Autonomization and Antitrust

On the Construal of the Cartel Prohibition in the Light of Algorithmic Collusion

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I. INTRODUCTION

The use of algorithms is associated with a risk of collusion. This bears on the construal of the cartel prohibition, on which the present chapter focuses. The hypothesis is that algorithms may achieve a collusive equilibrium without any involvement of natural persons. Against this backdrop, it is questionable whether and to what extent such an outcome can be qualified as a concerted practice in terms of the law.

The analysis will be structured as follows: first, it will be assessed in what way algorithms can influence competition on markets (Section II). Subsequently, the article will deal with the traditional criteria of distinction between explicit and tacit collusion, which might reveal a potential gap in the existing legal framework with respect to algorithmic collusion (Section III). Finally, it must be analyzed whether the cartel prohibition can be construed in a way that captures the phenomenon appropriately (Section IV). The chapter will close with a summary (Section V).

II. ALGORITHMIC COLLUSION AS A PHENOMENON ON MARKETS

It is widely accepted that the use of algorithms can precipitate collusive outcomes, at least in theory. There is no lack of attempts to systematize the different ways algorithms can be involved here. Since the first groundbreaking publications by *Ariel Ezrachi*, *Maurice Stucke*, and *Salil Mehra*, as well as other authors in the following, the matter has come into the focus of antitrust scholarship and practice.[1] Agencies have started to look

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[1] See, e.g., A Ezrachi and M E Stucke, 'Sustainable and Unchallenged Algorithmic Tacit Collusion' (2020) 17 *Nw J Tech & Intell Prop* 217; A Ezrachi and ME Stucke, 'Algorithmic Collusion: Problems and Counter-Measures, Note to the OECD Roundtable on Algorithms and Collusion' (*OECD*, 31 May 2017) www.oecd.org/officialdocuments/publicdis playdocumentpdf/?cote=DAF/COMP/WD%282017%2925&docLanguage=En; A Ezrachi and ME Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (2016); U Schwalbe, 'Algorithms, Machine Learning, and Collusion' (2018) 14 *J Comp L & Econ* 568; A Ittoo and N Petit, 'Algorithmic Pricing Agents and Tacit Collusion: A Technological Perspective' in H Jacquemin and A de Streel (eds), *L'intelligence artificiale et le droit* (2017) 241; SK Mehra, 'Antitrust and the Robo-Seller: Competition in the Time of Algorithms' (2016) 100 *Minn L Rev* 1323; VM Pereira, 'Algorithm-Driven Collusion: Pouring Old Wine Into New Bottles or New Wine Into Fresh Wineskins?' (2018) 39 *ECLR* 212; PG Picht and B Freund, 'Competition (Law) in the Era of Algorithms' (2018) 39 *ECLR* 403; VD Roman, 'Digital Markets and Pricing Algorithms – a Dynamic Approach towards Horizontal Competition' (2018) 39 *ECLR* 37; see for an assessment of the Commission's e-commerce sector inquiry regarding the risks of algorithmic collusion N Colombo, 'What the European Commission (Still) Does Not Tell Us about Pricing

into it.[2] First cases have emerged about restraints implemented on platforms involving computer technology. With respect to the United States (US) *Topkins*[3] must be mentioned, which involved alleged horizontal price fixing on a digital platform based on algorithms. For the European Union (EU), the *Eturas*[4] case comes to mind. The operator of a travel booking platform had informed the travel agencies using that platform that it intended to cap rebates granted to end-consumers. The European Court of Justice (ECJ) held that this amounted to a horizontally concerted practice among the travel agencies to the extent that these had not objected to this proposal. The Luxembourg competition authority in 2018 found the taxi booking app Webtaxi to be exempt from the cartel prohibition although the system involved an algorithmic horizontal alignment of prices. The agency found offsetting efficiencies to the benefit of consumers.[5] These cases have in common that the natural persons representing the companies involved were aware of the restrictions, or that they at least ought to have known about them. Algorithms were an element of implementing the restriction, yet the ultimate decision about the competitive restraint was taken by human beings. Under these conditions the cases did not pose severe difficulties in establishing explicit collusion. There is not a fundamental difference to cases in which parties communicate, for example, by way of hub-and-spoke cartelization through traditional means and forms of communication.[6]

A greater legal challenge is caused by the risk of autonomous algorithmic collusion. Computers with machine learning capabilities can possibly achieve or sustain a collusive equilibrium without any involvement of human knowledge or intent. The underlying scholarly discussion usually orbits around q-learning mechanisms.[7] The hypothesis is that algorithms with machine learning capabilities can act as computer agents exploring the success of their own actions, from which a collusive strategy can emerge as the optimum. In this event, it is

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Algorithms in the Aftermath of the E-Commerce Sector Inquiry' (2018) 39 *ECLR* 478; See also P Pohlmann, 'Algorithmen als Kartellverstöße' in J Kokott and others (eds), *Europäisches, deutsches und internationales Kartellrecht, Festschrift für Dirk Schröder* (2018) 633, 645 *et seq.*; D Zimmer, 'Algorithmen, Kartellrecht und Regulierung' in J Kokott and others (eds), *Europäisches, deutsches und internationales Kartellrecht, Festschrift für Dirk Schröder* (2018) 999 *et seq.*

