouse Elec. & Mfg. Co. 329 U.S. 402, 407 (1947) ("If it be determined on remand that the patent is invalid, there is no question but that, as MacGregor contends, the price-fixing agreement violates the anti-trust laws."). In the patent settlement context, Hovenkamp observes that antitrust courts avoid the difficult question of whether a patent is valid and infringed by instead asking whether it is "'obviously' invalid or very weak." Herbert Hovenkamp, *The Rule of Reason and the Scope of the Patent*, 52 SAN DIEGO L. REV. 515, 541 (2015).

[146] Priest, *supra* note 3, at 312–13.

[147] *Id.* at 309, 333.

[148] *See, e.g.*, Melissa J. Hatch & Robin Sumner, *United States: A Turducken Task: How* Actavis *Invites Relitigation of Patent Merits*, (Dec. 12, 2013), https://www.mondaq.com/unitedstates/patent/280776/a-turducken-task-how-actavis-invites-relitigation-of-patent-merits; Adam Mossoff, et al., *How Antitrust Overreach is Threatening Healthcare Innovation*, FEDERALIST SOCIETY: REGULATORY TRANSPARENCY PROJECT (Jan. 28, 2019), https://regproject.org/wp-content/uploads/RTP-Intellectual-Property-Working-Group-Paper-Drug-Patents.pdf.

fixing.[149] Furthermore, "[c]ourts regularly litigate patent issues within antitrust cases that involve allegations of sham litigation or allegations that a patent was procured by fraud. Courts also regularly conduct 'mini-trials' in legal malpractice cases involving patent issues such as when a patent is invalidated due to a lawyer's alleged incompetence."[150] Thus, courts appear to have the institutional competence to manage a trial within a trial if need be.

C. Charting a Way Forward to Evaluating Patents in Antitrust Suits: Rigorous Analysis in the Serial Collusion Context

We admire the elegance of the Priest test in the context of isolated cartels, but we also believe that Priest overstates the costs of asking antitrust courts to probe the quality of patents, patent licenses, and patent assertions that might be used to foster collusion. Such inquiries are essential for detection of collusion in settings where serial collusion is possible and the Priest test is apt to be ineffective. Moreover, rigorous antitrust review of patents does not threaten innovation to the extent that detractors warn.

Commentators who favor deferential antitrust review of patent licensing often exaggerate the importance of patents as a source of innovative incentive,[151] and underplay patents' potential for competitive harm. Surveys of most research and

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[149] For a discussion of the costs and benefits of analysis of intent in price fixing cases, *see* Ronald A. Cass & Keith N. Hylton, *Antitrust Intent*, 74 S. CAL. L. REV. 657, 666–70 (2001). Michael Carrier acknowledges that intent inquiries create both false positives and false negatives but is critical of "blind deference to the patent system." Michael A. Carrier, *Unraveling the Patent-Antitrust Paradox*, 150 U. PA. L. REV. 761, 764 (2002).

[150] Joshua B. Fischman, *The Circular Logic of Actavis*, 66 AM. U. L. REV. 9, 140–41 (2016). For non-patent trials addressing patent strength, see, for example, *Gunn v. Minton*, 133 S. Ct. 1059, 1065 (2013) (legal malpractice); *Walker Process Equipment, Inc. v. Food Machinery & Chemical Corp*., 382 U.S. 172 (1965) (Section 2 claims involving fraud in procuring a patent); and *Professional Real Estate Investors, Inc. v. Columbia Pictures, Inc.*, 508 U.S. 49 (1993) (sham copyright suit and Sherman Act Sections 1 and 2 claims).

[151] Empirical evidence suggests that patent incentives have little impact on innovation with the exception of pharmaceuticals, biotechnology, medical instruments, "and possibly specialty chemicals." Bronwyn H. Hall & Dietmar Harhoff, *Recent Research on the Economics of Patents*, 4 ANN. REV. ECON. 541, 548 (2012). *See also* Michael A. Klein, *Secrecy, The Patent Puzzle and Endogenous Growth*, 126 EUROPEAN ECON. REV. 1, 1 (2020) [hereinafter *Patent Puzzle*]. Klein summarizes findings of various empirical studies that find weak or no connection between the strengthening of patent regimes and increases in innovation, noting that empirical studies "find strong evidence that strengthening the patent regime increases . . . patenting!" *Id.* Klein adds: "First, firms routinely decide not to patent their innovations. Surveys of European and U.S. firms find that the average propensity to patent is between 30–55%. Second, firms widely consider secrecy to be a more effective appropriation mechanism than patents." *Id.* at 2.

development managers rate patents as the fourth or fifth most important method of appropriating value from inventions, the exception being the pharmaceutical context where patents rank first. Further, most patents cover minor and relatively obvious inventions. About 60% of the patents granted on chemicals are not renewed to their full term, suggesting the advances achieved in these patents may not be significant.[152] This is no surprise; many patents are obtained for reasons other than blocking imitation, like gaining bargaining power in lawsuits, license negotiations, or impressing investors.[153] In addition, there are other means to protect intellectual property outside the patent system. Trade secrecy is the favored method of obtaining value from process inventions in the chemical industry and other sectors.[154] And of course, the risks to innovative incentives must be balanced against the social costs of serial collusion, which has not been adequately deterred thus far.

Further, a more rigorous evaluation is especially important in the serial collusion context. There is good reason to believe that the patent portfolios built by serial colluders like those in the chemical industry contain many weak patents, patents that are likely invalid, and/or patents covering technology that is unlikely to be commercialized. Presumably, when firms compete in industries like the chemical industry, they have an incentive to challenge weak patents for invalidity in

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[152] Carlos J. Serrano, *The Dynamics of the Transfer and Renewal of Patents*, 41 RAND J. ECON. 686, 693 (2010).

[153] Wesley M. Cohen et al., *Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not)* 25 (Nat'l Bureau of Econ. Rsch., Working Paper No. 7552, 2000) [hereinafter *Intellectual Assets*] ("One broader use of patents observed particularly in chemical (apart from drugs) and other discrete product industries is their combination to build patent fences around some patented core invention. Such fence building involves the patenting, though not licensing (nor necessarily even commercializing), of variants and other inventions that might substitute for the core innovation in order to preempt rivals from introducing competing innovations."). *See also Patent Puzzle*, *supra* note 151, at 2 ("When firms do patent, it is often for reasons other than protecting their innovation from imitation as typically assumed. . . . In particular, patents are increasingly used strategically for their 'blocking' effect on rival innovations.").

