Journal of Competition Law & Economics, *00(00)*, *1–45*
doi: 10.1093/joclec/nhz011
Advance Access publication

HARMFUL SIGNALS: CARTEL PROHIBITION AND OLIGOPOLY THEORY IN THE AGE OF MACHINE LEARNING

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ABSTRACT

The traditional legal approach for distinguishing between illicit collusion and legitimate oligopoly conduct is to rely on criteria that relate to the means and form of how rivals interact, such as elements of "practical cooperation", or on the finding of an anticompetitive intent. These criteria ultimately refer to the inner sphere of natural persons and its emanations in communicative acts. Some authors therefore conclude that the cartel prohibition of Article 101 Treaty on the Functioning of the European Union (TFEU) or Section 1 of the U.S. Sherman Act is unable to capture collusion if it is achieved by autonomously acting computers relying on machine learning capabilities. It is instead suggested here to define collusion as parallel informational signals, which achieve a supracompetitive equilibrium, and to use the consumer welfare standard as a proxy for distinguishing between illicit collusion and legitimate oligopoly conduct. This approach is not tantamount to the idea of prohibiting tacit collusion as such. Rather, it is to check singular elements of communication, that is, "informational signals", within an existing oligopolistic setting for their propensity to create consumer harm. This approach can help to close potential regulatory gaps currently associated with the surge of algorithmic pricing.

JEL: K21, L13, L41

I. INTRODUCTION

This article contends that outside the scope of classic cartel agreements it is not possible to properly distinguish between illicit collusion and legitimate independent conduct by relying on proxies such as elements of practical cooperation, other so-called "plus factors", or anticompetitive intent. The classical legal approach toward collusion often fails to acknowledge that signaling or

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any other type of informational exchange is an emanation of tacit collusion in itself. Tacit collusion, however, is generally considered to be unobjectionable, because firms are deemed to have the right to adapt intelligently to their rivals' conduct.[1] However, tacit collusion can be characterized as a noncooperative game in the same way as concerted practices (and even legally unenforceable cartel agreements) can be considered as a noncooperative game. The law puts different labels on what is ultimately the same economic phenomenon, that is, conduct that leads to supracompetitive outcomes. Therefore, it is of limited value to try to find something idiosyncratic about concerted practices that is purported to be absent in "mere" tacit collusion cases. It is therefore suggested here that the only scientifically reliable criterion of distinction between legitimate and illicit collusion is whether the release of informational signals by two or more rivals creates or sustains a supracompetitive equilibrium, the consumer harm of which is not offset by efficiencies. This idea does not equate to the idea of condemning oligopolistic pricing as *per se* anticompetitive under the cartel prohibition, viz., to equate tacit collusion with agreements or concerted practices. Rather, the present suggestion is to scrutinize singular elements of communication, that is, informational signals, within an existing oligopolistic setting for their propensity to create consumer harm. This differentiated approach avoids some of the conceptual problems with the idea of considering oligopoly pricing without more to be tantamount to an agreement. At the same time, it may allow for application of the cartel prohibition to collusive outcomes without recourse to qualitative criteria such as the practical-cooperation shibboleth or "evidence of anticompetitive intent".

The approach advocated here integrates an efficiency analysis with the assessment of collusive conduct or concerted practice in terms of Article 101(1) Treaty on the Functioning of the European Union (TFEU) . That reflects the fact that the intricacy of delineating the scope of illicit communication lies in part in the ambiguity of welfare effects that come with it. A form-based approach relying on merely qualitative criteria, such as anticompetitive intent, is likely to do injustice to the ambiguity of welfare effects that are associated with an increase in transparency.

The use of theories of harm explicitly addressing information exchanges or the phenomenon of informational "signals" is not new, some dating back to the 1970s in the United States[2], and it seems clear that the economics of

[1] Joined Cases 40–48, 50, 54–56, 111, 113, and 114/73 [Coöperatieve Vereniging "Suiker Unie" UA and others v Comm'n] ECLI:EU:C:1975:174.

[2] United States v. General Motors Corp., [1974–2] Trade Cas. 75,253 (E.D. Mich. 1974), where the court, however, rejected the government's theory of harm stating that it had failed to prove that the defendant's announcements on prices had been intended as "signals" (*Id* 75,253, at 97,671.) and that such announcements had legitimate business purposes. Similar allegations had been raised by the Justice Department in another case, which, however, ended by a consent decree, United States v. Westinghouse Elec. Corp., [1977–2] Trade Cas. 61,661 (E.D. Pa. 1977); United States v. General Elec. Co., [1977–2] Trade Cas. 61,660 (E.D. Pa. 1977); United States v. General Elec. Co. and Westinghouse Elec. Corp., [1977–2] Trade Cas. 61,659 (E.D. Pa. 1977),

signaling to a large extent do not yield *per se* rules. The release of informational signals, such as pricing information, can be procompetitive or anticompetitive.[3] The exchange of pricing information can be a restraint by object,[4] yet it can be efficiency-enhancing for customers, depending on the facts of the case.

Information can be used by competitors to collude or to compete, and the challenge of competition law is being able to detect the differences. The Commission's commitments decision in the *Container Shipping* case[5] has suggested an aggressive stance toward public price announcements. The Report of the U.K. Digital Competition Expert Panel of March 2019 (the *Furman*[6] Report), however, has emphasized the efficiency potential associated with digital technology creating greater market transparency, inter alia in that digital comparison tools allow users to make better-informed choices.[7] The OECD comes to a similar conclusion stating that the use of "computer algorithms to improve [. . .] pricing models, customise services and predict market trends" is, despite concomitant competitive risks, "undoubtedly associated to significant efficiencies, which benefit firms as well as consumers in terms of new, better and more tailored products and services."[8]

A possible objection against the approach to be established here shall be addressed at the outset. One might want to argue that efficiency considerations are supposed to be considered under Article 101(3) TFEU. This might appear to make it unnecessary or even impossible to account for effects on consumers within the ambit of Article 101(1) TFEU. The hypothesis of this article, however, is that retaining efficiency as the default rule of distinction between

on that Michael D. Blechman, *Conscious Parallelism, Signalling and Facilitating Devices: The Problem of Tacit Collusion under the Antitrust Laws*, 24 N.Y.L. Sch. L. Rev. 881, 882, 889 (1979).

3 Willem Boshoff, Stefan Frübing, & Kai Hüschelrath, *Information Exchange Through Non-binding Advance Price Announcements: An Antitrust Analysis*, 45 Eur. J. L. & Econ. 439, 440 (2018): ("Despite these potential detrimental effects on welfare, authorities are fully aware that there might also be non-collusive, welfare-enhancing explanations for the implementation of advance price announcements"); Kai-Uwe Kühn, Designing Competition Policy towards Information Exchanges—Looking Beyond the Possibility Results, *in* OECD Report, Policy Roundtables: Information Exchanges between Competitors under Competition Law (COMP(2010)37), p. 416: ("It seems that almost under any circumstances information exchange could be good or bad."), available at http://www.oecd.org/competition/cartels/48379006.pdf (last accessed May 10, 2019).

4 Commission Case AT.39850 [Container Shipping] ¶ 52.

5 Commission Case AT.39850 [Container Shipping].

6 Jason Furman is the Chair of the Digital Competition Expert Panel.

7 UK Digital Competition Expert Panel, Report: Unlocking digital competition, March 2019, p. 3, available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/785547/unlocking_digital_competition_furman_review_web.pdf (last accessed May 10, 2019).

8 OECD, *Algorithms and Collusion—Competition policy in the digital age*, p. 3 (2017), available at https://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm, paper prepared by Antonio Capobianco, Pedro Gonzaga, and Anita Nyeső for the OECD (last accessed May 10, 2019).

concerted practices and lawful interdependent conduct (viz. "normal" tacit collusion) is inevitable already under Article 101(1) TFEU. That is because relying on qualitative criteria to show that there is something special about concerted practices, which cannot be found in cases of "normal" tacit collusion, does not reconcile with oligopoly theory. The risk of a qualitative approach, which relies on criteria such as the normative term "practical" cooperation or on subjective parameters such as anticompetitive intent, lies in producing random results within the ambit of Article 101(1) TFEU while shifting the burden of proof for offsetting efficiencies exclusively to the parties under Article 101(3) TFEU. It is argued here, instead, that the ambiguity of welfare effects must be accounted for within Article 101(1) TFEU. It is hypothesized that it is possible to reconcile an integrated effects analysis of informational signaling with the structure of Article 101(1) TFEU if the law is construed against the backdrop of the consumer welfare standard.

Relying on a consumer welfare[9] analysis allows for a more nuanced approach toward the economic effects of informational signaling. While harm and benefit can often be expressed in price effects, the consumer welfare standard is not confined to assessing impacts on prices.[10] Innovation, product variety, or security of supply are other features from which customers can benefit. These aspects will therefore be included in the assessment. Most importantly, though, the integrated effects analysis allows dispensing with qualitative criteria such as "practical cooperation" or "knowingly following an anticompetitive course" or having an anticompetitive "intent". This renders the application of Article 101 TFEU more robust in cases where direct human involvement in the coordination process is limited, absent, or hard to detect.

In the following analysis, I focus on Article 101 TFEU. Yet the article retains a close tie to the jurisprudence and scholarship under Section 1 of the U.S. Sherman Act. I will consider the risk potential of algorithms, especially machine learning, to induce collusive equilibria. It is beyond

[9] I apply a consumer welfare standard in this analysis, as it is endorsed by the U.S. agencies, widely accepted by the European Union (EU) Commission, and suggested by the *Furman* report with respect to the assessment of algorithmic competitive impediments; see UK Digital Competition Expert Panel, *supra* note 7, at 5; Neelie Kroes: ("Consumer welfare is now well established as the standard the Commission applies when assessing mergers . . ."), SPEECH/05/512: *European Competition Policy—Delivering Better Markets and Better Choices*, European Consumer and Competition Day, London, 15 September 2005, available at http://europa.eu/rapid/press-release_SPEECH-05-512_en.htm (last accessed May 10, 2019); Joaquín Almunia, SPEECH/10/233, Competition and consumers: the future of EU competition policy, speech at European Competition Day, Madrid, 12 May 2010, available at http://ec.europa.eu/competition/speeches/index_speeches_by_the_commissioner.html (last accessed May 10, 2019); See also, albeit on Article 82 EC, Case C-95/04 P [British Airways v Comm'n] ECLI:EU:C:2007:166 ¶ 86.

[10] On the foundations of the consumer welfare doctrine in EU competition law Svend Albæk, Consumer Welfare in EU Competition Policy, *in* AIMS AND VALUES IN COMPETITION LAW 67 (Caroline Heide-Jørgensen, Christian Bergqvist, Ulla Neergaard, Sune Troels Poulsen eds., DJØF Publishing, Copenhagen, 2013).

the reach of this paper, however, to assess the technological feasibility of algorithmic collusion as yet. I leave that to dedicated studies, for example, by Stucke & Ezrachi[11], Schwalbe[12], Ittoo & Petit[13], and Capobianco, Gonzaga, & Nyeső in their work for the OECD[14], Mehra[15], and other commentators.[16]

The article will proceed by establishing the practical need for rethinking the legal analysis of coordination in cases outside classical cartel agreements. This will include an analysis of potential risks to unimpeded competition associated with the evolution of algorithms, especially such with self-learning capabilities (Section II). Subsequently, the article will evaluate the existing criteria for distinguishing illicit collusion from legitimate communication (Section III). This will involve a systematization of the criteria as established by the European judiciary and scholarship on Article 101(1) TFEU (Section III.A and B) and an overview of the parallel discussion under Section 1 of the Sherman Act (Section III.C). The article will then undertake a critical assessment of the existing set of criteria (Section IV). Subsequently, it will suggest putting greater weight on an effects analysis. This allows to conceive of illicit coordination as parallel informational signals, which create an anticompetitive equilibrium without the consumer harm being offset by efficiencies (Section V). Finally, the article will analyze the burden of proof for an effects analysis under Article 101(1) TFEU with respect to the consumer harm precipitated by informational signals (Section VI.). Then final conclusions will be drawn (Section VII).

[11] Maurice Stucke & Ariel Ezrachi, *Sustainable and Unchallenged Algorithmic Tacit Collusion*, The University of Texas Knoxville College of Law research paper #366 (January 2019), available at http://ssrn.com/abstract=3282235; Ariel Ezrachi & Maurice Stucke, *Algorithmic Collusion: Problems and Counter-Measures, Note to the OECD Roundtable on Algorithms and Collusion*, 31 May 2017, DAF/COMP/WD(2017)25, available at https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DAF/COMP/WD%282017%2925&docLanguage=En (last accessed May 10, 2019); Ariel Ezrachi & Maurice Stucke, Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy, Harvard University Press, Cambridge, Massachusetts (2016).

[12] Ulrich Schwalbe, *Algorithms, Machine Learning, and Collusion*, 14 J. Competition L. Econ. 568 (2019).

[13] Ashwin Ittoo & Nicolas Petit, *Algorithmic Pricing Agents and Tacit Collusion: A Technological Perspective* (October 2017), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3046405 (last accessed May 10, 2019).

[14] OECD, *supra* note 8.

[15] Salil K. Mehra, *Antitrust and the Robo-Seller: Competition in the Time of Algorithms*, 100 Minn. L. Rev. 1323 (2016).

[16] See Virgílio Pereira, *Algorithm-Driven Collusion: Pouring Old Wine into New Bottles or New Wine into Fresh Wineskins?*, 39 Eur. Competition L. Rev. 212 (2018); Peter Georg Picht & Benedikt Freund, *Competition (Law) in the Era of Algorithms*, 39 Eur. Competition L. Rev. 403 (2018); Vlad Dan Roman, *Digital Markets and Pricing Algorithms—A Dynamic Approach Towards Horizontal Competition*, 39 Eur. Competition L. Rev. 37 (2018); see for an evaluation of the e-commerce sector inquiry of the Commission with respect to the risks of algorithmic collusion, Niccolò Colombo, *What the European Commission (Still) Does Not Tell Us About Pricing Algorithms in the Aftermath of the E-commerce Sector Inquiry*, 39 Eur. Competition L. Rev. 478 (2018).

II. WHY COLLUSION OUTSIDE EXPLICIT COORDINATION IS AN INCREASING CHALLENGE TO THE CARTEL PROHIBITION

Noncooperative games[17] can exhibit supracompetitive equilibria if detection and retaliation are plausibly present.[18] The most important sanctions are retaliatory price reductions or output expansions.[19] It does not require the involvement of a classical[20] cartel agreement. Where a supracompetitive equilibrium is sustained without a cartel agreement, this type of coordination is often referred to as tacit collusion or conscious parallelism, with the former expression being more common in the European Union (EU). Despite tacit collusion not involving any explicit agreement by definition, this type of collusion can be furthered by communication.[21] The Court of Justice therefore holds that competitors must not substitute a "practical cooperation" for the risks of competition.[22]

[17] Note that even cartel "agreements" due to the lack of enforceability can be conceived of as a noncooperative game. The present article, however, focuses on the types of coordination where even a nonbinding agreement is absent.

[18] Oliver Black, *Concerted Practices, Joint Action and Reliance*, 24 Eur. Competition L. Rev. 219, 223 (2003); Edward J. Green & R.H. Porter, *Noncooperative Collusion under Imperfect Price Information*, 52 Econometrica 87 (1984); Peter D. Camesasca & Laurie-Anne Grelier, *'Close Your Eyes'? Navigating the Tortuous Waters of Conscious Parallelism and Signalling in the European Union*, 7 J. Eur. Competition L. Prac. 599, 602 (2016); Margaret C. Levenstein & Valerie Y. Suslow, *What Determines Cartel Success?*, 44 J. Econ. Lit. 43, 45 (2006); William H. Page, *Objective and Subjective Theories of Concerted Action*, 79 Antitrust L.J. 234 (2013); Antoine Colombani, Jindrich Kloub, & Ewoud Sakkers, Cartels, *in* Jonathan Faull & Ali Nikpay, The EU Law of Competition ¶¶ 8.51 ff (Oxford University Press, Oxford and New York, 3rd edn, 2014); Blechman, *supra,* note 2, at 882 ff; Marc Ivaldi, Bruno Jullien, Patrick Rey, Paul Seabright, & Jean Tirole, *The Economics of Tacit Collusion*, IDEI Working paper, No. 186, Final Report for DG Competition, European Commission 5 (2003); Dennis A. Yao & Susan S. DeSanti, *Game Theory and the Legal Analysis of Tacit Collusion*, 38 Antitrust Bull. 113 (1993).