[2] *See* Autorité de la Concurrence and BKartA, 'Algorithms and Competition' (*BKartA*, November 2019) www.bundes kartellamt.de/SharedDocs/Publikation/EN/Berichte/Algorithms_and_Competition_Working-Paper.pdf?__blob= publicationFile&v=5; Autoridade da Concorrência, 'Paper on Digital Ecosystems, Big Data and Algorithms' (*AdC*, July 2019) www.concorrencia.pt/vEN/News_Events/Comunicados/Documents/Digital%20Ecosystems%20Executive% 20Summary.pdf; Competition & Markets Authority, 'Pricing Algorithms: Economic Working Paper on the Use of Algorithms to Facilitate Collusion and Personalised Pricing' (*CMA*, October 2018) https://assets.publishing.service.gov .uk/government/uploads/system/uploads/attachment_data/file/746353/Algorithms_econ_report.pdf.

[3] US Department of Justice, 'Former E-Commerce Executive Charged with Price Fixing in the Antitrust Division's First Online Marketplace Prosecution' (*US DoJ*, 6 April 2015) www.justice.gov/opa/pr/former-e-commerce-executive-charged-price-fixing-antitrust-divisions-first-online-marketplace.

[4] ECJ, Case C-74/14 *Eturas* (23 June 2016).

[5] Conseil de la Concurrence, 'Décision 2018-FO-01' (*Conseil de la Concurrence*, 7 June 2018) https://concurrence.public .lu/dam-assets/fr/decisions/ententes/2018/decision-n-2018-fo-01-du-7-juin-2018-version-non-confidentielle.pdf.

[6] In *Interstate Circuit v United States* from 1939 pricing restraints were implemented by vertical communication through analogue means, which, however, had the same effect as a digital communication would have had, *Interstate Circuit v United States* 306 US 208 (1939). On this case *see* BJ Rodger, 'The Oligopoly Problem and the Concept of Collective Dominance: EC Developments in the Light of U.S. Trends in Antitrust Law and Policy' (1995/1996) 2 *Colum J Eur L* 25, 30–36.

[7] This is a type of reinforcement-learning-algorithm, which adapts its conduct through experience. Learning takes place through the gaining of experience in these actions, which when proved successful, are repeated more frequently, while less successful actions are performed less frequently. Such a pattern allows the algorithms to develop a strategy that reaches the optimum or comes close to it. Therefore, q-learning allows an optimization without prior knowledge of the problem which is to be solved.

conceivable that even the programmer of the algorithm was not aware of this potential outcome.[8] The market effect, therefore, can be a collusive equilibrium, albeit absent any human involvement.

Lawyers, economists, and computer scientists are still at odds over the likeliness and actual occurrence of autonomous algorithmic collusion. Some consider it a realistic scenario that tends to be underestimated.[9] The German Bundeskartellamt and the French Autorité de la Concurrence have refrained from a definitive conclusion so far.[10] *Ulrich Schwalbe*, in his seminal article, points out that the game theoretical dilemma that has to be solved by autonomous computer agents to achieve a stable collusive equilibrium is huge and cannot be easily overcome in practice.[11] A more recent study by *Emilio Calvano* and others[12], however, concludes that q-learning algorithms, in fact, can autonomously collude. The EU Commission, in its proposal for a 'New Competition Tool', mentions the risk that digital platforms can create ecosystems in which collusion arises, which can be read as a recognition of the phenomenon as a matter of concern.[13] Against this backdrop, it is expedient to elaborate further on the application of the cartel prohibition in such cases.

III. ON THE SCOPE OF THE CARTEL PROHIBITION AND ITS TRADITIONAL CONSTRUAL

The conceptual problem behind the traditional construal of the cartel provision is the difference in the structure of the law on the one hand and the economic determinants for collusive equilibria on the other.[14] Anticompetitive collusive equilibria are characterized by the fact that the participants consider it individually rational to pursue such a strategy. That is the case for types of collusion that are usually referred to as explicit and which are illegal in the same way as it holds true for so-called tacit collusion, which is seen as not to fall within the scope of the prohibition. Agreements in breach of the cartel prohibition are null and void so that they cannot

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[8] S Thomas, 'Harmful Signals: Cartel Prohibition and Oligopoly Theory in the Age of Machine Learning' (2019) 15 *J Comp L & Econ* 159.

[9] A Ezrachi and ME Stucke, 'Sustainable and Unchallenged Algorithmic Tacit Collusion' (2020) 17 *Nw J Tech & Intell Prop* 217.

[10] Autorité de la Concurrence/BKartA, 'Algorithms and Competition, Nov 2019' (*BKartA*, November 2019) www.bundeskartellamt.de/SharedDocs/Publikation/EN/Berichte/Algorithms_and_Competition_Working-Paper.pdf?__blob=publicationFile&v=5; Autoridade da Concorrência, 'Paper on Digital Ecosystems, Big Data and Algorithms, July 2019, Executive Summary' (*AdC*, July 2019) www.concorrencia.pt/vEN/News_Events/Comunicados/Documents/Digital%20Ecosystems%20Executive%20Summary.pdf.