[154] Cohen and co-authors observe: "With regard to the protection of new processes, … [s]ecrecy is commonly the dominant mechanism, as in the chemicals industries, semiconductors and others." *Intellectual Assets, supra* note 153, at 6. They summarize research describing "how chemical firms will sometimes protect an innovation by applying for one or more patents on different elements of an innovation, while keeping other elements secret." *Id.* at 7. They find:

> "for product innovations, several industries apply for patents for more than two-thirds of their innovations, including chemicals (nec), drugs, mineral products, and medical equipment. In contrast, there are also many industries that applied for patents on fewer than 15% of their product innovations, including food, textiles, glass, steel and other metals."
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> *Id.* at 16 n.36.

opposition proceedings in Europe and Japan, inter partes review at the U.S. Patent and Trademark Office (USPTO), and declaratory judgment proceedings in U.S. federal courts. Yet, these kinds of challenges tend to disappear when competitors cooperate in serial cartels.[155] The colluding firms are likely to move in the opposite direction by settling patent litigation or validity challenges.[156] These agreements may then include no-challenge clauses in patent licenses that discourage parties from monitoring patent quality and challenging weak patents.[157] As a result, weak patents and collusive schemes proliferate, blocking entry for new competitors and expansion by existing rivals.

V
POLICY RECOMMENDATIONS

There is strong deference in the law to the protection of intellectual property and monopoly rents associated with innovation. Sophisticated cartels can capitalize on this deference. Our finding that patents increased from the pre-plea to the plea period and then again from the plea to the post-plea period for chemical firms that have been found to have regularly participated in cartels implies that firms are using patents to enhance the profits of their conspiracies. These patent surges may be facilitating cartel structures or may be harming both non-cartel firms and potential entrants. The surge in patents from the pre-plea to the plea period by non-producers that are among the most active cartel firms also suggests a sophisticated use of patents to enhance the portfolio of cartels that these firms may be running.

In an earlier article, we presented four principal policy recommendations to address the phenomenon of serial collusion.[158] First, antitrust enforcement agencies

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[155] Jay Pil Choi, *Patent Pools and Cross-Licensing in the Shadow of Patent Litigation*, 51 INT'L ECON. REV. 441, 458–59 (2010) ("[patent pools] can have the effect of sheltering invalid patents from challenges" and contribute to an environment in which there is a "serious lack of private incentives to weed out patents of suspect value through litigation.").

[156] The existence of a cartel that is made possible (or facilitated) by a patent license discourages licensees from inventing around or challenging the patent. *See* United States v. Masonite, 316 U.S. 265, 281 (1942). As noted above, many patent-licensing/price fixing cases in the first half of the twentieth century involved settlement of patent litigation. *Supra* Section I.A.

[157] *Licensing of IP Rights*, *supra* note 93, at 23 ("A no-challenge clause imposes direct or indirect obligations not to challenge the validity of the licensor's intellectual property right. Such clauses may conflict with the overriding interest of ensuring that IP rights are lawful. Invalid intellectual property rights should be eliminated because [they] stifle[] innovation rather than promoting it. Since licensees are often the parties with the greatest technical ability and economic incentive to challenge improperly granted IP rights, it is appropriate to impose limitations on no-challenge clauses.").

[158] *Serial Collusion*, *supra* note 11.

should work with cartel participants to carry out *cartel reconstructions* to help enforcement agencies learn how each cartel worked, who was responsible, and what other markets might be affected. Second, antitrust agencies should engage in *more extensive monitoring* of serial cartel offenders, with the monitoring obligation imposed in sentencing, settlement, or plea agreements. Third, existing leniency programs should be supplemented with *bounty programs* that give company insiders monetary rewards for informing on cartels. One major aim of such rewards would be to peel small firms away from cartels. Fourth, we would mandate *adjustments in merger review* for transactions involving a serial colluder. The revised merger control regime would mandate review of mergers from a coordinated effects perspective whenever a serial colluder notifies an enforcement agency regarding a merger for review.

In the balance of this paper, we supplement our previous recommendations with proposals that emerge from our study of patent practices and serial collusion. Presented below are a number of policy recommendations that, if implemented, would improve the ability of the competition policy system to detect and deter harmful collusive schemes that draw upon patent practices for their effectiveness.

Expanding Registration and Notification Obligations

Actavis and other pay-for-delay cases have renewed our awareness of how patent settlements can serve anticompetitive ends. In July 2002, the Federal Trade Commission (FTC) issued a study that documented branded drug producers' use of patent infringement settlements to delay market entry by producers of generic equivalents.[159] The following year, Congress passed the Medicare Prescription Drug, Improvement, and Modernization Act, which included a requirement that the parties to such settlements provide the FTC with a copy of their agreement.[160] Implementation of this provision has enabled the Commission to monitor and study pay-for-delay agreements. The notification mechanism has enhanced the FTC's ability to track industry trends and to identify possible targets for law enforcement intervention.[161]

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[159] FED. TRADE COMM'N, GENERIC DRUG ENTRY PRIOR TO PATENT EXPIRATION: AN FTC STUDY (2002), https://www.ftc.gov/sites/default/files/documents/reports/generic-drug-entry-prior-patent-expiration-ftc-study/genericdrugstudy_0.pdf.

[160] Medicare Prescription Drug, Improvement, and Modernization Act of 2003, Pub. L. No. 108-173, §§ 1111-1118, 117 Stat. 2066 (Dec. 8, 2003) (creating patent settlement notification mechanism).

[161] Press Release, FED. TRADE COMM'N, FTC Staff Issues FY 2017 Report on Branded Drug Firms' Patent Settlements with Generic Competitors (Dec. 3, 2020), https://www.ftc.gov/news-events/press-releases/2020/12/ftc-staff-issues-fy-2017-report-branded-drug-firms-patent.