[19] Under Bertrand competition a reduction in price will generally constitute a more effective retaliation than an increase in output under Cournot competition. An increase in output will reduce the rivals' output but it will not result in a total reallocation of customers to the retaliating seller. In an oligopolistic market with Bertrand competition, though, a price cut by one of the rivals might deprive all others of their customers instantly, provided that the retaliator faces no capacity restraints. See on the differences between Bertrand and Cournot oligopolies, Ulrich Schwalbe & Daniel Zimmer, Kartellrecht und Ökonomie 40 ff (Verlag Recht und Wirtschaft, Frankfurt a.M., 2nd edn, 2011).

[20] Note that under Article 101(1) TFEU an agreement is defined as a consent that yields a de facto commitment vis-à-vis the other party. That is the understanding of agreement in this article. As will be shown, however, the jurisprudence and academic writing on Section 1 of the Sherman Act sometimes stretch the notion of an agreement to types of coordination that would be considered a concerted practice, and not an agreement, under Article 101 (1) TFEU; see *infra* III.C.

[21] Experimental game theory suggests that with more than two or three players involved it is often impossible to reach a collusive equilibrium without communication; see Schwalbe, *supra* note 12.

[22] The definition was coined in 1972 in Case C-48/69 [ICI v Comm'n] ECLI:EU:C:1972:70 ¶ 64. It has since been continually used; see, for example, Joined Cases C-40/73 [Suiker Unie v Comm'n] ECLI:EU:C:1975:174 ¶ 26; Case C-199/92 P [Hüls v Comm'n] ECLI:EU:C:1999:358 ¶ 158; Case C-8/08 [T-Mobile Netherlands] ECLI:EU:C:2009:343 ¶ 26.

Communication, or put differently, the dissemination of competitively relevant information to the market, which fosters collusion, can take place in many ways.[23] Information can be exchanged between rivals exclusively, that is, as private communication. Communication can take place "over the market" by firms releasing and receiving information publicly, for example by making advance price announcements. That is often referred to as "signaling". In the Commission's decisional practice the *Container Shipping* commitments decision focused on public announcements of pricing intentions.[24] The *American Airline Braniff* case from the United States in 1983 is paradigmatic for a unilateral attempt to collude through private statements.[25]

There are reasons to assume that the practical relevance of coordination outside classical cartel agreements is increasing. With hard-core cartels being destabilized by leniency programs and private enforcement, firms may well shift to more sophisticated types of coordination that are not based on overt conspiracy.[26] That antitrust enforcement against cartel agreements can lure firms into less blatant forms of collusion was already observed in the 1940s in the United States. Then, the Temporary National Economic Commission asserted that[27] the most significant "current restraints" of competition did not result from overt conspiracies but rather came from parallel action of rival firms in concentrated markets.[28] The Commission said that the "picture of conspiracy as a meeting by twilight of a trio of sinister persons with pointed hats close together belongs to a darker age".[29] It was assumed that even after merely a few decades of antitrust enforcement in the United States, firms would switch to more elaborate methods of coordination "not by agreement

[23] See Nicolas Petit, The Oligopoly Problem in EU Competition Law, *in* Handbook on European Competition Law—Substantive Aspects, 259–349 (Ioannis Lianos & Damien Geradin eds., 2013).

[24] Commission Case AT.39850 [Container Shipping].

[25] U.S. v. American Airlines, 743 F.2d 1114. The U.S. DOJ brought charges in the *American-Braniff* case based on Section 2 of the Sherman Act; see 743 F.2d at 1120. See on that case Paula W. Render, J. Bruce Mcdonald, & Thomas York, *Sending the Wrong Message? Antitrust Liability for Signaling*, 31 Antitrust 83, 85 (2016). The District Court dismissed the DOJ's Section 2 theory; see American Airlines, 570 F. Supp. at 659 (The "proposition to [Braniff] was a unilateral invitation to affect a change in prices. . . . [T]he remedy does not lie in the antitrust laws."). The Fifth Circuit Court of Appeals reversed, holding that an invitation to raise prices could violate Section 2; see American Airlines, 743 F.2d at 1121–22. The case was eventually settled.

[26] OECD DAF/COMP(2012)17, Background Paper, Policy Roundtables on Unilateral Disclosure of Information with Anticompetitive Effects, 2012, ¶ 3.2: ("These intermediary situations between explicit and tacit collusion are becoming more and more frequent in sophisticated economies, where old fashioned agreements are increasingly replaced by more discrete, looser forms of co-ordination and informal understandings between firms. Such forms of interaction between competitors may still have anti-competitive effects and might require scrutiny under competition rules."), available at http://www.oecd.org/daf/competition/Unilateraldisclosureofinformation2012.pdf (last accessed May 10, 2019).

[27] On that see Blechman, *supra* note 2, at 882.

[28] Walton Hamilton & Irene Till, Antitrust In Action 13–15 (TNEC Monograph No. 16, 1940).

[29] Hamilton & Till, *supra* note 28, at 15.

among themselves but in automatic response to identical stimuli".[30] As to the current state of enforcement, authorities look more thoroughly into types of informational exchange and signaling. The recent judgment of the European Court of Justice in *Eturas*[31] , the Commission's *Container Shipping* case[32] , or the decision by the Spanish National Commission of Markets and Competition (CNMC) in the *Tobacco* case[33] of April 2019 are examples for this current focus.

The extent to which firms can communicate is limited by their ability to receive, process, and release information in terms of quantity, speed, and precision. That is where algorithms and machine learning come into play.[34] These developments, in theory at least, can pave the way for collusive equilibria as they reduce the need for time-consuming decisions or constant monitoring by natural persons.[35] Market platforms can become a space to observe rivals' conduct, and digital technology can help to provide an exchange of market-related information, especially on prices, and then possibly induce collusion. The *Eturas*[36] case is paradigmatic for that, and, in the United States, the Department of Justice (DOJ) charges in *Topkins*[37].

In being able to process larger amounts of information and to do this more quickly than human beings, computer algorithms might well result in more efficient exchange of information and thus create the framework for mechanisms of collusion that otherwise would not have existed.[38] Algorithms can make complex, fast moving markets more transparent, and technologically enhanced transparency can then be the basis for collusion. A recent example of how algorithms can become pivotal for nonexplicit collusion is the fine imposed by the Spanish CNMC in the *Tobacco* case.[39] Several tobacco manufacturers and a distributor had used, according to the allegations made by the competition watchdog, software applications to reciprocally access

[30] Hamilton & Till, *supra* note 28, at 14.

[31] Case C-74/14 [Eturas UAB] ECLI:EU:C:2016:42.

[32] Commission Case AT.39850 [Container Shipping].

[33] Spanish National CNMC of 10 April 2019, RESOLUCIÓN Expte. S/DC/0607/17 TABACOS, available at https://www.cnmc.es/sites/default/files/2416763_2.pdf (last accessed May 10, 2019).

[34] In this article the term "machine learning" is used for computer systems with self-learning capabilities, that is, the ability to create knowledge out of experience. Machine learning is understood as a discipline within the field of artificial intelligence.

[35] Ariel Ezrachi & Maurice E. Stucke, *Artificial Intelligence & Collusion: When Computers Inhibit Competition*, 1775 U. Ill. L. Rev. (2017); see also Nicolas Petit, *Antitrust and Artificial Intelligence: A Research Agenda*, 8(6) J. Eur. Competition L. Prac. 361–62 (2017).

[36] Case C-74/14 [Eturas UAB] ECLI:EU:C:2016:42.

[37] Press Release, U.S. Department of Justice, Former E-Commerce Executive Charged with Price Fixing in the Antitrust Division's First Online Marketplace Prosecution (April 6, 2015), https://www.justice.gov/opa/pr/former-e-commerce-executive-charged-price-fixing-antitrust-divisions-first-onlinemarketplace (last accessed May 10, 2019).

[38] Ezrachi & Stucke, *supra* note 35, at 1782.

[39] Spanish CNMC, RESOLUCIÓN Expte. S/DC/0607/17 TABACOS, *supra* note 33.

precise real-time data on sales developments, including by geographic area and brand.[40] The CNMC found the software applications had enabled rivals to understand whether changes in sales were due to a fall in demand or a result of competition. Despite not accusing the companies of a direct private exchange of information or public signaling, the agency concluded that the reciprocal data access provided for by the software applications had allowed the firms to reach a collusive equilibrium.[41] It is reported to be the first case in which the Spanish authority undertook an effects analysis in an information exchange scenario.[42]

It seems clear that information can now be exchanged more quickly and more reliably than in the past. The OECD[43] and other authors have voiced concerns, for example, that the use of blockchain technology can foster horizontal collusion: when blockchain technology is used as an instrument of communication, it can make the exchange of information more secure[44], and it can help the oligopolists to monitor their rivals' conduct more closely.[45] Blockchain technology may help conceal illicit information from the antitrust authorities thereby strengthening the members' trust in each other.[46] Above all, it is conceivable that algorithms account for the risk of detection by antitrust authorities and use counter strategies to disguise collusive price setting patterns by simulating "the appearance of competition".[47]

As noted, the use of pricing algorithms and machine learning can help to reduce the need of direct human involvement in the communication process. In that regard, it has been pointed out that computer systems relying on machine learning could enter into communication with each other to achieve and sustain a supracompetitive equilibrium within a framework of tacit

[40] Spanish CNMC, RESOLUCIÓN Expte. S/DC/0607/17 TABACOS, *supra* note 33.

[41] Note that the case is reported to be brought before the Spanish courts. The present article makes no allegations as to whether the findings and accusations of the Spanish authority were substantiated by the facts of the case or not.

[42] Matt Richards, *Spain smokes out tobacco information sharing*, 15 April 2019, available at https://globalcompetitionreview.com/article/1190241/spain-smokes-out-tobacco-information-sharing (last accessed May 10, 2019).

[43] OECD, Blockchain Technology and Competition Policy—Issues paper by the Secretariat, 8. June 2018, DAF/COMP/WD(2018)47 ¶ 3.3.

[44] Thibault Schrepel, *Collusion by Blockchain and Smart Contracts* (January 14, 2019), 25, available at SSRN: https://ssrn.com/abstract=3315182 (last accessed May 10, 2019, forthcoming in 33 Harv. J.L. & Tech.); Giovanna Massarotto, *From Digital to Blockchain Markets: What Role for Antitrust and Regulation* (Posted: February 13, 2019 Last revised: March 3, 2019), 14–15, available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3323420 (last accessed May 10, 2019); Christian Catalini & Catherine Tucker, *Antitrust and Costless Verification: An Optimistic and a Pessimistic View of the Implications of Blockchain Technology* (Posted: June 25, 2018 Last revised: October 2, 2018), MIT Sloane Research Paper, available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3199453 (last accessed May 10, 2019).

[45] Schrepel, *supra* note 44, at 29.

[46] Schrepel, *supra* note 44, at 31.

[47] This subject is reflected upon in *Ulrich Schwalbe's* article on Algorithms, Machine Learning, and Collusion; see Schwalbe, *supra* note 12, at 597.

collusion or parallel accommodating conduct.[48] Ezrachi & Stucke[49] or Michal Gal[50] consider this already a serious possibility. These authors already speak of "the end of competition as we know it"[51]. Schwalbe[52], on the other hand, is more skeptical about the current threats to competition by autonomous algorithmic agents. Yet he does not exclude the possibility that algorithms enter into collusion, or that this can at least happen in the future. The *Furman* Report of March 2019 takes a similarly nuanced view considering it hard to predict "whether greater use of algorithms will lead to algorithmic collusion" and recommends "to monitor how use of machine learning algorithms and artificial intelligence evolves to ensure it does not lead to anti-competitive activity or consumer detriment".[53] None of the authors, therefore, rules out the possibility of collusion induced by machine learning systems already today, and even less that it can be ruled out for the future with further evolved technology. Albeit the likelihood of a finding of anticompetitive harm depends

48 Ezrachi & Stucke, *supra* note 35, at 1789–90. The authors refer in addition to tacit collusion to the phenomenon of parallel accommodating conduct. It should be noted, though, that the latter is a theory of oligopolistic conduct that is highly contested among antitrust practitioners and scholars. The basic idea behind parallel accommodating conduct is that on oligopolistic markets, firms can have an interest in increasing prices even though they do not have the ability to retaliate in the event of an individual deviation from the collusive equilibrium. It is not the purpose of the present article to discuss the validity of the underlying economic theory. Rather, parallel accommodating conduct is only mentioned as an example for a type of oligopolistic behavior that might possibly be achieved by corresponding algorithms. The validity of that hypothesis would therefore require further scrutiny. On the phenomenon, see Joseph E. Harrington, *Evaluating Mergers for Coordinated Effects and the Role of "Parallel Accomodating Conduct"*, 78 Antitrust L.J. 651–668 (2013).

49 Stucke & Ezrachi, *supra* note 11; Ezrachi & Stucke, *supra* note 35, at 1782.

50 Michal Gal, *Algorithms as Illegal Agreements*, (May 2, 2018 forthcoming in Berkeley Tech. L.J.), available at https://ssrn.com/abstract=3171977 (last accessed May 10, 2019), at 45: ("As shown, algorithms can make coordination easier and quicker than ever, thereby reducing incentives to compete. This, in turn, increases the importance of tools to curtail potential welfare-reducing effects, while ensuring that consumers can enjoy the benefits offered by the digital world."); see also Michal Gal, *Algorithmic-Facilitated Coordination: Market and Legal Solutions*, (available at https://www.competitionpolicyinternational.com/wp-content/uploads/2017/05/CPI-Gal.pdf; last accessed May 10, 2019): ("At the same time, and based on similar technological abilities, algorithms ease coordination among competing suppliers. Indeed, coordination no longer requires firms to operate in oligopolistic markets; and firms can more quickly and easily detect and punish deviations from the status-quo, thereby reducing incentives for shirking. As our assumptions about which market conditions must exist for firms to coordinate are altered, the number of red flags that are raised across industries rises.").

51 Ariel Ezrachi & Maurice Stucke, Virtual Competition (Harvard University Press, 2016); on the fundamental impact of algorithms, see also Ariel Ezrachi & Maurice Stucke, *Virtual Competition (Editorial)*, 7 J. Eur. Competition L. Prac. 585–86 (2016).

52 Schwalbe, *supra* note 12, at 568. He puts forward that many studies have shown that when more than two firms are involved, some form of communication is of importance for collusion. While according to the latest research on artificial intelligence "algorithms can learn to communicate, albeit in somewhat limited ways" so that in Schwalbe's view "algorithmic collusion currently seems far more difficult to achieve than legal scholars have often assumed".

53 U.K. Digital Competition Expert Panel, *supra* note 7, at 15.

on the design of an algorithm[54], the current state of research does not permit the conclusion that there is no such risk in the future. EU Competition Commissioner *Vestager* has made this point clear.[55]

To the extent that the use of informational technology is based on an antecedent conspiracy or that it leads to conspiracy, the notion of "agreement"[56] can be readily fulfilled. If several rivals agreed to use the same algorithm, and if this created a higher price than what would have existed had the rivals set their prices independently, this type of conduct would be an unlawful agreement or combination.[57] In other cases, however, direct horizontal conspiracy might be absent. Competing firms might unilaterally employ pricing algorithms that allow them to collectively raise prices above a noncollusive level.[58] Such algorithms might rely on information about rivals' conduct and release information reciprocally. In this case, there is a technological exchange of information without human beings directly intervening other than by designing and initiating the algorithm. (the latter might even be undertaken by firms other than the competitors.) The colluding firms relying jointly on the same pricing algorithm might not even know of the fact that their prices are supracompetitively inflated.[59]

Machine learning can possibly further contribute to nonexplicit collusion. The supracompetitive outcome might be wholly separate from human intervention and knowledge. Initially, it could be the programmer who decides what the computers are doing. That can at least indirectly be accomplished by means of reward functions/objective functions and the (potentially intentionally selective) provision of data. While the programmer's knowledge or

[54] Ezrachi & Stucke, *supra* note 35, at 1788.