[11] U Schwalbe, 'Algorithms, Machine Learning, and Collusion' (2018) 14 *J Comp L & Econ* 568.

[12] E Calvano and others, 'Artificial Intelligence, Algorithmic Pricing, and Collusion' (2020) 110 *Am Econ Rev* 3267. The authors present a study on the capability of q-learning algorithms to achieve equilibria. They come to the conclusion that algorithms can learn to implement anticompetitive pricing.

[13] See the explanation given in the Inception Impact Assessment for a 'New Competition Tool', S. 1: 'The Commission's enforcement experience in both antitrust and merger cases in various industries points to the existence of structural competition problems that cannot be tackled under the EU competition rules while resulting in inefficient market outcomes. [...] Even short of individual market power, increasingly concentrated markets can allow companies to monitor the behaviour of their competitors and create incentives to compete less vigorously without any direct coordination (so-called tacit collusion). Moreover, the growing availability of algorithm-based technological solutions, which facilitate the monitoring of competitors' conduct and create increased market transparency, may result in the same risk even in less concentrated markets.' *see* European Commission, 'Inception Impact Assessment' (*EC*, 29 May 2020) https://ec.europa.eu/competition/consultations/2020_new_comp_tool/new_comp_tool_inception_impact_assessment.pdf.

[14] The following refers to Article 101 TFEU, yet the same problems arise under the cartel provisions of many other jurisdictions in a similar way.

be enforced. Therefore, any cartel is only stable so long as the firms participating in it consider it rational to remain involved. All types of collusive equilibria can, therefore, be considered as non-cooperative games in terms of game theory.[15] Yet still, the law does not prohibit the achievement or sustaining of a collusive equilibrium as such. Instead, the provision is confined to certain types of measures, which are described as agreement, concerted practice, or decision. Mere tacit collusion is supposed to be distinct from these aforementioned types of anticompetitive conduct. While explicit collusion (i.e. achieved by agreement), concerted practice, or decision, is prohibited, tacit collusion is found to be legitimate.

As becomes obvious, the traditional construal of the law rests on a description of the means and forms by which firms interact when defining collusion. In the context at hand, the category of concerted practices has the greatest relevance. It is conceived of as something whereby a 'practical cooperation' is substituted for the risks of competition. Such practical cooperation, in turn, is supposed to be different from merely observing a rival's conduct and reacting to it.[16] Similar approaches of distinction apply under section 1 of the US Sherman Act.[17] There, so-called conscious parallelism is deemed not to fall within the scope of the prohibition.[18] For the finding of a cartel, so-called plus factors,[19] or 'facilitating practices'/'facilitating devices' need to be established.[20]

It is argued that, whereas firms when tacitly colluding merely observe each other and react independently, the mechanism allegedly differs if they opt for a practical cooperation. A private exchange of pricing information can serve as an example for the latter. The jurisprudence of the courts requires that such practical cooperation must be substituted 'knowingly' for the risks of competition for it to amount to a concerted practice.[21] The concept, therefore, hinges on the inner sphere of the firms involved.

Against the afore, it is questionable whether autonomous algorithmic collusion is prohibited under the traditional enforcement paradigms. If the firms lack of knowledge or intent with

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[15] See, e.g., J Friedmann, *Game Theory with Applications to Economics* (1986) 184: 'The fundamental distinction between cooperative and noncooperative games is that cooperative games allow binding agreements while noncooperative games do not.'; L Kaplow, *Competition Policy and Price Fixing* (2013) 177; see also E J Green and R H Porter, 'Noncooperative Collusion under Imperfect Price Information' (1984) 52 *Econometrica* 87; D G Baird and others, *Game Theory and the Law* (1994) 165–178.

[16] ECJ, Case 48-69 *Imperial Chemical Industries Ltd. v Commission of the European Commission* [1972] paras 64 and 65; see also ECJ, joined cases C-89/85 and others *A. Ahlström Osakeyhtiö and Others v European Communities* [1993] para 63; ECJ, case C-8/08 *T-Mobile Netherlands BV and others v Raad van bestuur van de Nederlandse Mededingingsautoriteit* [2009] para 26.

[17] Act of July 2, 1890 (Sherman Anti-Trust Act) 15 U.S. Code § 1.

[18] *Theatre Enterprises v Paramount* 346 US 537 (1945); RH Bork, *The Antitrust Paradox* (1978) 178 *et seq.*; also arguing in favor of a distinction between 'illegal agreement' and 'conscious parallelism' MD Blechman, 'Conscious Parallelism, Signaling and Facilitating Devices: The Problem of Tacit Collusion under the Antitrust Laws' (1979) 24 *NYL Sch L Rev* 881, 882, 889.

[19] The notion 'plus factor' was, reportedly, used for the first time in this context in *C-O-Two Fire Equip. Co. v. United States* 197 F2d 489, 493 (9th Cir.), cert. denied, 344 U.S. 892 (1952); see on that MD Blechman, 'Conscious Parallelism, Signaling and Facilitating Devices: The Problem of Tacit Collusion under the Antitrust Laws' (1979) 24 *NYL Sch L Rev* 881, 885.