For patent settlements, the pay-for-delay notification obligation is the exception, not the norm. As Joseph Brodley and Maureen O'Rourke explain, antitrust agencies do not enjoy ready access to most patent settlement agreements:

> Antitrust scrutiny of patent settlements is further constrained because patent settlements are not disclosed to enforcement agencies. To be sure, the Patent Act requires filing of interference settlements and collateral agreements with the Patent and Trademark Office (PTO). But it appears doubtful that the PTO can police disclosure of collateral agreements and, under the Third Circuit's decision in *United States v. FMC Corp.*, the Department of Justice lacks standing to enforce compliance. . . . [D]efendants in settlement cases benefit from two legal presumptions that, while legitimate in themselves, impede antitrust challenge: a patent is presumed valid, and courts have frequently declared that patent settlements are to be encouraged.[162]

To close this gap, we would envision as an initial step that Congress would enact legislation that gives the FTC authority to establish a reporting system that mandates the disclosure to the FTC of patent settlements in infringement cases. The reporting mechanism could be modeled upon the system, described immediately above, for reverse payment settlements in the pharmaceutical sector. The legislation would give the FTC authority to define categories of transactions subject to the reporting requirement. Relevant criteria for establishing the reporting obligation might include the size of parties to the licensing arrangement, whether licensing practices in a sector had previously been the subject of antitrust proceedings, and other factors deemed relevant based on the experience of antitrust agencies examining the patent system and commercial licensing practices.[163]

A more ambitious program of disclosure would require the notification to the federal antitrust agencies of a larger body of patent licensing agreements. We would support the adoption of a new statute that delegated to the FTC the authority to

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[162] *Patent Settlement Agreements*, *supra* note 138, at 53.

[163] As suggested in this paper, federal antitrust agencies have accumulated considerable knowledge about patent-antitrust issues in the course of conducting investigations, prosecuting cases, and performing studies. Many of these activities are described in William E. Kovacic, *Intellectual Property Policy and Competition Policy*, 66 N.Y.U. ANN. SURV. AM. L. 421 (2011); William E. Kovacic, *The Importance of History in the Design of Competition Policy Strategy: The Federal Trade Commission and Intellectual Property*, 30 SEATTLE U. L. REV. 319 (2007); and William E. Kovacic & Andreas P. Reindl, *An Interdisciplinary Approach to Improving Competition Policy and Intellectual Property Policy*, 28 FORDHAM INT'L L.J. 1002 (2004).

promulgate rules that define the reporting obligation.[164] A model for this process would be the machinery used to delimit the merger reporting obligation imposed by the Hart-Scott-Rodino Antitrust Improvements Act of 1976.[165] Under this statute, Congress established a mandatory pre-merger reporting program and delegated its implementation through rulemaking and other administrative actions to the FTC. By this mechanism, we envision the creation of a dataset that enables the federal antitrust agencies to observe larger patterns of patenting activity. This data would also expand agency knowledge of patent licensing behavior to inform the development of cartel cases, as well as guide the investigation of mergers and single-firm conduct.[166]

Expanding "Super Plus Factors" to Cover Strategic Patent Surging

In earlier work, we introduced the concept of a "super plus factor."[167] Plus factors are economic actions and outcomes, above and beyond parallel conduct by oligopolistic firms, that are largely inconsistent with unilateral conduct but largely consistent with explicitly coordinated action.[168] When the conduct or outcome leads to the strong inference of explicit collusion, then the plus factor is referred to as a super plus factor.[169] We suggest that if there is a surge of patents by firms in an industry that have a history of colluding with one another, and there is no such surge by firms in the industry that have no history of explicit collusion, and each serial colluding firm is effectively refusing to license any producer outside of the group of historical cartel participants, then this conduct should be treated as a super plus factor. In addition, if a serial colluder that is a non-producer has a concurrent surge in patent activity and licenses only to other serial colluders, then this activity should be treated as a super plus factor pertaining to the involvement of the non-producer in the cartel.

This application of super plus factors to the serial collusion context can be expanded to further conduct as well. Suppose firm B and C operate a series of cartels

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[164] Among other tasks, the rulemaking deliberations would identify the scope of information that various reporting thresholds might elicit and the burden associated with compliance.

[165] Hart-Scott-Rodino Antitrust Improvements Act of 1976, Pub. L. No. 94-435, Sec. 201, §7A, 90 Stat. 1383, 1390-91 (codified at 15 U.S.C. §18a (2012)).

[166] As with a reporting mechanism for the settlement of infringement disputes, the design of the reporting system for patent licenses would draw upon the substantial experience of the federal antitrust agencies in dealing with patent-antitrust issues. *See supra* note 157.

[167] William E. Kovacic et al., *Plus Factors and Agreement in Antitrust Law*, 110 MICH. L. REV. 393 (2012) [hereinafter *Super Plus Factors*].

[168] *Id.*

[169] *Id.* at 396–97.

together and B has unintentionally sold beyond its agreed upon market share for product 3, while C has undersold. A transfer needs to occur from B to C to correct the imbalance in sales for product 3. This re-balancing can be directly handled in cash in the license agreement in product 2, where B is licensed by C.[170] Looking at cartels in a stovepipe without considering the portfolio of cartels run by each firm, this transfer would be completely invisible to enforcement authorities—it is part of a private license agreement and does not involve the product in question (product 3). Broadening of the interfirm transfer super plus factor we identified previously to multiple products for serial colluders would be useful in this scenario as well.[171] This is another way in which closer examination of patent licensing by serial colluders that interact in multiple product markets can inform the identification of conduct that suggests the existence of a collusive agreement.

Expanding Patent Misuse to Apply to Related Patents

The patent misuse doctrine states that a patent used to facilitate an antitrust violation cannot be enforced.[172] The doctrine creates a desirable pathway for new firms to enter markets that had been cartelized with threats of patent assertion. Courts should use their discretion and recognize that the defense is good even for patents owned by serial colluders who did not produce in the market in question so long as other members of the network of serial colluders were found liable for collusion in that market.[173] This may be significant because, as we observed in Section I, non-producers often obtain many patents on products in cartelized markets, and they may use those patents in various ways to facilitate collusion. Thus, any patent covering the cartel product, or some other product that was used to facilitate the collusion, should be subject to a misuse defense by any new entrant or non-colluding firm that wants to use the "innovation." Some may argue that this would thwart genuine innovation in the product, but we argue that the cartel firms forfeit the monopoly protection of patent laws when they use patents to further anticompetitive conduct.