[55] Margrethe Vestager, ("It's true that the idea of automated systems getting together and reaching a meeting of minds is still science fiction. But illegal collusion is not always put together in back rooms. There are many ways that collusion can happen, and some of them are well within the capacity of automated systems."), SPEECH 16 March 2017: *Algorithms and competition—Bundeskartellamt 18th Conference on Competition, Berlin, 16 March 2017*, available at https://ec.europa.eu/commission/commissioners/2014-2019/vestager/announcements/bundeskartellamt-18th-conference-competition-berlin-16-march-2017_en (last accessed May 10, 2019).

[56] On information exchange agreements, see Florian Wagner von Papp, Information Exchange Agreements, *in* Handbook on European Competition Law—Substantive Aspects, 130–73 (Ioannis Lianos & Damien Geradin eds, 2013).

[57] Ezrachi & Stucke, *supra* note 35, at 1787: ("The computers simply help execute the humans' anticompetitive agreement.").

[58] See Ezrachi & Stucke, *supra* note 35, at 1783.

[59] That distinguishes such a case from the scenario in *Eturas*, where the travel agencies using the *Eturas* platform had previously been informed on the platform's intervention into their pricing decisions, Case C-74/14 [Eturas UAB] ECLI:EU:C:2016:42. A much older case from the United States, which is very similar to *Eturas*, was Interstate Circuit v United States, 306 U.S. 208 (1939), only that the pricing information was sent to the participants by paper mail instead of electronic messages. On that case see B.J. Rodger, *The Oligopoly Problem and the Concept of Collective Dominance: EC Developments in the Light of U.S. Trends in Antitrust Law and Policy*, 2 Colum. J. Eur. L. 25, 30–36 (1996).

even intent might be clear, it is possible that firms relying on the algorithms are not aware of anticompetitive effects. Also, it is imaginable that emergent collusive equilibria develop, which were not foreseen or intended by even the designers of the program. Deep learning computer systems[60] can produce results without revealing to the programmers the "decision-making process", which has led to these results.[61] Moreover, intentional collusive elements in the design of a program could be hidden, so that programmers and firms might be able to argue that a market outcome has developed in an emergent fashion, although it is in fact based on the collusive design of an algorithm. In sum, self-learning systems therefore may be or become able to achieve and sustain collusive equilibria on their own by communicating with each other by design or by coincidence, and it might be difficult to tell the difference.[62]

Depending on the definition of illicit practices, such types of communication will either fall within the ambit of the cartel prohibition or be treated like individually rational conduct outside the scope of Article 101(1) TFEU or Section 1 of the Sherman Act. Several authors have expressed concerns over the capability of the existing legal framework in Europe and the United States to effectively remedy these risks. Ezrachi & Stucke state that the use of machine learning might escape legal scrutiny given a "lack of evidence of an anticompetitive agreement or intent".[63] Schwalbe concludes that collusion executed by machine learning systems would not violate existing EU competition laws, even if it leads to firms charging higher prices.[64] In a similar vein, Harrington concludes that "firms that collude through the use of [an autonomous artificial agent (AA)[65]] are not guilty of a Sherman Act Section 1 violation" so long as the AA does not convey a message to another AA other than "occurring through prices or other legitimate market data."[66] This statement is so broad that it might be seen as to cover most types of signaling undertaken by AA, because signaling is generally based solely on public price information. Signaling by AA would therefore fall outside the scope of Section 1 of the Sherman Act, according to this view. Capobianco et al. in their study for the OECD hold that, in "cases where algorithms allow firms to align business conduct in what looks very much like conscious parallelism", the "current legal standard does not allow intervention with the traditional rules on anti-competitive agreements between competitors".[67] Mehra is of a similar view, considering the use of "robo-seller technology" to fall outside the scope

[60] Deep learning is a subfield of machine learning, which allows the machine to model abstractions in data by creating artificial neural networks.
[61] OECD, *supra* note 8, ¶ 2.1.
[62] Stucke & Ezrachi, *supra* note 11; Ezrachi & Stucke, *supra* note 35, at 1795.
[63] Ezrachi & Stucke, *supra* note 35, at 1796.
[64] Schwalbe, *supra* note 12, at 22.
[65] Joseph E. Harrington, Jr., *Developing Competition Law for Collusion by Autonomous Artificial Agents*, 14 J. Competition L. Econ. 331, 341 (2019).
[66] Harrington, *supra* note 65, at 346–47.
[67] OECD, *supra* note 8, ¶ 7.

of Section 1 of the Sherman Act, "unless adopted as part of an agreement among competitors".[68]

It is against this background that the analysis will proceed with a critical assessment of the established criteria for defining illicit coordination. As mentioned above, I will focus on Article 101(1) TFEU, albeit with a summary of U.S. law on conscious parallelism under Section 1 of the Sherman Act.

III. THE ESTABLISHED CRITERIA OF DISTINCTION BETWEEN CONCERTED PRACTICES AND MERE TACIT COLLUSION

A. Searching for the Invisible: The Idea of Conscious Parallelism or Tacit Collusion

The classical conception of concerted practices is that this type of conduct is not "mere" tacit collusion. While the latter is considered a type of unilateral conduct of firms adapting intelligently to the dynamics of a market, a concerted practice is said to be a type of interaction, yet without the de facto binding commitment of an agreement.[69] While tacit collusion is often deemed as to constitute a "normal" outcome of an oligopolistic market structure, a concerted practice is said to be an "artificial" reduction of competition. These criteria of distinction therefore suggest an understanding of concerted practices as a type of "meta-coordination" that is supposed to sit somewhere between an agreement and mere unobjectionable tacit collusion. The OECD, for example, tries to fathom the essence as a "grey area of business behaviour which goes beyond conscious parallelism but at the same time does not involve an express agreement between competitors."[70]

The complexity of this concept lies in the description of this additional element of what "goes beyond conscious parallelism". The discussion on collusion is therefore often characterized by the struggle to describe the essence of the alleged meta-coordination.[71] EU jurisprudence and legal scholarship have suggested a variety of qualitative criteria that are categorized below. These will be referred to as "qualitative criteria" because they include no quantitative welfare analysis.

[68] Mehra, *supra* note 15, at 1365.

[69] On the notion of agreement, see inter alia Case T-7-89 [Hercules Chemicals v Comm'n] ¶ 256: ("Since it is clear from the case-law of the Court of Justice that in order for there to be an agreement within the meaning of Article 85 (1) of the EEC Treaty it is sufficient that the undertakings in question should have expressed their joint intention to conduct themselves on the market in a specific way [. . .]").

[70] OECD DAF/COMP(2012)17, Background Paper, Policy Roundtables on Unilateral Disclosure of Information with Anticompetitive Effects, 2012, ¶ 3.2, available at http://www.oecd.org/daf/competition/Unilateraldisclosureofinformation2012.pdf (last accessed May 10, 2019).

[71] For a comprehensive view on the economic theory behind collusion, modern oligopoly theory and its historical development, see Gregory J. Werden, *Economic Evidence on the Existence of Collusion: Reconciling Antitrust Law with Oligopoly Theory*, 71 Antitrust L. J. 719 (2003–2004).

B. A Typology of Qualitative Criteria

1. *Practical cooperation*

European jurisprudence has given the idea of "practical cooperation" a decisive role. The first time the Court of Justice gave a definition of the notion of concerted practices was in *Dyestuffs*. The Court stated that a concerted practice is "[…] a form of coordination between undertakings which, without having reached the stage where an agreement properly so-called has been concluded, knowingly substitutes practical cooperation between them for the risks of competition. By its very nature, a concerted practice does not have all the elements of a contract but may inter alia arise out of co-ordination, which becomes apparent from the behavior of the participants."[72]

In the *Sugar* case, the Court emphasized that the definition of concerted practices was not supposed to include situations where firms merely intelligently adapt their market strategy to the conduct of their rivals.[73] Moreover, the Court in *Sugar* elaborated the element of "practical cooperation" as "direct or indirect contact between such competitors, the object or effect whereof is either to influence the conduct on the market of an actual or potential competitor or to disclose to such a competitor the course of conduct which they themselves have decided to adopt or contemplate adopting on the market."[74] In *Propylene*, the Court addressed the concept by stipulating that the undertakings must have been "concerting together" and that their market conduct must have reflected "those collusive practices".[75]

2. *Subjective criteria*

Another strand of distinguishing criteria relates to the awareness and motives of the parties.[76] This idea surfaces early in the Court's definition in *Dyestuffs*

[72] Case 48/69 [ICI v Comm'n] ECLI:EU:C:1972:70 ¶¶ 64 and 65; see also Joined Cases C-89/85, C-104/85, C-114/85, C-116/85, C-117/85 and C-125/85 to C-129/85, [A. Ahlström Osakeyhtiö and others v Comm'n] ECLI:EU:C:1993:120 ¶ 63, and more recently Case C-8/08 [T-Mobile Netherlands] ECLI:EU:C:2009:343 ¶ 26.

[73] Joined Cases 40–48, 50, 54–56, 111, 113, and 114/73 [Coöperatieve Vereniging 'Suiker Unie' UA and others v Comm'n] ECLI:EU:C:1975:174.

[74] Joined Cases 40–48, 50, 54–56, 111, 113, and 114/73 [Coöperatieve Vereniging 'Suiker Unie' UA and others v Comm'n] ECLI:EU:C:1975:174 ¶ 174.

[75] Case C-49/92P [Comm'n Anic Partecipazioni SpA] ECLI:EU:C:1999:356 ¶ 118; see also Case 172/80 [Züchner v Bayerische Vereinsbank] ECLI:EU:C:1981:178 ¶ 17.

[76] The OECD wants, inter alia, to rely on the "objective or purpose" of the practice, OECD, *supra* note 70, ¶ 3.2; Roundtable on Facilitating Practices in Oligopolies—Note by the United States—OECD DAF/COMP(2007)112, available at https://www.ftc.gov/sites/default/files/attachments/us-submissions-oecd-and-other-international-competition-fora/usfp.pdf (last accessed May 10, 2019).

according to which the rivals must "knowingly" substitute a practical cooperation for the risks of competition.[77] The "knowingly" requirement presupposes a minimum of awareness of the negative effect of a firm's conduct on competition. Similarly, the OECD asserts that for a concerted practice a "manifested consensus to replace competition with forms of collusion between the participants" is of the essence.[78] The OECD also states that it is dispositive that "firms deliberately influence the conduct of other firms by disclosing to each other their respective course of conduct".[79] With respect to the rise of computer algorithms facilitating collusion, some authors would require proof of an "intent to change market dynamics"[80] before finding unlawful conduct.

3. *The artificiality concept*

As another way to distinguish interdependent lawful conduct from illegal concerted practices, it has been suggested that a concerted practice entails an element of "artificial" information as opposed to mere tacit collusion, which does not. The OECD states that communication between competitors can "artificially" increase "market transparency", thereby facilitating collusion.[81] This implies that there are other ways of increasing market transparency that are "natural" and thus would not be caught by Article 101(1) TFEU. The OECD states that "[a] rtificially increased transparency allows firms to monitor adherence to the collusive arrangement, and provides better information on when and how to punish firms where they deviate."[82] Harrington conceives of illicit coordination in terms of Section 1 of the Sherman Act as conveying "extraneous information", because, according to his view, Section 1 of the Sherman Act "does not prohibit collusion; it prohibits certain processes that might result in collusion".[83]

Similarly, Gal argues that algorithms can become illicit elements of collusion when their use is an "avoidable" action that changes "market conditions in a way that makes it easier to coordinate".[84] Relying on the "artificial-natural-schism", she concludes that "[...] the design and use of an algorithm is, in itself, an avoidable and intentional act. Such algorithms can facilitate,

[77] Case 48/69 [ICI v Comm'n] ECLI:EU:C:1972:70 ¶¶ 64 and 65; see also Joined Cases C-89/85, C-104/85, C-114/85, C-116/85, C-117/85 and C-125/85 to C-129/85, [A. Ahlström Osakeyhtiö and others v Comm'n] ECLI:EU:C:1993:120, ¶ 63, and more recently Case C-8/08 [T-Mobile Netherlands] ECLI:EU:C:2009:343 ¶ 26.

[78] OECD, *supra* note 70, ¶ 3.4.1.

[79] OECD, *supra* note 70, ¶ 3.4.1.

[80] Ezrachi & Stucke, *supra* note 35, at 1783.

[81] OECD, *supra* note 70, ¶ 4.1.

[82] OECD, *supra* note 70, ¶ 4.1., making reference to Genesove and Mullin, 2001.

[83] Harrington, *supra* note 65, at 346.

[84] Gal, *Algorithms as Illegal Agreements*, *supra* note 50, at 31: see also Michal Gal & Niva Elkin-Koren, *Algorithmic Consumers,* 30 Harv. J. L. & Tech. 309, 346 (2017): algorithms inducing collusion as positive actions departing from "the market's natural conditions".

maintain, or strengthen coordination by limiting incentives to compete beyond those that exist naturally". The use of an algorithm that fosters collusion is therefore conceived of as something "unnatural".

4. *The business justification paradigm*

To dispel the intricacies associated with exchange of information and signaling, it has also been suggested that the relevant criterion should be whether there is a business justification for the information being conveyed.[85] Where this is the case, the conduct should not come under Article 101 TFEU, so that no further effects analysis would be required.

5. *The "but-for-approach"*

In an attempt to bypass the complexities of a definition of concerted practices, the jurisprudence has also included what might be called a holistic approach. Under this view, a concerted practice exists if it is the sole explanation for the market outcome.[86] This approach appears to deny any further clarification of the characteristics of collusion. In fact, it is not a definition because it does not explain a degree of distinctiveness in a concerted practice. Rather, it is an evidentiary concept based on a but-for-approach that dispenses with the need to define the characteristics of a concerted practice.

6. *Corollary*

With exception of the but-for-approach, which is not a definition after all, it is characteristic of the other criteria that they try to capture the phenomenon of a concerted practice by focusing on the "means and the form used by competitors to collude", as the OECD puts it.[87] The existing criteria conceive of a concerted practice as a type of interaction that can be captured as an ontological category in its own right, and which can be distinguished from mere tacit collusion in qualitative terms.

C. The U.S. Law on Tacit Collusion

Before evaluating the prevailing criteria under EU law, it seems useful to review briefly the U.S. perspective on tacit collusion. This topic has yielded a substantial number of litigated cases and much legal and economic commentary over

[85] Tommy Staahl Gabrielsen & Ronny Gjendemsjø, *Prissignalisering—Signaling and Article 101 TEF*, Rapport 4/2016, 6.

[86] Case T-442/08 [CISAC v. Comm'n] ECLI:EU:T:2013:188 ¶ 181: ("It follows from the foregoing that the evidence relied on by the Commission is not sufficient to render implausible the explanation—other than the existence of concertation—for the collecting societies' parallel conduct put forward by the applicant, based on the need to ensure the effectiveness of the fight against the unauthorised use of musical works.").

[87] OECD, *supra* note 70, ¶ 2.1.

many years.[88] A brief review might give further guidance for the analysis of similar issues under EU law.

An early strand of commentary in the United States in the 1950s asserted that tacit collusion without more should be sufficient to establish the requisite agreement under Section 1 of the Sherman Act so long as the firms involved were aware of their interdependencies within the oligopoly.[89] This view was initially at least partially endorsed by courts in several private cases in the motion picture industry in the1940s and 50s.[90] The U.S. government also took this view in two cases in the same industry (and in no other industry).[91] Other U.S. commentators at the time vigorously opposed this view. They argued that mere conscious parallelism should not be deemed to constitute an agreement because such conduct was individually rational and unavoidable. Therefore, it was argued, no appropriate remedies would be available other than breaking up the oligopolistic firms[92], which would not be desirable for several practical reasons.[93] The U.S. Supreme Court eventually decided in 1954 in the *Theatre Enterprises* case (another private, not government motion-picture related case) that consciously parallel behavior was beyond the reach of Section 1 of the Sherman Act[94]: "Circumstantial evidence of consciously parallel behaviour may have made heavy inroads into the traditional judicial attitude toward

[88] On the judicial history of antitrust cases involving nonexplicit collusion, see Blechman, *supra* note 2, at 881.