[20] The US DoJ 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].' See US DoJ, 'Memorandum of John H Shenefield, Assistant Attorney General, Antitrust Division, Shared Monopolies' (1978) 874 *Antitrust & Trade Reg Rep (BNA)* at F-1. See also GA Hay, 'Facilitating Practices: The Ethyl Case (1984)' in JE Kwoka and LJ White (eds), *The Antitrust Revolution: Economics, Competition, and Policy* (3rd ed. 1999) 182–201.

[21] ECJ, Case 48-69 *Imperial Chemical Industries Ltd. v Commission of the European Commission* (14 July 1972) paras 64 and 65; see also ECJ, Joined Cases C-89/85 and others *Ahlström Osakeyhtiö and Others v European Communities* (20 January 1994) para 63; ECJ, Case C-8/08 *T-Mobile Netherlands BV and others v Raad van bestuur van de Nederlandse Mededingingsautoriteit* [2009] para 26.

respect to the fact that their computer agents pursue a collusive strategy, it cannot be said that these firms 'knowingly' substitute a practical cooperation for competition. Several authors, therefore, point to the risk that the cartel prohibition might stop short of preventing such outcomes. *Ezrachi and Stucke* argue that collusion achieved by machine learning systems can fall outside the scope of the cartel prohibition for 'lack of evidence of an anticompetitive agreement or intent.'[22] In a similar vein, *Calvano* and others conclude from their study[23]:

> From the standpoint of competition policy, these findings should probably ring an alarm bell. Today, the prevalent approach to tacit collusion is relatively lenient, in part because tacit collusion among human decision-makers is regarded as extremely difficult to achieve. While we have no direct comparative evidence for algorithms relative to humans, our results suggest that algorithmic collusion might not be that improbable. If this is so, then the advent of algorithmic pricing could well heighten the risk that tolerant antitrust policy will produce too many false negatives.

Some authors, therefore, highlight that the enforcement paradigms might warrant amendments to close such regulatory gaps.[24]

IV. APPROACHES FOR CLOSING LEGAL GAPS

1. *On the Idea of Personifying Algorithms*

It is questionable whether the potential enforcement gap in antitrust[25] can be overcome by defining algorithms as 'undertakings'. The notion of an undertaking in EU antitrust, indeed, is a very broad concept which has many facets and functions. As a working definition that applies to the most common types, an undertaking can be described as a combination of assets and people that act on a market governed by a management body or further representatives irrespective of the legal personality or corporate structure. For an undertaking to act, or to have knowledge or intent, it is the action, the knowledge, or the intent of the human beings representing it which is attributed to it. If a company manager knowingly enters into an exchange of sensitive pricing information with the manager of a rival, it can, therefore, be said that these 'undertakings' substituted a practical cooperation for the risks of competition.

Yet what substantive meaning would terminology such as a 'practical cooperation' or 'knowingly' have, if they were applied to an algorithm? The problem is that the legal terminology is coined on human interaction and cognition, so that it will be vastly deprived of its meaning if transferred to a computer system. How shall an action of an algorithm be identified as 'knowingly', as opposed to another action that is supposed to happen un-knowingly? In what way is it meaningful to consider the actions of an algorithm as a 'practical cooperation', as opposed to a mere intelligent adaption to information obtained by this algorithm on the market? To rely on such human concepts of cognition with respect to the regulation of algorithms will likely end up in semantic exercises with limited substance.

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[22] A Ezrachi and M E Stucke, 'Artificial Intelligence & Collusion: When Computers Inhibit Competition' (2017) 1775, 1796 *U Ill L Rev*.

[23] E Calvano and others, 'Artificial Intelligence, Algorithmic Pricing, and Collusion' (2020) 110 *Am Econ Rev* 3267, 3295.

[24] C Veljanovski, *Cartel Damages: Principles, Measurement & Economics* (2020) 100 para 7.07: 'the law may need to be applied in a different fashion.'

[25] On the attribution of legal personality to algorithms as a general legal issue see H Eidenmüller, 'The Rise of Robots and the Law of Humans' (2017) 4 *ZEuP* 765.

2. *On the Idea of a Prohibition of Tacit Collusion*

Another way of dealing with the problem could be in equating tacit collusion and explicit collusion.[26] This would mean that under antitrust law any collusive strategy would qualify as an illicit cooperation so that any further distinctions based on the inner sphere of the persons involved would become obsolete. Such view has been suggested in the past independently of the issue of algorithmic collusion. Notable proponents were *Richard Posner* in his earlier writings[27] (he has since changed his view[28]), *Richard Markovits*[29], and more recently *Louis Kaplow*.[30]

One might feel inclined to hold that such a view does not reconcile with the structure of the law. Yet it is questionable whether this counterargument would be very strong. The notion of concerted practices can possibly be construed in a way as to extend to cases in which the collusive outcome is based on a mechanism of observation and retaliation, which is characteristic for tacit collusion as it is for explicit collusion. As outlined earlier, both categories share the feature that they can be described as a non-cooperative game in terms of game theory. It is, therefore, rather a semantic issue whether some ways of engaging in such a non-cooperative strategy can be tagged as a 'practical cooperation' or not, while the underlying economic principles remain the same. Firms observe and react in ways that are deemed individually optimal irrespective of which words are used to describe this phenomenon. Especially in the grey area between typical cases of explicit cooperation on the one hand and tacit oligopoly conduct on the other, it becomes apparent how brittle the traditional concept of distinction is.[31] Consider that even in cases that would usually be qualified as tacit collusion, firms cooperate in that they observe each other and react to the information they have obtained from observing

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[26] For a critical review of this view see P Pohlmann, 'Algorithmen als Kartellverstöße' in J Kokott and others (eds), *Europäisches, deutsches und internationales Kartellrecht, Festschrift für Dirk Schroeder* (2018) 633, 645 *et seq*.