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[170] C sues for breach of the product 2 license, or threatens to do so, and B settles for the amount needed to "true up" the product 3 cartel.

[171] *Super Plus Factors*, *supra* note 167, at 423 n.117 ("It is a relatively simple matter for firms in an oligopoly to engage in contractual relationships with regard to a broad range of activities, many of which are completely meaningless from a productivity standpoint, and to use allegations of contract breach, and ensuing settlements, to legitimize cartel side payments.").

[172] This principle is embodied in the existing law of patent misuse. *Revisiting Patent Misuse*, *supra* note 22.

[173] Such an approach also would appear to involve the exercise of the U.S. Patent and Trademark Office of its existing power to rescind patents related to a patent for which the patentee made misstatements in its application. *Id.*

Greater Agency Investigation of the Role of Patents in Serial Cartels.

Today, EC decisions rarely mention patents when describing firm conduct at issue in prohibition decisions. For the 32 chemical cartels enumerated in Appendix A, patents are hardly mentioned in the corresponding EC decisions.[174] This is a remarkable omission given the historically significant role of patents in price-fixing agreements. Perhaps given scarce enforcement resources, the EC chose not to investigate cartel use of patents and focused instead on the low-hanging fruit of amnesty applicants' disclosures about price targets and customer and market share agreements. Going forward, European, U.S., and other global cartel investigators need to learn whether and what role patents play in instances of serial collusion. We note that in recent merger inquiries, the EC's Directorate for Competition has taken a greater interest in patenting and patent portfolios as focal points in merger analysis.[175] This indicates a greater willingness by enforcement agencies to undertake the laborious process of mapping out patent portfolios and, perhaps, licensing arrangements, as foundations for building cases beyond challenges to mergers. This is a helpful step forward.

Liability for Cartel Facilitators

A serial colluder that is facilitating collusion in a product that they do not make should be found liable in civil and criminal actions for collusion, just like producers.[176] In addition, they should be subject to civil liability from private litigants in class actions and individual suits. Liability and the determination of damages in such cases should be rooted in, at a minimum, a but-for theory of harm: but-for the facilitating conduct of the defendant, what would the producers have been able to accomplish through their collusion? Thus, the cartel facilitators' marginal harm should be traceable to them in future lawsuits. Cartel facilitators, like Fides/AC Treuhand, have already been penalized for participation in European cartels even though Fides/AC Treuhand is not a producer of any chemical product.[177]

Creation of an Anti-Cartel Research Program Focused on Serial Collusion and the Role of Patents in Cartel Maintenance

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[174] Just four of the cases listed in Appendix A—Food Flavor Enhancers, Hydrogren Periodide (2006), Organic Peroxide, and Polypropelene—mention patents.

[175] Bayer/Monsanto, Case M.8084, Merger Procedure Regulation 139/2004 (Mar. 21, 2018).

[176] This comports with existing U.S. doctrine which have used a "hub-and-spoke" model to impose civil and criminal liability on hold vertically-related firms that facilitate the operation of a price-fixing cartel. *See supra* note 92 (collecting cases).

[177] *Unobserved Collusion*, *supra* note 11, at 330. *See also* Heat Stabilisers in Appendix A at 188-190.

In this Article, we have focused mainly on the use of patents to facilitate serial collusion in the chemical industry, but our findings are relevant to the study and prosecution of collusion in a number of other important economic sectors. The electronics and auto parts industries, for example, have also been racked by serial collusion in recent years, and these are both patent-intensive industries.[178] Electronics is much like chemicals in that the pattern of anticompetitive behavior goes back a century. It would be worthwhile to study cartels in these industries and try to identify what role patents played. We would also propose using the research and information-gathering authority of the FTC, under Section 6(b) of the FTC Act, to study patent licensing. Such a study would seek to test some of the conjectures set out in this Article and determine, as noted above, whether a mandate that firms register patent licenses with antitrust agencies might be appropriate.[179]

CONCLUSION

Over a century ago, federal antitrust enforcement began to give careful attention to the possibility that patent licensing practices could enable rival producers to organize and manage price-fixing cartels. In modern enforcement practice and scholarly debate about antitrust policy, patent licensing practices have received comparatively little attention as instruments of cartel management. Compared to other possible focal points for anti-cartel enforcement, patent licensing arrangements can create difficult analytical complexities. A lesson from the earlier generations of antitrust-patent cases is that the use of patents by alleged price-fixers is often abstruse. Enforcers and courts may need to work harder to understand the

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[178] "The German chemical company BASF participated in 21[price-fixing agreements] with 17 of those ending in the current millennium. The French cement company Lafarge SA participated in 21 with 16 of those ending in the current millennium. The German pharmaceutical company Bayer AG participated in 20 with 5 of those ending in the current millennium. The Japanese conglomerate Hitachi Ltd. participated in 20 with 18 of those ending in the current millennium." *Serial Collusion*, *supra* note 11, at 22 n.22. Marvao describes the problem of serial collusion "in the manufacture of transport and electrical equipment." *Id.*

[179] The Final TNEC Report contained the following recommendation regarding the notification to the government of patent licenses:

> *Recording of transfers and agreements*.–We recommend that any sale, license, assignment, or other disposition of any patent be evidenced by an instrument in writing and that the same be required of any condition, agreement, or undertaking relating to any sale or disposition of any such patent; and that in any such case a copy of such written instrument be filed with the Federal Trade Commission within 30 days after execution.

TNEC FINAL REPORT, *supra* note 72, at 37.

technology, patent practices, and industry context specific to a case.[180] As it is, enforcement is often a demanding endeavor in terms of resources, time, and expertise needed to prosecute a case.[181] It is a daunting challenge for an enforcement agency to assemble a narrative that gives a court confidence that anticompetitive effects predominate in the face of benign or procompetitive effects often associated with patent licenses. In short, cases at the intersection of antitrust and patent law can be intimidating, and it takes a patient, determined, and properly resourced government prosecutor to execute them successfully.