[89] See James A. Rahl, *Conspiracy and the Anti-Trust Laws*, 44 Ill. L. Rev. 743, 755–62 (1950); Note, *Conscious Parallelism-Fact or Fancy?*, 3 Stan. L. Rev. 679, 680–82 (1951).

[90] The role of private cases in shaping U.S. antitrust law on this and other issues cannot be overstated. Milgram v. Loew's, Inc., 192 F.2d 579 (3d Cir. 1951), *cert. denied,* 343 U.S. 929 (1952); Ball v. Paramount Pictures, Inc., 169 F.2d 317 (3d Cir. 1948); William Goldman Theatres, Inc. v. Loew's, Inc., 150 F.2d 738 (3d Cir. 1945). See also Bordonaro Bros. Theatres v. Paramount Pictures, Inc., 176 F.2d 594 (2d Cir. 1949); Bigelow v. RKO Radio Pictures, Inc., 150 F.2d 877 (7th Cir. 1945), *rev'd on other grounds,* 327 U.S. 251 (1946); on that Blechman, *supra* note 2, at 883.

[91] Triangle Conduit & Cable Co. v. FTC, 168 F.2d 175 (7th Cir. 1948), *affd by* Clayton Mark & Co. v. FTC, 336 U.S. 956 (1949); United States v. Armour & Co., No. 48–1351 (N.D. Ill., filed Sept. 15, 1948); on that Blechman, *supra* note 2, at 883.

[92] Carl Kaysen, *Collusion Under the Sherman Act*, 65 Q.J. Econ. 263, 269–70 (1951): ("[T] he exhibition of parallel courses of action by rival oligopolists can legitimately form the basis of an inference of collusion . . ., yet it may fail to be equally useful in providing remedies for the evils complained of."); Almarin Phillips, *Policy Implications of the Theory of Interfirm Organization*, 51 Am. Econ. Rev. (PAPERS & PROCEEDINGS) 245, 251 (1961): ("With but a few firms, rivalry may be inadequate for good market performance . . . There can scarce be doubt that, in a behavioral sense, agreement exists among the few firms . . . Each acts in contemplation—frequently justified-that the others will react in a particular way . . . But, since agreements which affect prices are illegal, recognition of these tacit agreements by the courts would make simple oligopoly illegal per se."); on that part of the discussion, see also Werden, *supra* note 71, at 727.

[93] That is especially because it could destroy economic efficiencies of scale; see John R. Carter, *Collusion, Efficiency, and Antitrust*, 21 J.L. & Econ. 435, 441 (1978).

[94] Theatre Enterprises v. Paramount, 346 U.S. 537 (1945); on that case see Carter, *supra* note 93, at 442; Rodger, *supra* note 59, at 30–36; for details on the subsequent jurisprudence, see Werden, *supra* note 71, at 744–45 (2003–2004); Blechman, *supra* note 2, at 884.

conspiracy, but 'conscious parallelism' has not yet read conspiracy out of the Sherman Act entirely". While most commentators endorsed the *ratio decidendi* behind this ruling,[95] others continued to argue that the concept of agreement and combination under the Sherman Act was broad enough to extend to cases of pure conscious parallelism.[96] Academics, namely Posner[97], and in some respect Markovits[98], want to retain Section 1 as a basis for enforcement against sustained follow-the-leader oligopoly pricing. Kaplow has recently reiterated and refined this approach.[99]

Since *Theatre Enterprises*, debate in the United States has focused largely on the evidentiary requirements for proof of an agreement under Section 1 in cases where no explicit communication between firms can be shown.[100] One strand of case law and commentary focused on so-called plus factors[101],

[95] Robert Bork, The Antitrust Paradox 178–97 (1978); making the case for a distinction between illegal agreement and conscious parallelism also Blechman, *supra* note 2, at 882, 892.

[96] Some of them nonetheless rejected the case for enforcement, since appropriate remedies would force the oligopolists to refrain from acting rationally; see Donald F. Turner, The Definition of Agreement Under the Sherman Act: Conscious Parallelism and Refusals to Deal, 75 Harv. L. Rev. 655, 669–70 (1962).

[97] Richard A. Posner, *Oligopoly and the Antitrust Laws: A Suggested Approach*, 21 Stan. L. Rev. 1562, 1575 (1969): ("[. . .] the tacit colluder should be punished like the express colluder."); Richard A. Posner, *Oligopolistic Pricing Suits, the Sherman Act, and Economic Welfare, A Reply to Professor Markovits*, 28 Stan. L. Rev. 903 (1976).

[98] Markovits wants to distinguish between "normal" or "natural" oligopolistic pricing on the one hand, and "contrived" oligopolistic pricing on the other. He considers normal/natural oligopolistic pricing as oligopoly pricing that does not involve collusion or agreement and that has to be distinguished from what he conceives of as tacit collusion. Whereas he asserts that "natural oligopolistic pricing suits would be desirable", he holds that this type of conduct does not come under Section 1 of the Sherman Act. Richard S. Markovits, *A Response to Professor Posner*, 28 Stan. L. Rev. 919, 933–34 (1976). Contrived pricing, on the other hand, is understood as being based on threats and rewards, Richard Markovits, *Part II, Injurious Oligopolistic Pricing Sequences: Their Description, Interpretation, and Legality under the Sherman Act*, 26 Stan. L. Rev. 717, 738 (1974); see also Richard S. Markovits, *Oligopolistic Pricing Suits, the Sherman Act, and Economic Welfare, Part III, Proving (Illegal) Oligopolistic Pricing: A Description of the Necessary Evidence and a Critique of the Received Wisdom About its Character and Cost*, 27 Stan. L. Rev. 307, 315–19 (1975); Richard S. Markovits, *Oligopolistic Pricing Suits, the Sherman Act, and Economic Welfare, Part IV, The Allocative Efficiency and Overall Desirability of Oligopolistic Pricing Suits*, 28 Stan. L. Rev. 45, 55–60 (1975). It is questionable, however, whether the distinction between "normal" oligopoly conduct and "tacit collusion" is expedient under Section 1 of the Sherman Act. *Posner* rejects *Markovits'* approach; see Richard A. Posner, *Oligopolistic Pricing Suits, the Sherman Act, and Economic Welfare, A Reply to Professor Markovits*, 28 Stan. L. Rev. 903, 908, and 913–14 (1976).

[99] Louis Kaplow, *An Economic Approach to Price Fixing*, 77 Antitrust L.J. 343, 350 (2011); see also Louis Kaplow, *Direct versus Communication-Based Prohibitions on Price Fixing*, 3 J. Legal Analysis 449–538 (2011); Louis Kaplow, *On the Meaning of Horizontal Agreements in Competition Law*, 99 Cal. L. Rev. 683–818 (2011).

[100] William E. Kovacic, *Antitrust Policy and Horizontal Collusion in the 21st Century*, 9 Loy. Consumer L. Rep. 97 (1996–1997); Werden, *supra* note 71.

[101] The term "plus factor" is reported to have been mentioned for the first time in that context in C-O-Two Fire Equip. Co. v. United States, 197 F.2d 489, 493 (9th Cir.), *cert. denied*, 344 U.S. 892 (1952); on that see Blechman, *supra* note 2, at 885.

from which it might be inferred that, despite the lack of direct evidence, an agreement has in fact been reached between the rivals because an agreement is the only plausible (or the most compelling) explanation for the conduct in issue. Such plus factors were deemed to include, for example, prolonged parallel conduct, the existence of a rational motive to act in concert and perhaps against the individual best interest of each participant; the defendants' participation in past collusion cases; evidence that the firms had the opportunity to communicate or actually did so; and so forth.[102]

This plus factors theory has been substantially compromised, however, in a series of federal court of appeals decisions in the late 1990s and early 2000s. These cases held that, based upon Supreme Court decisions in other areas of antitrust law,[103] if each "plus factor" is as consistent with unilateral conduct as with conspiracy or agreement, then the conduct, without more, cannot be said to constitute an agreement.[104] After these and other cases, the plus factor theory has not been as rigorously applied in private cases, and not at all in the few civil government challenges to oligopoly conduct.

Another theory discussed extensively in U.S. cases and commentary are so-called "facilitating practices" or "facilitating devices".[105,106] The underlying idea here is that oligopolists can engage in avoidable conduct that reduces uncertainty about its and its rival's future conduct, for example, by deliberately increasing transparency about price, creating disincentives to discounting that have no legitimate business justification, and so forth. Such conduct can result in an effective horizontal coordination not possible through mere parallel conduct. Examples might also include market-wide resale price maintenance, price guarantees, or most-favored nation clauses perhaps newly adopted by competitors without explicit agreements but in a business context that suggests that the conduct would not have occurred unless all companies engaged in it.

[102] Mentioning these and further examples from the huge body of U.S. case law Kovacic, *supra* note 100, at 102.

[103] Monsanto Co. v. Spray-Rite Svc. Corp., 465 U.S. 752 (1984); Matsushita Electric Industrial Co. v. Zenith Radio Corp., 475 U.S. 574 (1986).

[104] *In re* Baby Food Antitrust Litigation, 166 F.3d 112 (3d Cir. 1999); Blomkest Fertilizer v. Potash Corp. of Saskatchewan, 176 F.3d 1055 (8th Cir. 2000; a 6–5 en banc decision).

[105] The Justice Department has defined "facilitating devices" as "mechanisms that facilitate the achievement of an industry pricing or output consensus and police deviations from it [in concentrated industries]." Memorandum from John H. Shenefield, Assistant Attorney General, Antitrust Division, Shared Monopolies, *reprinted in* [1978] 874 ANTITRUST & TRADE REG. REP. (BNA), at F-1. See George A. Hay, "Facilitating Practices: The Ethyl Case" in THE ANTITRUST REVOLUTION: ECONOMICS, COMPETITION, AND POLICY 182–201 (3rd edn, 1999).

[106] Announcing this policy Memorandum from John H. Shenefield, Assistant Attorney General, Antitrust Division, Shared Monopolies, *reprinted in* [1978] 874 Antitrust & Trade Reg. Rep. (BNA), at F-1; Remarks of Ky P. Ewing, Jr., Deputy Assistant Attorney General, Antitrust Division, before the Eighteenth Annual Advanced Antitrust Seminar, Practising Law Institute (December 1, 1978), at 13–14; Remarks of Assistant Attorney General John H. Shenefield at the Twelfth New England Antitrust Conference, [1978] 892 ANTITRUST & TRADE REG. REP. (BNA), at A-28; see on that Blechman, *supra* note 2, at 882, 891.

Also, the U.S. DOJ has taken the position that an otherwise legitimate joint venture can be used as a facilitating device to collude through signaling, as was alleged in the *Airline Tariff Publishing* case.[107] There the member airlines could electronically signal advance price announcements with no inventory at risk (no tickets could be sold at the future prices) and wait for return signals through the electronic joint venture from rivals to reach a "new" consensus price on the affected city-pair routes. The DOJ characterized this conduct as signaling through an "electronic bulletin board."

Although the legal and economic theories animating the United States debate about tacit collusion and much of the legal thinking behind it are useful in the discussion of the same issues under Article 101(1) TFEU, one must consider the differences in the legal structures of the regimes. Article 101(1) TFEU prohibits agreements and concerted practices, whereas Section 1 of the Sherman Act is confined to agreements, conspiracies, and combinations.[108] From a legal perspective, Section 1 therefore poses greater difficulty in challenging parallel conduct because under enduring U.S. case law it is necessary to prove the elements of conspiracy or agreement, that is, mutual exchange of assurances.[109] The legal question in the United States therefore is to what degree the proof of an agreement can be established by conduct void of any explicit declaration of a common will. Hay, for example, suggests that "when a group of firms has managed to coordinate their actions in such a way as to achieve supra-competitive prices (or some other anticompetitive result) and that coordination was facilitated by certain practices that the firms have engaged" and which have "no offsetting business justification [emphasis added], then the coordination can be described as constituting a tacit (and therefore unlawful) agreement."[110] Hay concedes, though, that it "remains to be seen" to what extent this approach will prevail as a concept under Section 1 of the Sherman Act.[111] As noted above, at least with respect to purely

[107] See 113 United States v. Airline Tariff Publ'g Co., No. 92 2854 (D.D.C. filed December 21, 1992); on that case Werden, *supra* note 71, at 765. Werden also mentions a Federal Communication Commission auction regarding licenses to broadband radio spectrum used to provide PCS Service. He concludes with respect to section 1 of the Sherman Act: ("In the terminology adopted above, both cases involved traditional conspiracies organized with spoken agreements."), Werden, loc. Cit. 767.

[108] E. States Retail Lumber Dealers' Ass'n v. United States, 234 U.S. 600, 612 (1914): ("some agreement must be shown under which the concerted action is taken. It is elementary, however, that conspiracies are seldom capable of proof by direct testimony, and may be inferred from the things actually done. . .").

[109] See Kovacic, *supra* note 100, at 98: ("A law whose reach hinges on the existence of an agreement requires courts to decide what conduct constitutes an agreement and how such an agreement may be proven in trial.").

[110] George A. Hay, *Horizontal Agreements: Concept and Proof*, 51 Antitrust Bull. 877, 913 (2006).

[111] Hay, *supra* note 110, at 914. Also, *Hay's* take relies on the finding of "certain [. . .] facilitating practices" and thereby presupposes an element which can be distinguished from pure tacit collusion.

conscious parallel conduct, the U.S. Supreme Court in *Theatre Enterprise*, at least in 1954, was skeptical about a broadening of the concept of agreement.

Article 101 TFEU, on the other hand, may offer a more accommodating framework to challenge nonexplicit collusion. The concept of concerted practices exists in addition to the notion of an agreement. This in theory at least extends the reach of the EU cartel provision beyond the scope of the wording and interpretation of its U.S. counterpart. Therefore, some of the arguments discussed with respect to matters of evidence for an agreement under Section 1 of the Sherman Act[112] can be treated as questions of substantive law under the notion of concerted practices in Article 101(1) TFEU. In other words, under EU law, plus factors themselves may qualify as a concerted practice irrespective of whether it can be inferred from them that an agreement exists in the first place. While it is argued that under Section 1 of the Sherman Act an agreement requires an element of "intent", "understanding", "commitment", or "assurance",[113] it is not clear that any of these elements are necessary to establish an illegal concerted practice under Article 101(1) TFEU, which by definition lies outside the scope of an agreement.

While the Sherman Act provides a more restrictive framework for the analysis of tacit collusion than Article 101(1) TFEU, § 5 of the U.S. FTC Act can be relevant in some cases in nonagreement contexts. § 5 bars any method of "unfair competition". Unlike the cartel prohibition, § 5 of the FTC Act does not require an agreement or any other type of bi- or multilateral commitment between rivals.[114] It can therefore gain relevance in cases of unilateral signaling, that is, in situations where one firm releases information to competitors or openly into the market in the anticipation that its competition will react in a way that would achieve a new collusive equilibrium.[115] With § 5 of the FTC Act, U.S. law therefore provides a somewhat more flexible instrument to tackle certain types of potentially harmful unilateral conduct.[116] In this context, mention can be made of the settlement reached by the U.S. FTC in a number of "invitation to collude" cases, including the *Valassis* case in 2006.[117]

[112] So-called "plus factors", see Blechman, *supra* note 2, at 897; in the matter of evidence on collusion see also Werden, *supra* note 71.

[113] Blechman, *supra* note 2, at 899–902.

[114] On the structure of § 5 FTC Act see OECD, *supra* note 8, at ¶ 5.2.

[115] Best price comparison sites might, depending on the facts of the case, unilaterally increase market transparency thereby fostering collusion.

[116] It prohibits "unfair or deceptive acts or practices in or affecting commerce." On the other hand, courts have not been receptive to using § 5 to challenge multilateral conduct by rivals that falls short of an agreement. See E.I. du Pont de Nemours & Co. v. FTC, 729 F.2d 128 (2d Cir. 1984) (*Ethyl*).

[117] Valassis Communications, 2006, FTC File No 051 0008. The case involved an alleged unilateral "invitation to collude" that was rejected by the defendant's rival but that the FTC nonetheless said violated § 5.