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

[28] Posner has meanwhile distanced himself from this view and takes the opposite position according to which tacit collusion should not be equated with explicit collusion, see RA Posner, 'Review of Kaplow, Competition Policy and Price Fixing' (2014) 79 *Antitrust LJ* 761; on that see also CS Hemphill, 'Posner on Vertical Restraints' (2019) 86 *U Chi L Rev* 1057, 1073.

[29] Markovits wants to distinguish between 'normal' or 'natural' oligopolistic pricing on the one hand and 'contrived' oligopolistic pricing on the other, see RS Markovits, 'A Response to Professor Posner' (1976) 28 *Stan L Rev* 919, 933–934; RS Markovits, 'Oligopolistic Pricing Suits, the Sherman Act, and Economic Welfare, Part II: Injurious Oligopolistic Pricing Sequences: Their Description, Interpretation, and Legality under the Sherman Act'(1974) 26 *Stan L Rev* 717, 738; see also RS 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'(1975) 27 *Stan L Rev* 307, 315–319; RS Markovits, 'Oligopolistic Pricing Suits, the Sherman Act, and Economic Welfare, Part IV: The Allocative Efficiency and Overall Desirability of Oligopolistic Pricing Suits'(1975) 28 *Stan L Rev* 45, 44–60. Posner criticizes this distinction as suggested by Markovits, see RA Posner, 'Oligopolistic Pricing Suits, the Sherman Act, and Economic Welfare, A Reply to Professor Markovits' (1976) 28 *Stan L Rev* 903, 908 and 913 *et seq*.

[30] L Kaplow, 'An Economic Approach to Price Fixing' (2011) 77 *Antitrust LJ* 343, 350; see also L Kaplow, 'Direct Versus Communications-Based Prohibitions on Price Fixing' (2011) 3 *J Legal Analysis* 449; L Kaplow, 'On the Meaning of Horizontal Agreements in Competition Law'(2011) 99 *Calif L Rev* 683; L Kaplow, *Competition Policy and Price Fixing* (2013). On this strand of arguments see also D Zimmer, 'Kartellrecht und neuere Erkenntnisse der Spieltheorie: Vorzüge und Nachteile einer alternativen Interpretation des Verbots abgestimmten Verhaltens (§ 25 Abs 1 GWB, Art 85 Abs 1 EWGV)' (1990) 154 *ZHR* 470.

[31] On that see also Nicolas Petit's suggestion of remedies against tacit collusion and the idea of applying a form of equivalence with express collusion: N Petit, 'Re-Pricing through Disruption in Oligopolies with Tacit Collusion: A Framework for Abuse of Collective Dominance' (2016) 119–138 World Competition; N Petit, 'The Oligopoly Problem in EU Competition Law' in I Liannos and D Geradin (eds), *Research Handbook in European Competition Law* (2013) 259–349.

each other. One might ask the question: In what way is this not a 'practical cooperation'? Also, a collusive equilibrium can bear negatively on consumer welfare[32] irrespective of the means and forms used by firms to sustain it. This seems to add to the argument that the distinction between tacit and explicit collusion is of limited expedience.

Yet still the idea of equating tacit collusion with explicit collusion faces severe objections, which might explain why it has not gained more recognition among scholars and enforcers.[33]

Any law must provide the addressee the opportunity to abide by it through choosing a compliant course of action. Otherwise, the law would be perplexing. Recall, now, that collusion in the realm of antitrust is a non-cooperative game.[34] This means that the strategy is individually rational for each participant. Sanctioning collusion without more, therefore, would amount to prohibiting the pursuit of an individually rational strategy. *Kaplow* reacts to this objection by pointing out that it is a common feature of the legal order to prohibit types of conduct that are individually rational[35], such as the stealing of an apple.[36] By imposing a sanction, the law ensures that it becomes rational to refrain from that course of action, he advances.

This argument, however, is not able to overcome the conceptual problems that would arise if the law prohibited the collusive outcome as such. While it is perfectly clear what a person must do to 'not steal an apple', it is much less obvious what course of action a firm would have to take in order to 'not pursue a collusive strategy'. The negatory of stealing an apple is unambiguous. The course of action in order to avoid the sanction is to not steal the apple. With a prohibition of a collusive market outcome, however, it would be much more difficult to describe, in an unambiguous way, what the compliant course of action would be. One of the reasons for this is that, from an *ex ante* perspective, it is unclear what outcome a collusive strategy among firms might produce. If that is not known, however, it is equally unclear what price a firm must set in order to not charge at a collusive level. If the firms do not know whether a collusive strategy would yield a market price of € 5 or rather of merely € 4, they cannot know *ex ante* whether individually charging a price of € 4 would be 'non-collusive' or not.