We believe the gains from focusing greater attention on patent licensing warrant the effort to deal with the analytical complexities. Licensing arrangements can provide attractive means for serial colluders to cloak illegal collaboration under the guise of seemingly legitimate activity, in which direct interaction among competing firms might seem normal and unremarkable from an antitrust standpoint. As antitrust systems seek to deter collusion through more powerful detection mechanisms and stronger sanctions, one cannot underestimate the ingenuity and perseverance that producers will deploy to devise counter measures and strategies

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[180] Till, *supra* note 2, at 309–310:

> While patent licensing arrangements are theoretically preferable to pure monopoly situations, often these agreements contain provisions designed to restrict competition. Increasingly these arrangements have become more sophisticated as the Justice Department's Antitrust Division has sought to confine the exercise of monopoly to the patent itself. In this effort, the government has generally secured the support of the courts. But the cases instituted by the Department of Justice have involved only a small number of industries. It is therefore impossible to say whether, in the many not investigated, blatant restrictions are still fully spelled out in licensing arrangements or whether they have simply been driven underground. In both cases, a comprehension of the restrictions contained in a license agreement requires knowledge, often extensive knowledge, of the operation of the industry and its trade practices.

[181] *See* Priest, *supra* note 3, at 365:

> The problem of detecting illegitimate arrangements . . . is more difficult than merely identifying those particular practices that might be employed by both cartels and patent licensors. . . . The most telling example is where a group of firms appoints a licensor and, foregoing explicit price, output, or territorial restrictions, authorizes the licensor to charge each member firm a royalty with the understanding that at later date the royalties exacted will be rebated in full. It would be impossible to detect a cartel agreement of this nature without a detailed investigation into the relationships between the licensees and the licensor, because the behavior of each licensee will appear irreproachable; each can set price exactly equal to its apparent marginal cost which will include the royalty.

that permit the accomplishment of their collusive objectives. Licensing arrangements that are either invisible to external observers or seem innocuous at first glance can provide means to this end.

We also believe the burdens associated with the analysis suggested here may be manageable. There are opportunities today for the antitrust enforcement community, especially U.S. enforcement agencies, to apply the substantial body of learning that they have accumulated regarding the operation of the intellectual property system and the use of patents in commerce. Intensified examination of the possibilities for patent licensing to facilitate coordination by serial colluders would build upon a significant foundation of enforcement experience and research. Such a program would complement other major efforts to apply competition policy to high technology sectors and industries that rely heavily upon the application of patents and other intellectual property rights.

For roughly half a century, from the 1920s through the 1970s, U.S. antitrust policy adopted a highly skeptical view of many patent licensing practices. This skepticism has attenuated over the past forty years, as antitrust enforcement agencies and courts disavowed the hostility toward the same doctrines and enforcement policy statements. The rebalancing that has taken place ought not to obscure the fact that some of the concerns of the enforcement community were not illusory. Our proposals seek to give effect to the sound understandings of the earlier era and bring the force of modern learning to bear upon the special problem of serial collusion.

APPENDIX A

EC Chemical Product Decisions and Cartel Firms

1. Bitumen: Case COMP / 38.456 – Bitumen - NL, September 13, 2006
    a. Shell
2. Butadiene Rubber: Case COMP/F/38.638 – Butadiene Rubber and Emulsion Styrene Butadiene Rubber, November 29, 2006
    a. **Bayer**, Shell
3. Calcium Carbide: Case COMP/39.396 – Calcium carbide and magnesium based reagents for the steel and gas industries, July 22, 2009
    a. **Akzo Nobel**, *Degussa*
4. Candle Waxes: Case COMP/39181 – Candle Waxes, October 1, 2008
    a. **Shell**
5. *Cartonboard: IV/C/33.833 - Cartonboard, July 13, 1994
    a. Fides/AC Treuhand
6. Chloroprene Rubber: COMP/38629 - Chloroprene Rubber, December 5, 2007
    a. **Bayer**
7. Choline Chloride: Case COMP/E-2/37.533 – Choline Chloride, Comm'n Decision, December 9, 2004
    a. *Akzo Nobel, BASF*
8. Citric Acid: Case COMP/E-1/36.604 – Citric Acid, Comm'n Decision, 2002 O.J.(L239) 18. December 5, 2001
    a. Bayer
9. *Fatty Acids: IV/31.128 — Fatty Acids, Comm'n Decision, December 2, 1986
    a. Fides/AC Treuhand
10. Food Flavor Enhancers: Case COMP/C.37.671 – Flood Flavour Enhancers, Comm'n Decision 2004 (L 75) December 17, 2002
    a. <None from those listed in Figure 5>
11. Heat Stabilizers: COMP/38589 – Heat Stablisers, November 11, 2009
    a. Akzo Nobel, *Arkema/ Atofina, Elf Aquitaine,* Fides/AC Treuhand
12. *Hydrogen Peroxide: IV/30.907 — Peroxygen products, November 23, 1984
    a. Atochem, Solvay, Degussa
13. Hydrogen Peroxide: Case COMP/F/38.620 – Hydrogen Peroxide and Perborate, May 3, 2006
    a. *Akzo Nobel, Arkema/Atofina*, **Degussa**, *Elf Aquitaine, Solvay*
14. Lysine: Case COMP/36.545/F3. Amino Acids, June 7, 2000
    a. <None from those listed in Figure 5>
15. Methacrylates: Case No COMP/F/38.645 — Methacrylates, May 31, 2006