Under Article 101(1) TFEU and Article 102 TFEU it is more difficult to craft theories of harm relating to unilateral signaling, viz., attempts to collude, for the former requires an element of reciprocity, and the latter is only applicable where market dominance can be established.[118] Depending on the provisions to be applied and the facts of the case, U.S. law is therefore potentially more restrictive or more flexible when it comes to the assessment of certain signaling behaviors.[119] This must be borne in mind when referencing the U.S. decisional practice and scholarly debate in the present context.

IV. THE INAPTNESS OF THE CLASSICAL DEFINITION UNDER ARTICLE 101(1) TFEU

A. The Problem with the Notion of "Practical Cooperation"

As outlined above, EU jurisprudence defines the notion of concerted practices as "a form of coordination between undertakings by which, without it having reached the stage when an agreement properly so-called has been concluded, practical cooperation between them is knowingly substituted for the risks of competition." [120] Despite this definition being widely quoted in academic literature[121] and endorsed by the Commission[122], it raises conceptual challenges if one attempts to reconcile it with oligopoly theory.

The reason for the difficulty is that the words "practical cooperation" are so broad that they provide limited exegetical value. While collusion between firms is a well-established phenomenon in antitrust economics[123], the notion of "practical cooperation" seems to have little relevance here. There is no

118 Note that this article will not home in on the application of Article 102 TFEU on informational signaling. Due to the dominance criterion, which is hard to establish in many cases, and further restrictions to be considered when applying this provision, the article will confine itself to the cartel prohibition. On the application of Article 102 TFEU on pricing algorithms, see Uwe Salaschek & Mariya Serafimova, *Preissetzungsalgorithmen im Lichte von Art. 102 AEUV*, Wirtschaft und Wettbewerb 118–23 (2019).

119 See also on an EU/U.S. comparison Catalina Gonzalez Verdugo, *Horizontal Restraint Regulations in the EU and the US in the Era of Algorithmic Tacit Collusion*, 7 UCL J. L. and J. 114 (2018).

120 The definition was coined in Case 48/69 [ICI v Comm'n] ECLI:EU:C:1972:70 ¶ 64. It has since been continually used; see, for example, Joined Cases C-40/73 [Suiker Unie v Comm'n] ECLI:EU:C:1975:174 ¶ 26; Case C-199/92 P [Hüls AG v. Comm'n] ECLI:EU:C:1999:358 ¶ 158; Case C-8/08 [T-Mobile Netherlands] ECLI:EU:C:2009:343 ¶ 26.

121 Roger Van den Bergh, Comparative Competition Law and Economics 205 (2017); Jonathan Faull & Ali Nikpay, Article 101, *in* Jonathan Faull & Ali Nikpay, The EU Law of Competition ¶ 3.126 (3rd edn 2014); Christopher Bellamy & Graham D. Child, European Union Law of Competition ¶ 2.056 (Vivien Rose & David Bailey eds., 7th edn, 2013).

122 EU Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements, Communication from the Commission—Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements (hereinafter referred to as "EU Horizontal Guidelines"), OJ 2011 C 11/1, ¶ 60.

123 See in general Blechman, *supra* note 2, at 881; Carter, *supra* note 93; Kovacic, *supra* note 100; Werden, *supra* note 71.

categorial difference in the economic effects that are being precipitated by explicit collusion and that by tacit collusion[124], because both variants do not involve enforceable contracts. The notion of "concerted practice" seems to lie somewhere in between those two in linguistic terms,[125] yet the mechanisms allowing for coordination are the same: detection of deviation from the affected price or output and retaliation.[126] Formal economic theory can therefore contribute little to the identification of an unlawful "concerted practice" vs. that of mere tacit collusion, which is considered legitimate under the law.[127]

Classical legal interpretation of the wording of the law is also of limited avail. The concept of "agreement" stems from the field of private law and involves a reciprocal commitment by at least two parties.[128] The binding nature of contracts can be traced to the legal idea of "fides" ("credit"), as established in ancient Roman law, where it was considered that "what is promised is performed", as Cicero put it.[129] Yet while this line of thought might contribute to defining the distinctive features of an agreement, it does not help to distinguish between concerted practices and tacit collusion, because these two categories by definition lie outside the scope of an agreement. It is therefore unclear what a "practical cooperation" is supposed to mean. It entails no element of promise, for if it did, it would qualify as an agreement. But what is it then that distinguishes it from other types of economic interaction? It has rightly been observed that the search for mere linguistic synonyms for prohibited collusion is rarely fruitful because it in itself cannot substitute for establishing an entire legal concept.[130]

The most critical problem is that the criterion of "practical cooperation", while being broad and flexible in linguistic terms, has limited conceptual force if viewed in the context of oligopoly theory. A practical cooperation can be individually rational, and parallel individually rational conduct can

[124] Van den Bergh, *supra* note 121, at 206.

[125] Boshoff, Frübing, & Hüschelrath, *supra* note 3, at 440–41.

[126] Camesasca & Grelier, *supra* note 18, at 602; Levenstein & Suslow, *supra* note 18, at 45; Page, *supra* note 18, at 234.

[127] Van den Bergh, *supra* note 121, at 206 ff.

[128] Jack Beatson, Andrew Burrows, & John Cartwright, Anson's Law of Contract 31 (Oxford University Press, Oxford UK 2016).

[129] Marcus Tullius Cicero, De re publica, VII.: ("...Fides enim nomen ipsum mihi videtur habere, cum fit, quod dicitur...""); see with respect to Section 1 of the Sherman Act Blechman, *supra* note 2, at 882, 895: ("First, an essential characteristic of agreement would appear to be a sense of commitment in the minds of the agreeing parties."), and 896: ("A second, related characteristic of agreement would appear to be some assurance as to what the other agreeing parties are going to be doing in the future.").

[130] On Section 1 of the Sherman Act see Blechman, *supra* note 2, at 882, 895: ("The discussion is often cast in terms of synonyms for agreement-such as 'collusion,' 'concerted action' or 'a meeting of the minds'- which do not further define the concept. Other terms, such as 'unity of purpose' and 'common design,' would seem to apply to conscious parallelism as well as to agreement. See, for example, American Tobacco Co. v. United States, 328 U.S. 781, 810 (1946)."); see also Werden, *supra* note 71, at 778: ("Agreement in antitrust law is a broad and ill-defined concept.").

be conceived of as a type of collaboration or cooperation. If firms venture to achieve a new collusive equilibrium by applying a so-called *grim trigger strategy*, for example, a firm will start choosing an action, which maximizes total profits. It will then retain this course of action as long as all other firms have done so in all previous periods of the game. If a firm deviates, the punishment phase is triggered.[131] It is important to stress, however, that this type of oligopolistic interaction, even though one might feel inclined to label it as a "cooperation" in linguistic terms, remains an individually rational strategy. Therefore, from a game theory perspective it is still correct to consider it a noncooperative game. However, even when firms exchange information actively and privately, even if they enter into anticompetitive agreements, their interaction can be considered a noncooperative game, because there is no legally enforceable commitment between them, and the strategic dilemma in all cases is the same.[132] When the criterion of distinction as crafted by the courts is set against this economic background of oligopoly theory, one ends up with the perplexing notion of a "non-cooperative practical cooperation".

It must be noted that with respect to noncooperative games, the terminology often used to label the possible outcomes can be confusing in that it distinguishes between cooperative outcomes and noncooperative outcomes.[133] Cooperative outcomes mean a collusive equilibrium achieved by tacit or explicit collusion, whereas a noncooperative outcome is a competitive outcome. However, a cooperative outcome in this sense describes the outcome of the game. It is not a description of the means of communication by which this outcome was achieved. It applies to outcomes of classic hard-core cartels as to any other collusive outcome.[134] Therefore, the economic category of a "cooperative outcome" of a noncooperative game cannot contribute to the distinction between concerted practices and "mere" tacit collusion.

B. The Questionable Role of Knowledge or Intent

Given these difficulties in distinguishing between agreements, concerted practices, and mere tacit collusion, as alluded to above, some authors suggest rely-

[131] Paul Belleflamme & Martin Peitz, Industrial Organization—Markets and Strategies, (Cambridge University Press, Cambridge UK , 2nd edn, 2015) ¶ 14.2.1.

[132] See James W. Friedmann, Game Theory with Applications to Economics 184 (Oxford University Press, Oxford UK 1986): ("The fundamental distinction between cooperative and noncooperative games is that cooperative games allow binding agreements while noncooperative games do not."); Louis Kaplow, Competition Policy and Price Fixing 177 (Princeton University Press, Princeton 2013); see also Green & Porter, *supra* note 18.

[133] Kaplow, *supra* note 99, at 350.

[134] See Kaplow, *supra* note 99, at 350; Kai-Uwe Kühn & Xavier Vives, *Information Exchanges Among Firms and Their Impact on Competition* 43 (1995) (report to the European Commission); Robert E. Hall, 45 J. Econ. Lit. 1066, 1067 (2007) (review of Michael D. Whinston, Lectures on Antitrust Economics [2006]).

ing more on subjective criteria.[135] Under the language used by the European Courts, a concerted practice relates to a form of cooperation that "*knowingly* substitutes practical co-operation for the risks of competition".[136] Similarly, the U.S. Supreme Court held in 1984 in *Monsanto Co. v. Spray-Rite Service Corp.* with respect to Section 1 of the Sherman Act, that for an agreement to be found, "there must be direct or circumstantial evidence that reasonably tends to prove that [the parties] had a conscious commitment to a common scheme designed to achieve an unlawful objective."[137]

However, the criterion of "knowingly", or the reliance on evidence of an "objective" are also not robust or reliable tools for distinguishing lawful tacit collusion and unlawful concerted practices. And, in any event, it is unclear what degree of knowledge is supposed to be necessary to qualify the conduct as a concerted practice. Firms will often "know" what they are doing when they release information into the market or toward competitors. Should the notion of "knowingly" therefore relate to the creation of a collusive equilibrium? Firms could then contend that they could not or did not anticipate that their conduct would have such an effect. Relying on the "objective", on the other hand, has a somewhat circular characteristic in that the unlawfulness of a common scheme is supposed to hinge on the finding of the unlawfulness of the objective.[138]

Also, any definition of a concerted practice (or agreement for the matter of Section 1 of the Sherman Act) involving an element of knowledge or intent has a tendency to privilege those who, without reflecting on the intricate mechanisms of tacit collusion, rely on their "gut feeling" when setting prices and when communicating, or at least purport to have done so without leaving behind evidence of a "knowing" participation in an illegal common scheme.

Moreover, there can be cases where firms release business information without any knowledge that this helps to create a new equilibrium. For example, by simultaneously using corresponding algorithms, firms might achieve market outcomes that deviate from a competitive counterfactual.[139] The firms applying these technologies might not be aware of this effect. Gal considers it possible in these instances to argue that "algorithms intend to reach a certain goal".[140] Yet such an interpretation of the criterion of "intent" would ultimately be based on an idea of fictitious nonpersonal consciousness, when it refers to the *algorithm* as an intentionally acting agent. Algorithms, like any other nonhuman disposition, can be a cause for a specific outcome. Yet if causality is tantamount to intent, then any type of tacit collusion would

[135] See *supra* III.B.2.

[136] Simon Bishop & Mike Walker, The Economics of EC Competition Law: Concepts, Application and Measurement, ¶ 5–007 (Sweet & Maxwell, London, 3rd edn, 2010), (emphasis added).

[137] Monsanto Co. v. Spray-Rite Svc. Corp., 465 U.S. 752 (1984).

[138] Sceptical towards the *Monsanto-standard* Kovacic, *supra* note 100, at 101.

[139] See *supra* II.

[140] Michal Gal, *Algorithms as Illegal Agreements*, *supra* note 50, at 35.

be intentional. On the other hand, if one relied on the intent of the designer and the users to establish an agreement[141] or unlawful concerted practice, the prohibition would stop short if one of these persons was unaware of the effects. This could create antitrust blind spots because consumer harm may nonetheless occur.

Above all, this stance toward collusion could create a business incentive to invest more in self-learning computer technology to make use of an antitrust loophole. The achievements of machine learning can possibly allow to sustain a supracompetitive equilibrium without any humans directly involved.[142] While the imposition of a fine or a criminal sanction as well as private antitrust liability must be ruled out in those cases for the lack of negligence or intent, antitrust authorities should nonetheless have the power to intervene by administrative remedies to prevent consumer harm or—as in the United States—through a civil injunctive action with no penalty sought.

C. The Problems with the Artificiality Criterion

Another criterion of distinction that has been advanced is that a concerted practice should entail an element of "artificial" information.[143] This artificiality criterion, however, seems to lead to a circular argument. Artificiality is not a category that can be explained by the economics of collusion. Collusion can be achieved by employing signals (private or public) to reach a new common understanding, viz., a new focal point.[144] Moreover, signaling can increase transparency and thereby make detection and retaliation more effective.[145] The conclusion by each firm that informational signaling can have these effects can arise autonomously without any prior agreement. When an agreement is absent, however, the release of informational signals is as natural as the phenomenon of tacit collusion is. When rival firms decide individually to develop algorithms to foster collusion, then this collective decision to follow such a technological strategy can be seen as an emanation of tacit collusion.[146] If that is the case, though, such cannot be distinguished as something "artificial" from mere "normal" tacit collusion. Any attempt to distinguish between the categories of normal vs. artificial collusion is therefore highly likely to be only semantics. Adelman already in 1948 considered that any speculation as to whether a market outcome in an oligopolistic setting is the result of "natural economic forces" or comes "from a conspiracy 'artificially' imposed" is "useless hairsplitting".[147]

[141] Suggesting this as an alternative Michal Gal, *Algorithms as Illegal Agreements*, *supra* note 50, at 35.
[142] See *supra* II.
[143] OECD, *supra* note 70, at ¶ 4.1.
[144] EU Horizontal Guidelines, *supra* note 122, ¶ 66.
[145] EU Horizontal Guidelines, *supra* note 122, ¶ 67.
[146] Ezrachi & Stucke, *supra* note 35, at 1794.
[147] M.A. Adelman, *Effective Competition and the Antitrust Laws*, 61 Harv. L. Rev. 1289, 1322 (1948).

The problem with the artificiality criterion becomes apparent if one turns toward the potentially anticompetitive effects of public price announcements. Harrington concludes that it is illicit coordination in terms of Section 1 of the Sherman Act to convey "extraneous information".[148] He therefore argues that while an "overt act of communication" or "conveying a message to another" player is illegal, a communication "occurring through prices or other legitimate market data" should not be considered an "overt act of communication" coming under Section 1 of the Sherman Act.[149] When public price announcements are concerned, however, the point is that there is no extraneous information or communication other than that of publicly announced prices. Still, such announcements can harm consumers, depending on the facts of the case, and even have as their object a restriction of competition.[150]

D. The Ambiguity of the Business Justification Paradigm

The business justification paradigm[151] also raises problems. First, any attempt to distinguish legitimate information from information used in illicit coordination by normative terms, such as "normal"[152] or "justified by a business cause", are likely to be tautological, because the normative term calls for a definition that cannot follow from itself.[153] Second, the business justification paradigm is too broad as a concept to square with the structure of Article 101 TFEU. This is not to say that Article 101 TFEU is agnostic toward business justifications. The opposite is true. Yet the structure of Article 101 TFEU features a highly differentiated grasp of matters of business justification. For example, a business justification can bear on the scope of Article 101(1) TFEU under the ancillary restraints privilege. Under that doctrine, a restriction of competition does not fall within Article 101(1) TFEU where it is "directly related and necessary to the implementation of a main operation"[154], which

[148] Harrington, *supra* note 65, at 346.

[149] Harrington, *supra* note 65, at 346–47: ("According to that jurisprudence, I claim that firms that collude through the use of AAs are not guilty of a Sherman Act Section 1 violation. In making this claim, the presumption is that these AAs only have access to information that would be present under competition, such as past prices, sales, and other market data. In particular, the AAs do not post any extraneous information that could possibly be construed as one AA conveying a message to another AA. If there is any communication (broadly defined) between AAs, it is occurring through prices or other legitimate market data. As there is no overt act of communication, a requisite piece of evidence is absent.").

[150] Commission Case AT.39850 [Container Shipping].

[151] See *supra* III.B.4.

[152] Blechman, *supra* note 2, at 901: ("The question, then, is how to distinguish between the normal commercial practice of a businessman communicating his prices to customers [and thus, indirectly, to competitors] and the use of 'signals' to create a conspiracy in restraint of trade.").