On a more philosophical level, another objection buoys. Effectively, the law would require the addressee to pursue any market strategy so long as it is not rational, assumed that the rational strategy would be collusion. It is questionable, however, whether an addressee of the law can be required to intentionally act irrationally. Any legal prohibition must conceive of the addressee as an intelligent entity, for if the addressee were not intelligent, it could not abide by the law in the first place. From a philosophical perspective, it is unclear, however, whether a person can 'rationally act irrationally'. Can a firm be obliged to randomize prices in order to protect itself from being accused of acting rationally-collusive?

Yet even ignoring this fundamental problem and moreover assuming it were possible to define a hypothetical collusive price level *ex ante*, it would remain unclear whether a non-collusive strategy could be defined with a sufficient degree of precision so that firms could abide by the law. Would it suffice to undercut the hypothetical collusive price by, for example, 2%? Or

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[32] Or other competitive parameters, such as quality.

[33] S Thomas, 'Harmful Signals: Cartel Prohibition and Oligopoly Theory in the Age of Machine Learning' (2019) 15 *J Comp L & Econ* 159; S Thomas, 'Herausforderungen des Plattformwettbewerbs für das Kartellverbot' in S Thomas and others (eds), *Das Unternehmen in der Wettbewerbsordnung, Festschrift für Gerhard Wiedemann zum 70. Geburtstag* (2020) 99 *et seq*; S Thomas, 'Horizontal Restraints on Platforms: How Digital Ecosystems Nudge into Rethinking the Construal of the Cartel Prohibition' (2021) 44 *World Competition* 53. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3645095.

[34] See supra n 15.

[35] Setting aside religious beliefs and ethical convictions of the individual.

[36] L Kaplow, 'An Economic Approach to Price Fixing' (2011) 77 *Antitrust LJ* 343, 431.

would the law require every firm to price at marginal cost, for under perfect competition this would be the hypothetical competitive price, even though perfect competition usually does not exist? Merely imposing a sanction on the pursuit of a collusive strategy does not solve any of these conceptual problems.[37]

3. *Harmful Informational Signals As Point of Reference for Cartel Conduct*

a. Conceptualization

Another conceptual venture to solve the issue could be to maintain a distinction between illicit cartel conduct and legitimate coordination, yet to substitute a new criterion for the traditional paradigm, viz. for the practical cooperation adage. Such alternative criterion of distinction could be checking the informational signals released by colluding firms for their propensity to create a net consumer harm. Accordingly, an illicit concerted practice would be found if firms, or the algorithms relied on by firms, released informational signals which reduced consumer rent if compared to a counterfactual in which such informational signals were absent. The counter-factual, therefore, would not be a hypothetical market without collusion. It would be the same market absent a particular informational signal.[38] To clarify the specifics of this approach, and to contrast it with the view expressed by *Kaplow* and others, the following explanations shall be made.

In contrast to a situation where any collusive equilibrium is prohibited, so that it is unclear which course of action to take in order to abide by the law, confining the prohibition to harmful signals leaves the addressee a binary choice that is conceptually clear: an informational signal that is ultimately harmful to consumers can either be released or not. There is no element of imposed irrationality in such a prohibition. To refrain from the release of a harmful infor-mational signal can also mean that the addressee must choose to release a different signal in order to avoid a harmful effect. To exemplify the idea, reference can be made to the EU Commission's remedy decision in *Container Shipping*, where public price announcements were not abandoned completely but limited in scope in order to avoid the creation of a consumer harm.[39]

A relevant signal in this sense can be any release of market-related information independent of whether it takes place publicly or in private, whether consumers are involved or not. Even price lists, price announcements, or other types of public display of prices or other parameters can qualify as a signal that ultimately leads to a collusive equilibrium. In contrast to the aforemen-tioned opinion of *Kaplow*, however, this would not suffice for the conclusion that a restriction of competition in terms of the cartel prohibition is established. Rather, the release of such infor-mational signals would fall outside the scope of Article 101(1) TFEU to the extent that it produces offsetting consumer benefits.

This reflects the fact that there is a plethora of cases where public market information leads to collusive equilibria, although the benefit to consumers being derived from this information outweighs the gross harm of the collusive outcome if compared to a situation in which such informational signals were not made. The reason why, in most cases, public price lists and similar forms of information are not prohibited despite their risk to precipitate collusive

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[37] Also voicing concerns E Elhauge and D Geradin, *Global Competition Law & Economics* Chapter 6 C (2nd ed. 2011) 843.

[38] S Thomas, 'Harmful Signals: Cartel Prohibition and Oligopoly Theory in the Age of Machine Learning' (2019) 15 *J Comp L & Econ* 159.