a. *Arkema/Atofina*, **Degussa,** ICI, Elf Aquitaine

16. Methionine: Case C.37.519 – Methionine, Comm'n Decision, 2002 (L 255) 1. July 2, 2002
    a. *Degussa*, **Rhone Poulenc/Aventis**
17. Methyglucamine: Case COMP/E-2/37.978 – Methylglucamine, Comm'n Decision, November 27, 2002
    a. *Rhone Poulenc/Aventis*
18. Monochloroacetic Acid: Case COMP/E-1/.37.773– MCAA, Comm'n Decision, January 19, 2005
    a. *Akzo Nobel, Arkema/Atofina, Elf Aquitaine*, Fides/AC Treuhand, Hoechst
19. Organic Peroxides: Case COMP/E-2/37.857 – Organic Peroxyde, Comm'n Decision, December 10, 2003
    a. **Akzo Nobel**, *Arkema/Atofina*, Degussa, Fides/AC Treuhand,
20. *Polyethylene: IV/31.866, LdPE, December 21, 1988
    a. Atochem, BASF, Bayer, Dow, Enichem, Fides/AC Treuhand, Hoechst, ICI, Repsol, Shell
21. *Polypropylene: IV/31.149 – Polypropylene, April 23, 1986
    a. Atochem, BASF, Fides/AC Treuhand, Hoechst, ICI, Rhone Poulenc/Aventis, Shell, Solvay
22. *Potash: IV/795 – Kaliand Salz/Kali Chemie, December 21, 1973
    a. BASF, Solvay
23. *PVC: IV/31.865, PVC, December 21, 1988
    a. Atochem, BASF, Enichem, Fides/AC Treuhand, Hoechst, ICI, Shell, Solvay
24. Rubber Chemicals: Case COMP/F/38.443 – Rubber Chemicals, Comm'n Decision December 21, 2005 (summary at 2006 (L 353) 50)
    a. **Akzo Nobel (through Flexsys)**[182]**,** *Bayer*
25. *Soda Ash: Case COMP/33.133-B: Soda-ash, December 19, 1990
    a. BASF, Solvay
26. Sodium Chlorate: Case COMP/38.695 – Sodium Chlorate, June 11, 2008
    a. **Akzo Nobel**, Arkema/Atofina, Elf Aquitaine
27. Sodium Gluconate: http://europa.eu/rapid/press-release_IP-01-1355_en.htm?locale=en#file.tmp_Foot_1, March 19, 2002
    a. *Akzo Nobel*

[182] See the cited EC decision at para 13, "The holding company for Flexsys is Flexsys Holding B.V. of which Akzo Nobel Chemicals International B.V. holds 50%, the remaining 50% being held by Solutia Inc and Solutia Europe N.V. together."

28. Sorbates: Case COMP/E-1/37.370 – Sorbates, Comm'n Decision October 1, 2003
    a. *Hoechst*
29. *Synthetic Fibers: IV/30.810 - Synthetic fibres, July 4, 1984
    a. Bayer, Hoechst, ICI, Rhone Poulenc/Aventis
30. Vitamins: Case COMP/E-1/37.512– Vitamins, Comm'n Decision, 2001 O.J. (L6) November 21, 2001
    a. *BASF*, **Rhone Poulenc/Aventis,** *Solvay*
31. *Woodpulp: IV/29.725 - Wood pulp, December 19, 1984
    a. Fides/AC Treuhand
32. Nitrile Butadiene Rubber: COMP/38.628 - Nitrile Butadiene Rubber, January 23, 2008
    a. *Bayer*

APPENDIX B[183]

I. GOOGLE PATENTS ADVANCED SEARCH INSTRUCTIONS

FIELD	*INPUT*
Synonym	CL="[product keyword]" Product keywords are listed below (see "Product Keywords" section) *Claims search (CL=):* ▪ *Restricts search to claims of patents* ▪ *Increases relevance of resulting patents by limiting results to patents in which the product is a notable input or process patents for the product* *Note:* ▪ *To search the union of multiple search terms, separate each "synonym" with OR* ▪ *To search the intersection of multiple search terms, separate each "synonym" with AND*
Date	Choose "filing" from the dropdown list Enter years from January 1 to January 1 of the next year (i.e. 1984-01-01 – 1985-01-01) *Note:* ▪ *Pre-plea years: 10 years prior to the start of the earliest starting year of a firm's plea period in the corresponding EC decision* ▪ *Plea years: the earliest starting year of a firm's plea period in the corresponding EC decision to the latest ending year of a firm's plea period in the corresponding EC decision* ▪ *Post-plea years: 10 years after the latest ending year of a firm's plea period in the corresponding EC decision*
Inventor	Leave blank
Assignee	Firm search terms, university search terms (see "Assignee Search Terms" below) *Note:* ▪ *To search the union of multiple search terms, separate each "synonym" with OR* ▪ *To search the intersection of multiple search terms, separate each "synonym" with AND*
Patent Office	Do not change (this generates a global search)
Language	Do not change
Status	Choose "grant" from the dropdown list
Type	Choose "patent" from the dropdown list
Sort by	Relevance *Note: This option can be changed only after the search results are displayed.*

[183] This Appendix was prepared by our three research assistants: Katherine Bartuska, Naira Batoyan, and Hope Bodenschatz, at the direction of the authors of the paper. Any errors are the responsibility of the authors of the paper.

II. PRODUCT SELECTION

Focusing on the firms of Akzo, BASF, Bayer, Solvay, and Degussa as producers and non-producers, if the pre-plea or the plea period has more than an average of two patents per year than chemical product was included. Otherwise, the product was excluded.

III. PRODUCT KEYWORDS

PRODUCT	*SEARCH TERM(S)*
1. Bitumen	"bitumen"
2. Butadiene Rubber	"butadiene rubber" OR "polybutadiene"
4. Candle Wax	"candle waxes" OR "paraffin waxes" OR "slack waxes" OR "candle wax" OR "paraffin wax" OR "slack wax"
6. Chloroprene Rubber	"chloroprene rubber" OR "chlorobutadiene rubber" OR "polychloroprene" OR "neoprene"
8. Citric Acid	"citric acid"
11. Heat Stabilizers	"heat stabilizers" OR "heat stabilizer" OR "heat stabilisers" OR "heat stabiliser" OR "thermal stabilizers" OR "thermal stabilizer" OR "thermal stabilisers" OR "thermal stabiliser" OR "tin stabilizers" OR "tin stabilizer" OR "tin stabilisers" OR "tin stabiliser" OR "epoxidised soybean oil" OR "epoxidized soybean oil" OR "ESBO"
12. Hydrogen Peroxide 1984	"hydrogen peroxide" OR "hydrogen peroxides" OR "sodium perborate"
13. Hydrogen Peroxide 2006	"hydrogen peroxide" OR "hydrogen peroxides" OR "sodium perborate"
15. Methacrylates	"methacrylates" OR "methacrylate"
16. Methionine	"methionine"
17. Methylglucamine	"methylglucamine" OR "meglumine"
18. Monochloroacetic Acid (MCAA)	"monochloroacetic acid" OR "MCAA" OR "sodium monochloroacetate" OR "SMCA"
19. Organic Peroxides	"peroxides" OR "peroxide" OR "peroxy" AND –hydrogen *Note: when performing a claims search, do not use CL= before -hydrogen*
20. Polyethylene	"polyethylene" OR "LdPE"
21. Polypropylene	"polypropylene" OR "polypropene"
23. PVC	"PVC" OR "polyvinyl chloride"
24. Rubber Chemicals	"anti-degradants" OR "anti-degradant" OR "antidegradants" OR "antidegradant" OR "accelerators" OR "accelerator" OR "rubber chemicals" OR "rubber chemical" OR "antioxidants" OR "antioxidant" OR "antiozonants" OR "antiozonant" OR "retarder" OR "retarders" OR "peptizer" OR "peptizers"