[153] Consider the underlying syllogism: collusion is illicit if it is not justified by a business cause. It is not justified by a business cause if it is illicit.

[154] Case T-111/08 [MasterCard v Comm'n] ECLI:EU:T:2012:260 ¶ 77; Case T-112/99 [M6 v Comm'n] ECLI:EU:T:2001:215 ¶ 104.

can be a business operation, such as an M&A-deal with a legitimate noncompete clause.[155] Also, business reasons can become relevant within the ambit of Article 101(3) TFEU with respect to the legal exemption for consumer-benefiting restraints. Moreover, the jurisprudence of the Court of Justice, according to which the finding of a restriction of competition calls for an analysis of its effects on the market, in conjunction with the Commission's consumer welfare approach, can be the basis for a consideration of business justifications under Article 101(1) TFEU so long as the conduct produces consumer benefits.[156]

All these provisions and principles, however, depend upon a set of complex criteria involving an analysis of efficiencies and legitimate objectives. A general business justification paradigm would fall short of addressing these criteria in a sufficiently specific manner. It is unclear, for example, whether the business justification would be subject to a welfare analysis, and, if so, which welfare standard should apply. Merely increasing producer surplus could hardly suffice, for if it did, it could legitimatize any cartel. It must therefore be concluded that while Article 101 TFEU is open toward economic effects that can eventually be labeled in linguistic terms as a type of "business justification", the notion itself is not sufficiently precise to serve as a legal criterion of distinction within the structure of the law.

E. Corollary

The conclusion reached so far rests on the assumption that both, tacit collusion and concerted practices, are based on the same noncooperative game. From an economic perspective, it is therefore not dispositive to a collusive outcome whether the information used to tacitly collude comes from price lists published in the internet; whether it stems from public price announcements made by the firm's management; whether it is about information on existing prices or on planned price changes. All these bits and pieces, which can be related to individual transactions, which can be aggregated by third parties, or which are possibly accessible to algorithms, can be and will be used by a firm within a framework of tacit collusion where this leads to an increase in profits. The qualitative criteria tested above, which relate to the process of communication or the firms' inner spheres, have therefore demonstrated to be insufficient to delineate convincingly the difference between illicit collusion and lawful interdependent conduct.

155 Case 42/84 [Remia v Comm'n] ECLI:EU:C:1985:327.
156 On that see *infra* V.C.2.

V. HARMFUL INFORMATIONAL SIGNALS AS CONCERTED PRACTICES

A. Conceptual Solutions

Against this backdrop, there remain two conceptual solutions to the problem. Either the notion of concerted practices prohibits tacit collusion in its entirety, or, alternatively, there are two sub-categories within the scope of tacit collusion that can be distinguished by an external criterion, which is not itself related to the determinants of tacit collusion. Both concepts are analyzed in the following sections.

B. The Idea of Illegal Tacit Collusion

The idea of considering any tacit collusion as a type of illicit horizontal coordination is not new. As alluded to above, this view had decades ago gained some prominence in the United States. Some U.S. legal scholars[157] expressed the opinion that tacit collusion, follow the leader pricing or other "consciously parallel conduct", and so forth should be deemed a "meeting of the minds" and thus constitute an agreement in terms of Section 1 of the Sherman Act. Similar opinions have been expressed in regard to European and German antitrust law[158] and have gained new impetus in view of the collusive risks of self-learning algorithms.[159]

This view, however, faces objections. As to EU antitrust law, the jurisprudence[160] and a significant strand of commentary[161] vindicate the stance of

[157] See *supra* III.C.

[158] Daniel Zimmer, *Kartellrecht und neuere Erkenntnisse der Spieltheorie*, 154 Zeitschrift für das gesamte Handelsrecht [ZHR] 470 (1990).

[159] Jasper van den Boom, *The artificial hand of the free market: Algorithms and collusion*, 54 Tilburg University, Master Thesis—EU Economic and Competition Law (2018), available at http://arno.uvt.nl/show.cgi?fid=145648 (last accessed May 10, 2019); see also Petra Pohlmann, Algorithmen als Kartellverstöße, *in* Europäisches, Deutsches und Internationales Kartellrecht, Festschrift für Dirk Schroeder zum 65. Geburtstag, 633, 645–48 (Juliane Kokott, Petra Pohlmann, & Romina Polley, 2018), however, without expressing a personal view on this question.

[160] Case 48/69 [ICI v Comm'n] ECLI:EU:C:1972:70 ¶ 66; Case 85/76 [Hoffmann-La Roche & Co. AG v Comm'n] ECLI:EU:C:1979:36 ¶ 39; Joined Cases C-89/85, C-104/85, C-114/85, C-116/85, C-117/85 and C-125/85 to C-129/85, [A. Ahlström Osakeyhtiö and others v Comm'n] ECLI:EU:C:1993:120 71; Commission Case IV/30.350 [Zinc Producer Group] ¶ 75; Camesasca & Grelier, *supra* note 18; Patrick S. Ryan, *European Competition Law, Joint Dominance, and the Wireless Oligopoly Problem*, 11 Colum. J. Eur. L. 355, 358 ff (2005); Teresa Vecchi, *Unilateral Conduct in an Oligopoly according to the Discussion Paper on Art. 82: Conscious Parallelism or Abuse of Collective Dominance?*, 31 World Competition 385, 387 ff (2008).

[161] Kaysen, *supra* note 92, at 269–70: ("[T] he exhibition of parallel courses of action by rival oligopolists can legitimately form the basis of an inference of collusion . . .., yet it may fail to be equally useful in providing remedies for the evils complained of."); Phillips, *supra* note 92, at 251: ("With but a few firms, rivalry may be inadequate for good market performance . . . There can scarce be doubt that, in a behavioral sense, agreement exists among the few firms . . . Each acts in contemplation-frequently justified-that the others will react in a particular way . . . But, since agreements which affect prices are illegal, recognition of these tacit agreements

the U.S. Supreme Court in *Theatre Enterprises* in holding that tacit collusion cannot be deemed an agreement or a concerted practice *per se* under Article 101 TFEU. This view is convincing. Where a mechanism of detection and retaliation exists, sticking to supracompetitively high prices can be individually rational for any of the rivals involved. It would be unconvincing, however, to interpret the antitrust laws in a way as to oblige firms to act irrationally. As *Chamberlin* had already put forward in 1929: "[W] hen there are only two or a few sellers, their *fortunes* are not independent . . . Each is forced by the situation itself to take into account the policy of his rival in determining his own, and this cannot be construed as a 'tacit agreement' between the two."[162]

Kaplow rejects this view. He finds it "puzzling" and states[163]: "The simple point is that what is natural and rational depends on whether sanctions are imposed."[164] He argues that by punishing tacit collusion it would become rational for firms to avoid it.

However, the problem is that if a conduct is sanctioned to make it rational for the addressee to refrain from it, it is still necessary to define the precise conduct by which the addressee could avoid the fine. That is where the problem with the proposed prohibition of tacit collusion starts. The law can prohibit to do X, if this gives the addressee a clear basis to understand what X means and then to rationally refrain from doing X to avoid the sanction. Yet the law cannot prohibit one to "act rationally" because the compliance with this prohibition is akin to an obligation to act irrationally. Such an obligation, however, would deprive the addressee of her constitutional right to understand what she has to do to obey the law.[165] It would amount to an impossible obligation.[166] According to the principle of *impossibilium nulla est obligatio*, however, such an interpretation of the law cannot prevail.

Kaplow rejects this argument, too. He suggests that the case is not different from the prohibition of stealing an apple.[167] While stealing an apple might

by the courts would make simple oligopoly illegal per se."); on that part of the discussion see also Werden, *supra* note 71, at 727.

162 Edward H. Chamberlin, *Duopoly: Value Where Sellers Are Few*, 44 Q.J. Econ. 63, 65 (1929); pointing out this article of Chamberlain Werden, *supra* note 71, at 725.

163 Kaplow, *supra* note 99, at 430–31.

164 Kaplow, *supra* note 99, at 431.

165 With respect to the imposition of fines, see inter alia the principle of legality as enshrined in Article 49 of the Charter of Fundamental Rights of the European Union, OJ EU 2012 No. C 326/391.

166 See Turner, *supra* note 96, at 669: ("It gives no indication as to what defendants are supposed to do in order to comply. Superficially, the injunction would be somewhat more meaningful if it prohibited each defendant from taking into account the probable price decisions of his competitor in determining his own price or output. Indeed, such taking into account would have been the only basis for finding agreement and conspiracy in the first place, so that a change in this respect would seem necessary to make subsequent price behavior lawful. But such an injunction, read literally, appears to demand such irrational behavior that full compliance would be virtually impossible.").

167 Kaplow, *supra* note 99, at 431.

be economically rational, the sanction made it irrational to steal it. Yet a prohibition of tacit collusion would not be the same as the apple example. In fact, the apple example highlights the difference. Sanctioning the stealing of an apple gives the contingent perpetrator the possibility to rationally analyze what to do to escape the sanction. That is, to pay for the apple or to leave it where it is. An oligopolist facing a penalty for tacit collusion, however, would not be able to rationally analyze what to do to escape the sanction. The law cannot force a person to "un-know" something, if she knows it.[168] Elhauge & Geradin therefore are clearly correct when they observe that the problem with prohibiting tacit collusion as such would be that firms in oligopolistic markets "cannot avoid knowing their prices are interdependent when they set their prices, so that it would be hard to define any prohibition in a way that tells firms how to behave".[169]

Also, prohibiting oligopoly conduct as such would involve the impossible task of defining a 'sufficiently non-oligopolistic conduct' to comply with the law. If an oligopolist, after having processed all the information available, came to the conclusion that a price of £5 would be rational in terms of oligopolistic pricing, then would it suffice to charge £4.99 to escape the sanction on oligopoly pricing? Or would it be required to set prices equal to marginal costs[170], or average variable costs to "mimic" perfect competition?[171] Would it even be legitimate to charge £6? Also, it is impossible for an individual firm to anticipate which price level will eventually be achieved by means of tacit collusion for a certain period. Therefore, it is equally impossible for this firm to know which price level would be different from a possible collusive price level in the future. One can impose the heaviest sanctions conceivable: this will

168 White House Task Force on Antitrust Policy 5 (1968), reprinted in Antitrust & Trade Reg. Rep. (BNA) No. 411, spec. supp. II (May 27, 1969): ("antitrust law . . . cannot order the several firms to ignore each other's existence"); Herbert Hovenkamp, The Antitrust Enterprise 128 (2005): ("implicit in condemnation of any practice under the antitrust laws is that the defendant was obliged to behave in some other way than it did"); see also Sigrid Stroux, US and EC Oligopoly Control 114 (2004): ("Imposing competitors to disregard their rival[s'] behaviour would obviously be nonsense, as it would require them to behave irrationally."); F.M. Scherer & Davi Ross, Industrial Market Structure and Market Performance 342 (3rd edn, 1990): ("How should oligopolists change their behavior so as to avoid breaking the law? Must they begin ignoring their interdependence in pricing decisions, when to do so would be irrational?"); see also William Fellner, Competition Among the Few 309–10 (1949).

169 Einer Elhauge & Damien Geradin, Global Antitrust Law and Economics, 801–02; see furthermore 835 (2007).

170 Gunnar Niels, *Collective Dominance: More Than Just Oligopolistic Interdependence*, 22 Eur. Competition L. Rev. 168 (2001): ("In perfect competition, price equals marginal cost"); OECD, *supra* note 70, ¶ 2.1.: ("In a perfectly competitive market (that is, a market with an infinite number of firms, homogeneous products and perfect information) prices will be set at marginal cost.").

171 While the marginal firm will earn zero profits, more efficient rivals will earn a positive profit, Bishop & Walker, *supra* note 136, ¶ 6–016. It is also being pointed out that prices above short-run marginal cost may often be necessary to completely recover fixed costs and achieve a competitive return on investments; see Werden, *supra* note 71, at 761.

not change the inherent exegetical dilemma that would accompany a general prohibition of tacit collusion.[172]

C. Concerted Practices as Harmful Informational Signals

1. *Defining harmful conduct in collusive settings*

While the law cannot stipulate the obligation to deliberately act irrationally, it can prohibit certain measures so long as these are clearly defined. To describe illicit nonexplicit conduct it is therefore necessary to rely on a criterion of distinction that is not in itself related to the determinants of nonexplicit collusion. This makes it necessary to find a workable external standard. The present article suggests reliance on a finding of a consumer harm. A concerted practice in terms of Article 101(1) TFEU should, thusly, be defined as *any informational signals of two or more firms which have, as their object or effect, a restriction of competition, in that they harm consumers through a collusive equilibrium without creating offsetting efficiencies*.[173] This leads to the conclusion that, outside the scope of classical express agreements, the cartel prohibition comprises the finding of a restriction of competition as an integral element of itself.[174]

To avoid misunderstandings, it should be emphasized in what way this approach is different from the idea of a general prohibition of tacit collusion. As explained above, the latter should be rejected because firms cannot be obliged to "un-know" what they know or to otherwise act irrationally. What they can be obliged to do, however, is to abstain *entirely* from a specific conduct if it precipitates consumer harm. The criterion of distinction suggested here therefore readjusts the focus for the counterfactual analysis. Instead of comparing the equilibrium price with a hypothetical competitive outcome, each element of communication of the firms should be checked for its

[172] Michal Gal rightly observes that imposing a fine on any type of collusion would still leave uncertainty as to what conduct is prohibited, Gal, *Algorithms as Illegal Agreements*, *supra* note 50, at 28: ("Kaplow addresses this problem by arguing that if the remedy is sufficiently strong, market players will have sufficiently strong motivations not to engage in the prohibited conduct. In our view, the question still remains how to clarify what conduct is prohibited.") (footnote omitted).

[173] As a fact of the matter, the general definition of "concerted practices", as rendered by the Commission in its Horizontal Guidelines, to some extent reflects the postulate of an integrated analysis in that it presupposes that the "practical cooperation between" firms is "substituted for the risks of competition"; see EU Horizontal Guidelines, *supra* note 122, ¶ 60. What is argued here, though, is that a "substitution for the risks of competition" must be understood as to be tantamount to the finding of a restriction of competition by object or effect.

[174] Article 101(1) TFEU distinguishes between the conduct, that is, agreement/concerted practice/decisions, and the object or effect of this conduct, that is, prevention, restriction, or distortion of competition (the latter often, for the sake of brevity, referred to as "restriction of competition"). What is argued here is that if nonexplicit collusion is concerned it is impossible to properly decide on the finding of a concerted practice without knowing about its object or effect on competition. Both notions—concerted practice and restriction of competition—therefore must be conflated to reach a conclusion. This deviates from the classical approach that tries to analyze both separately.

propensity to cause a consumer harm. If a certain element of communication is found to create harm, then the firms are obliged to refrain from this type of informational signal completely.[175] In contrast to the idea of a general prohibition of tacit collusion, this approach defines clearly the conduct which must be avoided to abide by the law. The negative of the prohibited conduct is not irrationality; rather the negative is a predefined action: to refrain from this type of informational signal *entirely*. The definition of the legally required conduct therefore does not entail "imposed irrationality".

Some information, like price lists, might be indispensable to do business. They will therefore ultimately benefit consumers if weighed against a counterfactual in which such price lists were not used. Therefore, the release of such pricing information, even though it might give rise to a collusive equilibrium, might create a greater consumer benefit than it would be the case in a hypothetical counterfactual in which such information were not released at all, because that would hamper the distribution of the good or service even more. Other types of information, such as a private exchange of price announcements, or the use of certain pricing algorithms, on the other hand, might induce a collusive price without concomitant benefits to consumers. If compared with a hypothetical counterfactual, in which such pricing information is absent, these measures therefore create a consumer harm and should be prohibited.

The approach suggested here is therefore based on two conditions: (1) the element of conduct, which is under scrutiny, must contribute to a collusive equilibrium, and (2) if and to the extent it does, the consumer harm must not be offset by consumer benefits (2). Both elements of the test shall be analyzed more closely in the following.