[39] EU Commission, decision of 7 July 2016 *Container Shipping* AT 39850.

equilibria lies in the fact that they usually bring about benefits to consumers that offset the potential harm.[40] If firms refrain from the release of such pricing signals, the distribution of goods might be significantly impeded. Consumers can face difficulties in planning their purchases ahead or in pursuing multisource strategies. It can be said, therefore, that sometimes 'vertical transparency' creates a greater benefit to consumers than what is taken away by the horizontal collusion that concomitantly results from it. It is necessary, therefore, to balance both effects in order to get a full picture of the economic impact of an informational signal. If such an analysis of the economic effects is integrated into the assessment of a concerted practice, this creates a system in which harm and benefit of a measure can be distinguished without the need to make recourse to notions such as the 'practical cooperation' adage or the intention of the firms involved.

This concept would allow an entity to deal with the phenomenon of autonomous algorithmic collusion under the cartel prohibition. Achieving or sustaining such a market outcome would be prohibited if and to the extent that the harm to consumers were greater than the benefits associated with the release of the underlying informational signals.[41] If algorithms achieved a collusive equilibrium by communicating with each other and without this interaction providing any useful information to consumers, this could, therefore, constitute a concerted practice in terms of the law. If, on the other hand, a digital platform aggregated and provided information to consumers in a way that benefits them, and if the efficiency potential of this platform could not materialize without this release of information, Article 101(1) TFEU would not be triggered even though the conduct might, ultimately, give rise to a collusive equilibrium, if and to the extent that the benefit of the former offsets the harm of the latter. The counterfactual, therefore, would not be a digital platform without collusion. It would be a situation in which the informational signals were not released. If the platform, in such a counterfactual scenario, were not operated or operated with a lesser efficiency, consumers could be deprived of the benefits resulting from it. This could mean a smaller range of suppliers being visible to them, less information being available to help consumers plan their purchases, etc.

This demonstrates that a collusive outcome can be an inevitable consequence of an algorithm-based system that produces benefits, although horizontal restraints, even on prices, are involved. The decision of the Luxembourg competition agency has made this clear with respect to the taxi app Webtaxi.[42] The agency found consumer benefits in the fact that the platform improved on the supplies with transportation services, even though a horizontal collusion on prices was an inevitable side effect. While the decision accounted for these efficiencies within the scope of an exemption from the cartel prohibition, the concept presented here would integrate this analysis already into the assessment of a concerted practice. As previously outlined, this is a consequence resulting from the substitution of an effects analysis for the less useful 'practical cooperation adage' in order to discriminate between legitimate and illicit collusion in algorithm cases.

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[40] OECD, 'Background Paper, Policy Roundtables on Unilateral Disclosure of Information with Anticompetitive Effects' (*OECD*, 11 October 2012) paras 1 and 2.3.1. www.oecd.org/daf/competition/Unilateraldisclosureofinformation2012.pdf.

[41] S Thomas, 'Harmful Signals: Cartel Prohibition and Oligopoly Theory in the Age of Machine Learning' (2019) 15 *J Comp L & Econ* 159.

[42] See supra n 5.

b. Possible Objections

Such a concept of harmful informational signals, of course, provokes objections. They shall be dealt with in the remainder of this chapter. One might want to invoke that this construal of the law does not reconcile with the structure of the provision as shaped by the jurisprudence. Admittedly, the courts have not yet recognized an interpretation as suggested here. Rather, the Court of Justice, currently, relies on the notion of 'practical cooperation' in order to distinguish between concerted practices and tacit collusion. The established set of criteria does not contain a place for an economic effects assessment. On the other hand, the Court of Justice has not yet had an opportunity to hone the law with respect to the phenomenon of autonomous algorithmic collusion. It is, therefore, conceivable that the courts, upon preparatory enforcement steps done by the agencies, ultimately consider the option to readjust some of the enforcement paradigms in order to close potential regulatory gaps.

Also, it should be noted that even under the current decisional practice an effects analysis can be part of the assessment of Article 101(1) TFEU. As to the distinction between restrictions by effect and those by object, the potential of the measure to produce restrictive effects bears significance.[43] In that regard, the Court of Justice has made clear that, among other things, it must be analyzed whether and in what way consumers might suffer from the measure at stake.[44] This line of reasoning already mirrors an effects analysis based on the consumer welfare paradigm, which also is the backbone of the present proposal. In a similar way, the Commission practice demonstrates that the notion of a competitive restraint involves an analysis of the effects on consumer rent. Even though the Court of Justice has ruled that, for a restriction of competition to arise, it is unnecessary to demonstrate concrete consumer harm[45], the Commission takes this into account if it helps to discriminate between legitimate and illicit conduct. The Commission, for example, argues that even horizontal price fixing, depending on the structure and function of the cooperation, might warrant a close examination within the 'by effect category', which demonstrates that it is possible to conceive of cases where such conduct falls outside of the scope of Article 101(1) TFEU without any further examination of the legal exemption rule in Article 101(3) TFEU.[46]

On a practical level, one might want to invoke that the assessment of whether an informational signal precipitates a net consumer harm or not is too complicated to rely on as an enforcement paradigm. Yet it must be noted that even the currently existing decisional practice is not void of elements of an effects analysis, as demonstrated previously. Beyond that, firms and enforcers face exactly these difficulties already within the realm of Article 101(3) TFEU, so that it could not be said that such difficulties are idiosyncratic to the proposal made here.