25. Soda Ash	"sodium carbonate" OR "soda ash"
29. Synthetic Fibers	"polyamide textile yarn" OR "polyamide carpet yarn" OR "polyester textile yarn" OR "polyamide staple" OR "polyester staple" OR "acrylic staple" OR "synthetic fibers" OR "synthetic fibres" OR "synthetic fiber" OR "synthetic fibre"
30. Vitamins	"vitamin A" OR "vitamin C" OR "ascorbic acid" OR "vitamin E" OR "vitamin B" OR "thiamine" OR "riboflavin" OR "calpan"
32. Nitrile Butadiene Rubber	"nitrile butadiene rubber" OR "nitrile rubber" OR "acrylonitrile butadiene rubber"

IV. ASSIGNEE SEARCH TERMS

Assignee names to be used in all cases, with the exception of the outstanding mergers, acquisitions, and name changes listed below.

Akzo Nobel	Atochem / Atofina / Arkema*	Aventis	BASF
Bayer	Degussa	Hoechst	ICI
Rhone Poulenc	Shell	Solvay	

*see Mergers, Acquisitions, and Name Changes below

V. MERGERS, ACQUISITIONS, AND NAME CHANGES – ALL SEARCHES

These cases are relevant in all instances, even when the firms are not in the cartel.

FIRM	*SEARCH*	
Akzo Nobel	Start year – 1993	Akzo OR Nobel
	1994 – end year	Akzo Nobel
Atochem / Atofina / Arkema	Start year – 1999	Atochem
	2000 – 2003	Atochem OR Atofina
	2004 – end year	Atochem OR Atofina OR Arkema
Bayer	Start year – 2003	Bayer
	2004	Bayer OR Lanxess
	2005	Bayer
Hoechst / Rhone Poulenc / Aventis	Search the relevant firms in separate columns for entire time period	

VI. MERGERS, ACQUISITIONS, AND NAME CHANGES – CASE SPECIFIC FOR CARTEL MEMBERS

CARTEL	*FIRM*	*SEARCH*	
3. Calcium Carbide	Degussa	1994 – 2003	Degussa OR SKW
		2004 – 2006	Degussa OR SKW OR Alzchem Hart
8. Citric Acid	Bayer	1981 – 2003	Bayer OR Haarman & Reimer
		2004	Bayer OR Haarman & Reimer OR Lanxess
		2005	Bayer OR Haarman & Reimer
12. Hydrogen Peroxide 1984	Atochem / Atofina / Arkema	1948 – 1982	Pechiney Ugine Kuhlmann
		1983 – 1990	Pechiney Ugine Kuhlmann OR Atochem
13. Hydrogen Peroxide 2006	Akzo Nobel	1948 – 1985	Akzo OR Nobel
		1986 – 1993	Akzo OR Nobel OR Eka
		1994 – 2010	Akzo Nobel OR Eka
	Solvay	1984 – 2001	Solvay
		2002 – 2010	Solvay OR Ausimont
19. Organic Peroxide	Atochem / Atofina / Arkema	1961 – 1982	Pennwalt OR Luperox
		1983 – 1999	Pennwalt OR Luperox OR Atochem
		2000 – 2003	Pennwalt OR Luperox OR Atochem OR Atofina
		2004 – 2009	Pennwalt OR Luperox OR Atochem OR Atofina OR Arkema
20. Polyethylene	Atochem / Atofina / Arkema	1966 – 1982	Aquitaine Total Organico
		1983	Aquitaine Total Organico OR Atochem
		1984 – 1994	Atochem
21. Polypropylene	Atochem / Atofina / Arkema	1966 – 1982	Aquitaine Total Organico
		1983	Aquitaine Total Organico OR Atochem
		1984 – 1993	Atochem
24. Rubber Chemicals	Akzo Nobel and Flexsys	1986 – 2011	Akzo Nobel and Flexsys are searched separately and placed in separate columns
25. Soda Ash	Solvay	1977 – 1985	Kali Chemie OR Solvay
		1986 – 2000	Solvay
26. Sodium Chlorate	Akzo Nobel	1984 – 1985	Elektrokemiska Aktiebolaget OR Akzo OR Nobel
		1986	Elektrokemiska Aktiebolaget OR Eka OR Akzo OR Nobel
		1987 – 1993	Eka OR Akzo OR Nobel
		1994 - 2010	Eka OR Akzo Nobel

DATA VALIDATION PROCEDURES USED FOR KOVACIC, MARSHALL, AND MEURER ARTICLE

VOLUME 10 EDITORIAL BOARD OF THE NYU JOURNAL OF INTELLECTUAL PROPERTY AND ENTERTAINMENT LAW (JIPEL)

As a policy of the journal, JIPEL provides readers with a short appendix that supplements authors' empirical analysis and attempts to validate a sample sets of findings, where possible. For a description of JIPEL's policy, please see the journal's Fall 2020 issue editorial on the subject.

In order to validate the authors' empirical analysis contained in this Article, journal staff reviewed the authors' patent tabulations for a subset of chemicals under the assumption that the accuracy of the coding of this subset is representative of the accuracy of the coding of all the chemicals.[1] Per the request of the JIPEL editors, the authors provided the journal a complete disaggregation of patent counts by chemical product. In its review, journal staff validated patent tabulations across all firms for three chemicals, Methacrylates, Polyethylene, and Polypropylene, which were associated with a total of 855 "results."[2] The total population of coded "results" numbered 6,121.[3] A "result" is defined as *one coded finding* for patenting by a firm on a chemical product in a single year, distinguished from "patent tabulation," which refers to the recorded *number of patents* sought for that firm / chemical / year. So, for example, BASF may have sought multiple patents related to a given chemical in a single year, but this would be considered one "result." JIPEL drew this distinction since it was interested in reviewing the potential error rate on the authors' findings by "result" as well as by patent tabulation, shown in Tables 1 and 2 below.