2. *Harmful informational signals*

Creating a new collusive equilibrium For the creation of a new equilibrium, firms must create a focal price point and sustain prices at that level.[176] In

[175] This includes refraining completely from an informational signal of a certain scope, and to confine oneself instead to an informational signal of a lesser extent, for example, refrain entirely from making price announcements 6 months in advance and confine to announcements with a shorter period.

[176] Raphaël De Coninck, *Information Exchanges and Price Signaling: An Economic Perspective*, Bruylant 137, 140 (2016); Joseph E. Harrington, Roberto Hernan Gonzalez, & Praveen Kujal, *The Relative Efficacy of Price Announcements and Express Communication for Collusion: Experimental Findings*, 128 Journal of Economic Behavior and Organization 251 ff (2016); John M. Kuhlman, *Price Fixing, Nonprice Competition, and Focal Point Pricing: A Rose by Any Other Name*, 10 Antitrust L. & Econ. Rev. 75, 79 ff (1978); F.M. Scherer, *Focal Point Pricing and Conscious Parallelism*, 12 Antitrust Bulletin 495, 503 (1967); OECD, *supra* note 70, ¶ 1 and 2.3.2 with further references.

the following, price will be taken as *pars pro toto* for the competitive parameters on the market, but what is said can hold for several other parameters on which firms can possibly collude.[177] The challenge with algorithmic collusion as well as with human collusion therefore lies in the analysis of whether the outcome deviates from a competitive counterfactual. There is a significant body of research on indirect cartel evidence that gains relevance here. It is not the purpose to recapitulate it.[178] Yet the present article makes the point that in the absence of direct evidence for an agreement, it should be considered dispositive for an antitrust intervention to infer that prices are supracompetitively elevated.[179] It is not expedient to confine the analysis to an evaluation of the means that are being used to communicate, because there is no positive correlation between an increase in market transparency and a restriction of competition. Transparency can facilitate collusion as it can increase competition, depending on the facts of the case.[180] It can make markets more efficient if firms know of their rivals' prices and output.[181] The U.S. Supreme Court has stated that the dissemination of information in the market "is normally an aid to commerce".[182] Also, the same Court has highlighted that information "can in certain circumstances increase economic efficiency and render markets more, rather than less, competitive."[183] Consumers can benefit from a more vigorous competition that comes along

[177] Note that this relates to the conceptual approach of defining concerted practices only. If and to what extent collusion on other parameters than price precipitates harmful effects is another issue which requires a case-by-case analysis. For example, coordination on research & development can, depending on the facts of the case, create synergies and foster competition with other innovation poles; see EU Horizontal Guidelines *supra* note 122, ¶ 120.

[178] For an excellent analysis of this, see Kaplow, *supra* note 99, at 383–88.

[179] The recent decision in the Spanish *Tobacco* case reflects this; see Spanish CNMC, RESOLUCIÓN Expte. S/DC/0607/17 TABACOS, *supra* note 33, p. 64. There, the antitrust watchdog based its decision inter alia on indirect evidence in that it compared prices and market share developments with a hypothetical scenario. The authority held that a decline in demand for cigarettes should have made it likely for prices to fall and market shares to change. The absence of such effects, in the authority's view, demonstrated the existence of a collusive equilibrium: ("La realidad es que, mediante los intercambios de información, el mercado muestra un panorama muy diferente al que cabría esperar en un contexto competitivo, pues, como se analiza posteriormente, de un lado los precios han subido sistemáticamente más que los impuestos en un contexto de fuerte caída de la demanda y de otro las cuotas relativas de los fabricantes han permanecido casi inalteradas durante los últimos 10 años." *Unofficial convenience translation*: "The reality is that, through the exchange of information, the market shows a very different picture than one would expect in a competitive context, since, as discussed below, on the one hand prices have risen systematically more than taxes in a context of a sharp fall in demand and on the other hand the relative shares of manufacturers have remained almost unchanged over the last 10 years.").

[180] OECD, *supra* note 70, ¶ 2.3.

[181] Richard A. Posner, Antitrust Law (University of Chicago Press, Chicago 2nd edn, 2001); Ezrachi & Stucke, *supra* note 35, at 1797.

[182] Sugar Inst., Inc. v. United States, 297 U.S. 553, 598 (1936).

[183] United States v. U.S. Gypsum Co., 438 U.S. 422, 441 n.16 (1978).

with better-informed choices, as the OECD[184] and the Furman report rightly observe.[185]

Indeed, the expedience of an effects approach even surfaces in the jurisprudence of the European Court of Justice in *CRAM/Rheinzink*. There, the court held that when a concerted practice appears as the sole explanation for a conduct, it is upon the firms to rebut the presumption that the market outcome was caused by it.[186] By the same token, the Court of Justice later held in the seminal *Wood Pulp* case that it is upon the Commission to give full evidence of the fact that a market outcome had, as its sole cause, a collusion between firms, viz., to demonstrate a causal link between conduct and effect.[187] While this approach is not a viable definition for a concerted practice, as established above,[188] the underlying idea nonetheless displays the court's susceptibility to an effects analysis in oligopoly cases.

As alluded to above, the use of algorithms, machine learning, and blockchain technology can possibly facilitate collusion in several ways.[189] However, it is not the use of a technology as such that qualifies as a concerted practice. Nor is it the fact that computers or human beings increase market transparency. It is whether a collusive outcome is being created or not. If such can be established, though, knowledge or anticompetitive intent should not be held dispositive to the finding of a concerted practice. What counts is if prices are based, as a matter of naked causality, on the supracompetitive outcome of a noncooperative game, even though the latter is executed exclusively by self-learning algorithms. Engaging in a noncooperative game is not an emotional exercise exclusive to human beings. It is a rational operation which can, at least in theory, be run by an algorithm. That includes the public or private release of informational signals to foster collusion. This, too, is a rational operation. Self-learning systems might thus, in fact, be or become able to achieve and sustain such equilibria. These outcomes should therefore be susceptible to

[184] OECD, *supra* note 70, at ¶ 2.3.1.

[185] U.K. Digital Competition Expert Panel, *supra* note 7, at 3.

[186] Joined Cases 29 and 30/83 [Compagnie Royale Asturienne des Mines SA and Rheinzink GmbH v Comm'n] ECLI:EU:C:1984:130 ¶ 16: ("The Commission's reasoning is based on the supposition that the facts established cannot be explained other than by concerted action by the two undertakings. Faced with such an argument, it is sufficient for the applicants to prove circumstances which cast the facts established by the Commission in a different light and which thus allow another explanation of the facts to be substituted for the one adopted by the contested decision."); see also Case C-286/13 [Dole v Comm'n] ECLI:EU:C:2015:184; Commission Case IV/29.595 [Pioneer], OJ EC 1980 No. L 60/21 ¶ 73.

[187] Joined Cases C-89/85, C-104/85, C-114/85, C-116/85, C-117/85 and C-125/85 to C-129/85, [A. Ahlström Osakeyhtiö and others v Comm'n] ECLI:EU:C:1993:120 ¶ 71: ("In determining the probative value of those different factors, it must be noted that parallel conduct cannot be regarded as furnishing proof of concertation unless concertation constitutes the only plausible explanation for such conduct."). Note that this rule must be considered and evidentiary principle, not a legal definition for a concerted practice. On that see *supra* III.B.5.

[188] See *supra* III.B.5.

[189] See *supra* II.

full antitrust scrutiny, because their existence by no means depends on human beings to have developed intentions or feelings about it.

The efficiency criterion *The efficiency potential of informational signals* Following a consumer welfare approach[190], an integrated effects analysis of concerted practices must also account for welfare effects that can come along with the oligopolistic conduct. Information signals, despite giving rise to oligopoly prices, can nonetheless create benefits that offset these effects. Enhanced market transparency can benefit consumers, for example, by reducing their search costs.[191] Depending on which effect prevails, public pricing signals might, in fact, create more benefit than harm. Also, public information can serve consumers in planning their purchases ahead, which can also reduce their costs. In many cases, the release of information is even necessary for doing business in the first place. This holds true for much of the information publicly available on the internet, such as price lists, catalogues, or commercials. The reason why price advertising is unobjectionable under most circumstances is not that this type of information cannot help to collude. It can, and it often does. Yet it is unobjectionable in most cases because it creates efficiencies in that it enables consumers to make informed choices, which is a benefit "generally considered outweighing in magnitude the collusive effects of the announcements."[192] The benefits of vertical transparency can therefore offset the concomitant harm resulting from horizontal transparency.

The effects analysis leads to a different conclusion, however, where private communication elevates prices without providing benefit to consumers. Public price announcements can lack offsetting efficiencies if they are nonbinding or are being made so much in advance that consumers cannot base their purchasing plans on them. Similarly, when algorithms help firms to collude without improving consumers' choices, the market outcome can be worse than it would be in a counterfactual absent these pricing devices. When collusion is achieved by interoperating pricing algorithms that do not provide additional informational value to consumers, the harmful effects will likely predominate. In any event, the assessment will be a matter of thorough effects analysis, not of form-based categories.[193]

[190] See *supra* note 9 and 10.

[191] OECD, *supra* note 70, at ¶ 2.3.1.

[192] OECD, *supra* note 70, at ¶ 2.3.1.; referring to Chiara Fumagalli & Massimo Motta, *Advertising Restrictions in professional services*, EUI, Florence, September 1999; on the distinction between private and public information based on the efficiency side see also Itai Rabinovici, *Public Exchange of Information After Container Shipping*, 8 JECLAP 149, 151 (2017).

[193] See as an example the remedies imposed in the *Container Shipping* case, which restricted the release of price announcements without prohibiting them completely, Commission Case AT. 39850 [Container Shipping]. On the feasibility of a case-by-case efficiency analysis in exchange of information-settings, see Kai-Uwe Kühn, Carmen Matutes, & Benny Moldovanu, *Fighting Collusion by Regulating Communication between Firms*, 16 Centre for Economic Policy

The legal challenge of integrating efficiencies into Article 101(1) TFEU It could be argued against this approach that the framework for considering consumer benefits is Article 101(3) TFEU. One might be inclined to argue that under Article 101(1) TFEU, efficiency considerations should be kept out of the assessment. This argument, however, is not persuasive. First, the analysis above has demonstrated that none of the other criteria can provide a conceptually clear characterization of what distinguishes an illicit concerted practice from legitimate tacit collusion. Because there is not an equally expedient criterion of distinction, the efficiency-test remains the sole inflection point by which these two types of cases can be distinguished.

Moreover, the recognized principles of Article 101(1) TFEU demonstrate that this section of the prohibition is not agnostic toward the efficiency potential of a conduct. For a cooperation to come under the cartel prohibition, it is dispositive that it has "actual effects on the market", as the European Court of Justice has put it in *Cartes Bancaires*.[194] Effects on markets can be measured by the consumer welfare standard.[195] Therefore, the effects of a conduct on consumer rent can be retained as a guiding principle for the interpretation of the laws. As the Court of Justice has made clear in *Cartes Bancaires*[196], such an effects analysis is not reserved for Article 101(3) TFEU. It is already an integral element of the finding of a restriction of competition in the first place, for which establishing an agreement or a concerted practice defines the starting point.

The Commission in its Horizontal Guidelines reflects this principle. There, the Commission argues that while privately exchanged information will most likely amount to a restriction by object, it is different with publicly disclosed information. The latter should often not be considered a restriction in terms of Article 101(1) TFEU.[197] Both types of informational signals, privately exchanged information, as well as publicly released information, can, however, create a focal point for collusion. From an economic perspective, therefore, the distinction between these two types of information primarily lies in the different potential to create positive welfare effects.[198]

VI. CALIBRATING THE BURDEN OF PROOF

A. Effects Analysis: Dealing with Uncertainty

Another possible objection against the approach suggested here could be that for the finding of a concerted practice an effects analysis is too complicated,

Research (CEPR) 167, 194 (2001) on the U.K. Agricultural Tractor Registration Exchange case (1992/1994) for which the authors conclude offsetting efficiencies were absent.

194 Case C-67/13 P [Groupement des Cartes Bancaires v Comm'n] ECLI:EU:C:2014:2204 ¶ 51.

195 On that see *supra* note 9 and 10.

196 Case C-67/13 P [Groupement des Cartes Bancaires v Comm'n] ECLI:EU:C:2014:2204 ¶ 51.

197 EU Horizontal Guidelines, *supra* note 122, ¶ 94.

198 OECD, *supra* note 70, ¶ 1 and ¶ 2.3.1.

involves too much of uncertainty, and therefore is prone to weaken Article 101(1) TFEU.[199] Indeed, any legal definition must pay heed to its viability in real-world cases. The present article suggests, however, that integrating an effects analysis into the notion of concerted practices does not weaken antitrust enforcement. In fact, it can help to overcome enforcement lacunas that can otherwise arise with the surge of technologically sophisticated types of information exchange and signaling. A consumer harm analysis does not hinge on criteria relating to the inner sphere of colluding individuals, such as knowledge or intent. To the extent those elements are dispensable, the cartel prohibition can be invoked in cases where human decisions are largely substituted by algorithms.

The approach suggested here, comes at the expense of an economic effects analysis that can be challenging. This should not, however, be considered a reason to reject it. The intricacies of an effects analysis can be accounted for by defining the evidentiary burdens within the ambit of Article 101(1) TFEU in an appropriate way. Econometric uncertainty is inherent to any antitrust assessment based on a counterfactual analysis.[200] The default rule for dealing with this problem is in distributing the burden of proof in an effective but fair way. Often, efficiencies are considered a defence for which the firms are responsible.[201] That holds for efficiencies in merger cases[202], or for the legal exemption under Article 101(3) TFEU.[203] Yet, even within Article 101(1) TFEU, the evidentiary burdens for anticompetitive effects are calibrated in relation to the likelihood of consumer harm. While the category of restraints by object allows to a greater extent to infer harmfulness from the type of a conduct that is concerned, the by effect category mandates that the authorities and courts undertake a more in-depth analysis. It is against this background that the article will venture to refine the evidentiary burdens for establishing a competitive harm in oligopoly cases.

[199] Considering a rule of reason approach toward algorithmic pricing under Section 1 of the Sherman Act not well suited due to the analytical complexities coming along with it, Mehra, *supra* note 15, at 1365.

[200] On the matter of balancing effects in antitrust analysis, see Herbert J. Hovenkamp, *Antitrust Balancing*, 12 NYU JLB 369, 379 (2016).

[201] For an analysis of the burden of proof for efficiencies under U.S. procedural law, see Andy Gavil, *Burden of Proof in U.S. Antitrust Law*, 1 Issues in Competition Law and Policy 125, 154 (ABA Section of Antitrust Law 2008).

[202] Case T-175/12 [Deutsche Börse v Comm'n] ECLI:EU:T:2015:148 ¶ 275: ("The issue of the demonstration of anti-competitive effects, which is a matter for the Commission, differs from the issue of the demonstration of the fact that the efficiencies benefit consumers, are merger-specific and verifiable, which is a matter for those parties, as is apparent, in essence, from point 87 of those guidelines."); European Union Commission Horizontal Merger Guidelines, 2004 OJ C 31/5 ¶ 87.

[203] Council Regulation (EC) No 1/2003 of 16 December 2002 on the implementation of the rules on competition laid down in Articles 81 and 82 of the Treaty, 2003 OJ L1/25, Article 2 sentence 2.

B. Restrictions by Object and by Effect

1. The doctrinal background

The European Court of Justice laid out the criteria for restraints by object in its seminal *Cartes Bancaires* judgment.[204] The practices must "reveal a sufficient degree of harm to competition that it may be found that there is no need to examine their effects."[205] This requires the agreements or concerted practices to be "by their very nature, . . . harmful to the proper functioning of normal competition".[206] For a restriction by object, the likelihood of anticompetitive effects must be so great that it would have to be "considered redundant, for the purposes of applying Article 81(1) EC, to prove that they have actual effects on the market".[207]

The Court of Justice notes that for a finding of a restraint "by object", a comprehensive analysis of the agreement or concerted practice must take place attending to "the content of its provisions, its objectives and the economic and legal context of which it forms a part."[208] Additionally, the Court asserts that "(w)hen determining that context, it is also necessary to take into consideration the nature of the goods or services affected, as well as the real conditions of the functioning and structure of the market or markets in question".[209]

As far as the analysis of the typical harmfulness is concerned, the Court of Justice, albeit not explicitly mentioning the consumer welfare approach, refers to the effects of the conduct on consumer welfare. The Court makes mention of "falls in production and price increases, resulting in poor allocation of resources to the detriment, in particular, of consumers."[210] These statements embrace the consumer welfare criterion as an antitrust paradigm.[211] The *Cartes Bancaires* jurisprudence therefore allows one to conclude that the "by object" category is governed by the typical propensity of a certain type of conduct in relation to a given context to cause a consumer harm.[212] If such a typical harmfulness can be established, no further effects analysis is required. Otherwise, the "by effects" category is triggered and calls for a more thorough assessment, which cannot rely on the evidentiary shortcut that the very nature of the conduct allows one to assume a negative consumer impact.