Beyond that, one might raise the question in what way firms can become responsible for the conduct of an algorithm, if the strategy pursued by the latter is unknown to the former. In legal terms, however, it is possible to hold someone responsible for the organization of an enterprise. Firms, therefore, could be considered obliged to terminate the use of an algorithm or to alter its

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[43] ECJ, Case C-32/11 *Allianz Hungária Biztosíto v Gazdásagi Versenyhivatal* (14 March 2013) para 66.
[44] ECJ, Case C-67/13 P *Groupement des Cartes Bancaires v European Commission* (11 September 2014) para 51.
[45] ECJ, Joined Cases C-501/06 P and others *GlaxoSmithKline Services Unlimited v European Commission* (6 October 2009) para 63.
[46] See, e.g., EU Commission, 'Guidelines on the Applicability of Article 101 of the Treaty on the Functioning of the European Union to Horizontal Co-Operation Agreements' (2011) OJ 2011 C 11/1 para 161, where the Commission explains that in the case of a joint distribution which is downstream to a joint production, horizontal price fixing can be assessed within the 'by effect category'. While this situation is not identical with the case of algorithmic collusion, it demonstrates that it is not conceptually impossible to turn towards the effects on consumer rent when evaluating whether a certain conduct amounts to a breach of Article 101(1) TFEU or not.

paradigms, if and to the extent that it produces more harm than benefit to consumers. Firms could, therefore, be ordered, by way of an administrative decision, to make such adjustments to their business strategy either by tweaking the algorithm or by stopping its use altogether. Antitrust economists already expound ways to design platforms in a way that counters collusive risks emerging on it from machine learning systems. *Justin Johnson*, *Andrew Rhodes*, and *Matthijs Wildenbeest* published a study in 2020 on how a choice algorithm on a sales platform can impact the likeliness of collusion among independently acting q-learning algorithms.[47] It goes without saying that the imposition of a fine, or a liability for damages would, in any event, require negligence or intent on the firm's part. That, in turn, would require the agency to establish that some degree of knowledge or intent with respect to the achievement of a collusive equilibrium can be established among the actual firms that relied on the algorithm. Such would be absent if the equilibrium were achieved or sustained independently by a machine learning process not guided or anticipated by the firms that rely on the outcome.[48] Yet still, in such an event a mere administrative order, absent any sanction or damages award, could be issued.

Finally, one might want to invoke that it would be disproportionate to make such far-reaching amendments to the construal of the cartel prohibition for the sole purpose of closing a regulatory lacuna with respect to algorithms. It is not the intention behind this proposal, however, to render the established enforcement paradigms obsolete in their entirety. Rather, the suggestion made here should be conceived of as a mere addition to the established principles that would still bear relevance in the majority of non-algorithmic collusion cases. A private exchange of pricing information between the managers of two rivals, for example, could still be considered a practical cooperation without further effects analysis required, for its potential to precipitate a consumer harm, as reflected in the Commission's Horizontal Guidelines.[49] The informational signal approach suggested here, on the other hand, could become relevant if, in an algorithm case, the traditional criteria did not allow the application of the law in a meaningful way. The present suggestion, therefore, is meant as a humble contribution to existing paradigms, not as a postulate of a total substitution for them.

V. CONCLUSION

This article is a conceptual sketch of a way to deal with the intricacies coming along with autonomous algorithmic collusion. Such risk is being discussed, especially, with respect to q-learning algorithms. Even though practical cases have not yet emerged, there is sufficient reason to address potential issues as a precautionary measure at this point in the scholarly debate. It was the intention to demonstrate that the traditional construal of the law, which relies on a description of human behavior, appears inapt for effectively tackling machine-induced equilibria. Applying the established criteria in such cases would very likely lead to a harping on words without substance. There is simply no point in venturing to assess whether algorithms

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[47] J Johnson and others, 'Platform Design when Sellers Use Pricing Algorithms' (*SSRN*, 12 September 2020) https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3691621.

[48] The problem of how to detect algorithmic collusion is independent of the concept of the notion of a concerted practice. Enforcers will struggle with a total absence of direct evidence if the algorithmic computer agents acted independently of human interaction. Market comparison methods, however, could be used to find out about the competitiveness of the pricing level. This is an area with a great demand for further research. Yet the problems to detect algorithmic collusion do not call into question the need to expound ways how the law should be construed in the event that algorithmic collusion can be found.

[49] EU Commission, 'Guidelines on the Applicability of Article 101 of the Treaty on the Functioning of the European Union to Horizontal Co-Operation Agreements' (2011) OJ 2011 C 11/1 para 94.

'practically cooperated' as opposed to 'merely observed each other'. The present proposal, therefore, is intended to serve as a conceptualization of the notion of concerted practices for cases that would otherwise elude the cartel prohibition. To conclude, the entire problem of autonomous algorithmic collusion is an example of the necessity for interdisciplinary research between lawyers, economists, and computer scientists. At the same time, the problem highlights how enforcement paradigms, that hinge on descriptions of the inner sphere and conduct of human beings, may collapse when applied to the effects precipitated by independent computer agents. The subject matter of this chapter is, therefore, an example for the greater challenges that the entire legal order faces in light of the progress of machine learning.