From this review, JIPEL staff did find slight discrepancies associated with approximately 31% of "results" across Methacrylates, Polyethylene, and Polypropylene, as shown in Table 2.[4] That said, these discrepancies tended to be in the amount of one to three patents greater or fewer than the authors' tabulated

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[1] *See, e.g.*, *Sample Size Calculator*, CLINCALC, https://clincalc.com/stats/samplesize.aspx (last visited June 1, 2021) (describing a means to calculate minimum experiment sizes for a known population size). While JIPEL and the authors both followed the Article's Appendix B to architect their patent tabulations, it is possible that the errors that affected some or all of the three chemicals reviewed by JIPEL were dissimilar to errors that affected other studied chemicals.

[2] Methacrylates, Polyethylene, and Polypropylene were associated with 286, 261, and 308 "results," respectively.

[3] The "results" from the remaining chemicals totaled 5,292 "results."

[4] In total, JIPEL found discrepancies associated with 269 "results" across the three chemicals. Dividing 269 by 855 "results" gives a discrepancy rate of approximately 31%.

findings for patenting in a particular year. Thus, on net, JIPEL's total tabulated findings did not tend to be very different than the authors' findings. As shown in Table 1 below, in all periods, the authors' counts did not exceed the JIPEL's counts. And, the findings for the total number of patenting in the pre-plea, plea and post-plea periods tended to be very close.

TABLE 1: SUM OF PATENTING ACROSS FIRMS FOR A GIVEN CHEMICAL IN EACH PERIOD, SHOWING NET DIFFERENCE ("DIFF.") IN SUMMED TOTALS BETWEEN ARTICLE AUTHORS AND JIPEL

	Methacrylates			**Polyethylene**			**Polypropylene**		
	Authors	*JIPEL*	*Diff.*	*Authors*	*JIPEL*	*Diff.*	*Authors*	*JIPEL*	*Diff.*
Pre-plea	1688	1718	30 (1.78%)	353	362	9 (2.55%)	174	174	0 (0)
Plea	931	943	12 (1.29%)	934	973	39 (4.18%)	439	445	6 (1.37%)
Post-plea	1215	1292	77 (6.34%)	1774	1831	57 (3.21%)	1065	1084	19 (1.78%)

JIPEL also disaggregated its own tabulated errors on "results" by core versus non-core producers, as shown in Table 2, to determine if errors were any likelier for one set of firms versus the other.[5] JIPEL did observe greater errors in patenting "results" for core producers, but again, the magnitude of these errors remained very small, as seen in Table 1. JIPEL did not observe any greater magnitude of errors associated with "results" for core producers versus non-core producers.

[5] The authors explain their rationale for distinguishing between "core" and "non-core" producers in Section I of the main Article.

TABLE 2: JIPEL OBSERVED ERROR COUNTS FOR REVIEWED "RESULTS," SPLIT BETWEEN ERRORS ASSOCIATED WITH "RESULTS" FOR CORE AND NON-CORE PRODUCERS[6]

	Methacrylates		**Polyethylene**		**Polypropylene**	
	"Result" count (%)	*Error count (%)*	*"Result" count (%)*	*Error count (%)*	*"Result" count (%)*	*Error count (%)*
Core producer "results" and JIPEL observed errors	130 (45.45%)	80 (61.77%)	145 (55.56%)	49 (57.65%)	140 (45.45%)	28 (52.83%)
Non-core producer "results" and JIPEL observed errors	156 (54.55%)	51 (38.23%)	116 (44.44%)	36 (42.35%)	168 (54.55%)	25 (47.17%)
Total "results" and JIPEL observed errors	286	131	261	85	308	53

In sum, JIPEL finds that the aggregate differences in the number of patents recorded by the journal staff and the authors does not materially change the magnitude or direction of the findings for any of the three chemicals examined. Based on our assumption that discrepancies in the patents tabulated for these three chemicals by the authors and the JIPEL staff are representative of the magnitude of discrepancies for all the chemicals examined by the authors in this article, JIPEL data validation supports the authors' empirical analysis.

Some theories for why these errors persist include errors from human coding or errors in Google's automated document reading, which also automatically translates patent information across languages.[7] Errors might also be due to Google's "deduplication by family" option, which was turned on for the authors' and JIPEL's searches. This option is supposed to group together equivalent inventions and hide redundant patents from view.[8] It is possible that certain patents were hidden for the

[6] As noted above, JIPEL found discrepancies associated with 269 "results" across the three chemicals, the sum of 131, 85 and 53, shown in Table 2. Dividing 269 by 855 total "results" (the sum of 286, 261 and 308, shown in Table 2) gives a discrepancy rate of approximately 31%. In Table 2, JIPEL disaggregated "results" and its error rate on "results" by core and non-core producers. Percentages in Table 2, then, reflect the distribution of core versus non-core producer "results" and errors on "results" from JIPEL's analysis. The overall discrepancy rate remains 31%.

[7] *See About Google Patents: Coverage*, GOOGLE, https://support.google.com/faqs/answer/7049585 (last accessed June 1, 2021) (describing Google's process to upload and make available for digital searching 120 million global patents).

[8] *See About Google Patents: Search results page*, GOOGLE, https://support.google.com/faqs/answer/7049588/search-results-page?hl=en&ref_topic=6390989 (last accessed June 1, 2021). In its description of its deduplication by patent family option, Google

authors' searches that were visible to JIPEL, based on JIPEL performing its searches at a different time than the authors.

describes how similarly architected searches may nonetheless lead to slightly dissimilar conclusions. *Id.* The company observes how when using deduplication by family:

> Only the highest-ranking patent from the same "simple patent family" is displayed and the other family members are removed from the results list. The simple patent family is all of the patents that share the same set of priority claims. This is usually when the same or very similar patent is filed in more than one country.

Id. This grouping is done algorithmically using what Google describes as Cooperative Patent Classification (CPC) codes. *Id.* For further description of how patent families are created for global patents that seek protection for equivalent inventions, *see DOCDB Simple Patent Family*, EUR. PAT. OFF., https://www.epo.org/searching-for-patents/helpful-resources/first-time-here/patent-families/docdb.html (last accessed June 3, 2021).