[204] Case C-67/13 P [Groupement des Cartes Bancaires v Comm'n] ECLI:EU:C:2014:2204 ¶¶ 48 ff.

[205] Case C-67/13 P [Groupement des Cartes Bancaires v Comm'n] ECLI:EU:C:2014:2204 ¶ 49.

[206] Case C-67/13 P [Groupement des Cartes Bancaires v Comm'n] ECLI:EU:C:2014:2204 ¶ 50.

[207] Case C-67/13 P [Groupement des Cartes Bancaires v Comm'n] ECLI:EU:C:2014:2204 ¶ 51.

[208] Case C-67/13 P [Groupement des Cartes Bancaires v Comm'n] ECLI:EU:C:2014:2204 ¶ 53.

[209] Case C-67/13 P [Groupement des Cartes Bancaires v Comm'n] ECLI:EU:C:2014:2204 ¶ 53.

[210] Case C-67/13 P [Groupement des Cartes Bancaires v Comm'n] ECLI:EU:C:2014:2204 ¶ 51.

[211] On the consumer welfare standard, see *supra* note 9 and 10.

[212] On "efficiency and consumer welfare" as the gauges for an "object" analysis, see Kelvin Hiu Fai Kwok, *Re-Conceptualizing 'Object' Analysis under Article 101 TFEU: Theoretical and Comparative Perspectives*, 14 J. Competition L. Econ. 467, 473 (2019).

2. The ambiguity of the effects of communication on consumer welfare

If measured against these standards, the release of informational signals, by computers as well as by human beings, can amount to a restriction by object or constitute a restriction by effect depending on the likelihood of harm to consumers. Which of these categories is triggered will depend on the facts of the case. Categorizations pose difficulties in the present context.[213] Economic theory suggests that there is an "ambiguity of the welfare effects" in signaling.[214] When analyzing economic studies, it must be taken into consideration that they often focus on specific scenarios. A paper on signaling based on a symmetric duopoly involving homogenous products and Bertrand-competition might produce clear results, yet it likely only holds for this specific setting. The study might not provide guidance on what to assume when more than two oligopolists are involved or when differentiated products are at issue. The analysis of welfare effects of signaling is even difficult in static games with only two players.[215] Yet it is even more complicated in repeated pricing games.[216] Moreover, antitrust economics teaches that even if information is shared reciprocally and where it has in fact reduced uncertainty, it is not necessarily the case that this has had an effect on the firms' conduct.[217] Information might be ignored.[218]

This can also have bearing when algorithms are involved. As it has been pointed out, the propensity of algorithms to facilitate collusion depends on their design and context.[219] Even where information flows between computers, the potential effects on a collusive equilibrium depend on the reward functions/objective functions and the selection of data provided to the algorithm. It might be designed in a way as to process data and produce reciprocal informational signals to achieve anticompetitive equilibria. It might, however, also be based on reaction patterns that mimic competitive conduct. It is even conceivable that pricing algorithms are designed in a way as to disseminate misleading information to other firms to allow for cheating strategies.

C. Types of Effects

Despite the uncertainty about the effects that information can have on oligopolistic markets, it is useful to classify types of conduct according to their likely harmfulness. This article cannot, however, provide a comprehensive account of the current state of economic research in this field. Also, it must

[213] Calling for a case-by-case analysis of anticompetitive effects of information exchange EU Horizontal Guidelines, *supra* note 122, ¶ 75.
[214] Willem Boshoff, Stefan Frübing, & Kai Hüschelrath, *supra* note 3, at 458; see also *supra* I.
[215] Gabrielsen & Gjendemsjø, *supra* note 85, at 17.
[216] Gabrielsen & Gjendemsjø, *supra* note 85, at 17.
[217] Gabrielsen & Gjendemsjø, *supra* note 85, at 23 ff.
[218] Willem Boshoff, Stefan Frübing, & Kai Hüschelrath, *supra* note 3, at 442.
[219] See *supra* II.

be recognized that the research on and development of machine learning is progressing at a daunting pace. The assessment of the typical harmfulness of information, especially in the context of pricing algorithms and machine learning, therefore must be constantly reassessed.[220] Against this background, the following can only give a rough estimate.

A private exchange of information between rivals is oftentimes perceived as to indicate more clearly a risk to competition, because this type of communication is deemed to be "significantly less costly and more effective than public announcements"[221] if the purpose of the firms involved is to provide a new focal point for pricing. Also, private communication between competitors is generally deemed unlikely to produce efficiency justifications.[222] It is argued here that in the absence of verifiable efficiencies[223] such type of communication will likely be motivated by a purpose to elevate prices[224] and therefore qualify as a restriction by object.[225]

Public price announcements, however, are often associated with the possibility to create "significant benefits to consumers".[226] They can help consumers make better-informed decisions in the first place, which can foster competition.[227] It is not the mere public character of information that creates efficiencies, however. Rather, for consumers to derive benefits from information, it must provide a commitment value on which consumers can rely.[228] Signaling will generally be the more problematic the fewer players

[220] U.K. Digital Competition Expert Panel, *supra* note 7, at 15: ("Strategic recommendation D: The government, CMA and the Centre for Data Ethics and Innovation should continue to monitor how use of machine learning algorithms and artificial intelligence evolves to ensure it does not lead to anti-competitive activity or consumer detriment, in particular to vulnerable consumers.").

[221] OECD, *supra* note 70, ¶ 2.3.1; EU Horizontal Guidelines, *supra* note 122, ¶ 74.

[222] OECD, *supra* note 70, ¶ 4.2.1., *citing* Kai-Uwe Kühn, *Fighting Collusion by Regulating Communication between Firms*, 16 Economic Policy 167 (2001) *and* Massimo Motta, *Cartels in the European Union: Economics, Law, Practice*, Paper written for the Conference on—Fifty years of the Treaty: Assessment and Perspectives of Competition Policy in Europe, IESE Business School, Barcelona, 19–20 (November 2007), *and* Matthew Bennett & Philip Collins, *The Law and Economics of Information Sharing: the Good, the Bad and the Ugly*, 6 Eur. Competition J. 311 (2010).

[223] It must be stressed that these statements as to the typical harmfulness of privately exchanged information, which can suffice for the "by object" category, are related to price competition. It would be wrong to assume that the mere private character of the exchange of *any information* suffices for the allegation of likely harmfulness. A cooperation on research and development, for example, will most likely involve a private exchange of technological information. The Commission, however, rightly emphasizes in its Horizontal Guidelines that joint research and development will often create procompetitive effects and efficiencies, even though this type of coordination usually is not open to the public. See EU Horizontal Guidelines, *supra* note 122, ¶ 129.

[224] See also OECD, *supra* note 70, ¶ 4.2.1.

[225] See also EU Horizontal Guidelines, *supra* note 122, ¶ 73.

[226] OECD, *supra* note 70, ¶ 4.2.1.

[227] OECD, *supra* note 70, ¶ 4.2.1.

[228] OECD, *supra* note 70, ¶ 4.2.2.

are involved[229]; the more precise the information is,[230] the longer the period is between the release of the information of price changes and the actual change date.[231] Nonbinding public price announcements are at a greater risk of inducing collusion without creating offsetting efficiencies than binding price announcements. This is reflected in the remedies accepted in the *Container Shipping* case[232], where the Commission required the public price announcements to be shaped as binding maximum price caps.[233] Thus, even some types of public price announcements can therefore bear such a high likelihood to cause harm that the "by object box" must be ticked, as it might have been the case in the Commission's view in *Container Shipping*.[234]

Between a strictly private exchange of information and public signaling, however, are varying grades of exposure or exclusivity, which can make anticompetitive effects more or less likely. In the Spanish *Tobacco* case[235], for example, the distributor, which had provided information to all manufacturers who distributed through it, had also made some of it available to the Spanish tobacco market Commissioner. The exchange therefore was neither strictly private nor genuinely public. Although the Spanish competition authority stopped short of alleging a by object restraint, it found anticompetitive effects[236], viz., inflated prices. The Spanish authority also took issue with the fact that the information shared through the distributor exceeded in scope and data quality[237] what was published by the Spanish tobacco regulator.[238]

229 Ivaldi, Jullien, Rey, Seabright, & Tirole, *supra* note 18, at 12 ff.
230 De Coninck, *supra* note 176, at 144 ff.
231 De Coninck, *supra* note 176, at 145.
232 Commission Case AT.39850 [Container Shipping].
233 Commission Case AT.39850 [Container Shipping] ¶ 65. It is, in fact, questionable whether binding minimum-price caps would be a more effective remedy to foster competition. Minimum-price caps would make it more difficult to punish deviant rivals which could, in turn, destabilize a collusive equilibrium.
234 Commission Case AT. 39850 [Container Shipping] ¶ 52.
235 Spanish CNMC, RESOLUCIÓN Expte. S/DC/0607/17 TABACOS, *supra* note 33.
236 On the effects analysis, see Spanish CNMC, RESOLUCIÓN Expte. S/DC/0607/17 TABACOS, *supra* note 33, p. 60–83.
237 Spanish CNMC, RESOLUCIÓN Expte. S/DC/0607/17 TABACOS, *supra* note 33, p. 20 ff.
238 Spanish CNMC, RESOLUCIÓN Expte. S/DC/0607/17 TABACOS, *supra* note 33, p. 50 ff: ("Se trata de una información que difiere sustancialmente de la que periódicamente publica el CMT, por lo que no es posible considerar que estemos ante el acceso a una información pública. Como ya se ha señalado en esta resolución, el CMT publica información agregada sobre ventas provinciales con carácter mensual por lo que se trata de información sobre ventas pasadas. Asimismo, el grado de detalle de la información publicada por el regulador es inferior a la proporcionada por LOGISTA a todos los fabricantes que distribuyen sus productos a través de ella. En efecto, la información publicada en la página web del CMT no está desagregada dentro de cada provincia (se da información de las ventas totales en cada provincia, pero con la máxima agregación, es decir, sin distinguir por marcas o fabricantes) y además no cubre todas las referencias del mercado, sino que en muchos casos las agrega por marca, algo especialmente notorio para aquéllas con menor cuota de mercado." *Unofficial convenience translation:* "This information differs substantially from that published periodically by the CMT, so it cannot be considered as access to public information. As has already been pointed out in this resolution,

This conclusion, however, was only reached after an in-depth effects analysis, which led the authority to believe that the software applications providing reciprocal real-time patterns of consumer behavior had sufficed to induce a collusive equilibrium and that these effects were not offset by efficiencies.[239] In such circumstances, the by effect category can therefore be the appropriate framework for the competition analysis.

Explicit collusion is deemed to make reaching a new focal point by rivals more efficient, at least within the starting period of the coordination.[240] With the advancements of machine learning, however, market transparency can possibly be increased in areas where it previously would have been difficult to detect the behavior of competitors.[241] Also, machine learning is considered to enable one to predict rivals' reactions more precisely, which can, at least in theory, make explicit communication dispensable for reaching a focal point.[242] Depending on the context of the case, their effect can thus possibly come close to that of an explicit agreement, which would then warrant the same legal assessment as a concerted practice within the by object category.

the CMT publishes aggregated information on provincial sales on a monthly basis, so that it is information on past sales. Likewise, the degree of detail of the information published by the regulator is lower than that provided by LOGISTA to all manufacturers distributing their products through it. In effect, the information published on the CMT website is not disaggregated within each province (information is given on total sales in each province, but with the maximum aggregation, that is, without distinguishing by brand or manufacturer) and also does not cover all market references, but in many cases aggregates them by brand, something especially notorious for those with the lowest market share.").

239 Spanish CNMC, RESOLUCIÓN Expte. S/DC/0607/17 TABACOS, *supra* note 33, p. 99: ("No hay ninguna razón objetiva que permita a esta Sala considerar que el intercambio sobre ventas provoca eficiencias en el mercado sino más bien todo lo contrario, ya que ha permitido a las empresas adoptar una postura de inmovilismo durante un largo periodo de tiempo a través del cual estas consiguen perpetuar el statu quo y eliminar los incentivos para desviarse de los precios que establecen los competidores, todo ello en un mercado en el que la competencia ya está muy debilitada dadas las características del mismo." *Unofficial convenience translation*: "There is no objective reason for this Chamber to consider that the exchange on sales leads to efficiencies in the market, quite the contrary, since it has allowed companies to adopt a stasis position for a long period of time through which they manage to perpetuate the status quo and eliminate the incentives to deviate from the prices set by competitors, all in a market in which competition is already very weakened given the characteristics of the market.").

240 OECD, *supra* note 70, ¶ 3.2.

241 The OECD rightly observes: ("These intermediary situations between explicit and tacit collusion are becoming more and more frequent in sophisticated economies, where old fashioned agreements are increasingly replaced by more discrete, looser forms of co-ordination and informal understandings between firms. Such forms of interaction between competitors may still have anti-competitive effects and might require scrutiny under competition rules."), OECD, *supra* note 70, ¶ 3.2.

242 With respect to the problem of multiple equilibria in Bertrand supergames, see Francisco Beneke & Mark-Oliver Mackenrodt, *Artificial Intelligence and Collusion* 50 IIC 109, 127 (2019).

VII. CONCLUSIONS

There are reasons to assume that the classical hard-core cartel based on explicit agreements relating to prices, quantities, or customer allocation is gradually being replaced by more sophisticated types of public or private exchange of information. Leniency programs and stricter private enforcement regimes have destabilized cartel agreements, and the use of algorithms, especially machine learning, and blockchain technology can possibly provide effective forms of nonexplicit collusion.

Against this backdrop, the currently prevailing criteria for distinguishing between illicit cartel conduct and legitimate tacit collusion are prone to create enforcement blind spots. They rest on the assumption that concerted practices are a collusive phenomenon beyond the mere intelligent adaption to the rivals' conduct. This concept, however, does not reconcile well with oligopoly theory. Moreover, the decisional practice in relying on criteria such as "practical cooperation" and the oligopolists acting "knowingly" hinges on human perceptions and intents. These are probably hard to establish or may even be absent in cases where algorithms, machine learning, or blockchain technology are involved.

The present article suggests that to distinguish between legitimate and illicit collusion, an economic effects analysis should be integrated into the notion of concerted practices. The precipitation of a restriction of competition by object or by effect must be conceived of as an integral element of the establishment of a concerted practice. The integrated effects analysis should be governed by the consumer welfare standard as the default gauge for competitive restraints under EU law. This dispenses with qualitative criteria such as knowledge, intent, or the equivocal "practical cooperation" standard. Along the lines of this approach, the existing legal framework of the European competition law order can provide an effective toolkit to react to competitive risks associated with technologically sophisticated types of collusion. The cartel prohibition can be applied in scenarios in which it could not if based on the established set of criteria.

The core postulate therefore is that anti-cartel enforcement should focus on an economic effects analysis instead of pursuing a form-based approach. The challenges that come with an effects analysis should not be seen exclusively as a weakness of the concept. In fact, it helps to close regulatory gaps in the first place. Moreover, based on the categories of restraints by object and by effect, it is possible to calibrate the burdens of proof. Where a certain conduct displays a great likelihood of creating consumer harm, it can become possible to conclude from this conduct on the existence of a concerted practice without more. Ultimately, the findings of the present analysis lead to the conclusion that the limits for antitrust enforcement are not so much to be found in alleged deficits of the existing legislation. Rather, the factual assessment of the harmfulness of technologically sophisticated types of collusion is possibly the bigger challenge. Scientific progress will therefore be a determinant for future enforcement policy. It will hinge on the ability of computer sciences, the economics, and legal scholarship to coalesce for further interdisciplinary research.