Digital Polyopoly

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The digital economy has significantly changed many aspects of our lives, including the way firms do business and compete with each other. In addition to the benefits the digital world has introduced, it has also brought challenges for competition law, including new ways to restrict competition, with computing algorithms representing one of the most prominent examples. Algorithms can lead to, facilitate and maintain anticompetitive collusion, and one of the most pressing tests for competition law and its enforcement in the digital world is algorithmic parallel conduct. The terminology introduced for this conduct in this article is 'digital polyopoly'. Digital polyopolies encompass conditions similar to oligopolies, in particular, interdependency and transparency. However, unlike parallel conduct arising from oligopolies, digital polyopolies are not limited by their number of competitors. This new phenomenon requires fitted interpretation and rethinking of existing competition-law and economic concepts. What digital polyopolies are, how they differ from pre-digital era concepts and how competition law should tackle them (with a particular emphasis on the European Union competition law's concept of 'concerted practice'), are questions explored in this article.

1 INTRODUCTION

The digital world we live in is characterized by many features, including new technologies, global and fast connectivity and artificial intelligence (AI) animated by algorithms. The idea of AI is not recent. It was almost a hundred years ago that writer Karel Čapek introduced the new word 'robot' in his science-fiction play 'R. U.R'.[1] The term 'AI' became part of computer science's lexicon not long after, in 1956.[2] From the branch of studies related to the machine learning, algorithms

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1 The idea of artificial creatures with AI is much older. For instance, the tale of the 'Golem' is assigned to the rabbi, Judah Loew ben Bezalel, who lived in Prague in the sixteenth century.

2 The founder of AI was John McCarthy, who used the term 'Artificial Intelligence' in his proposal in 1955 and then in the Dartmouth Conference in 1956, which was the first conference on artificial intelligence. *See* Martin Childs, *John McCarthy: Computer Scientist Known as the Father of AI*, The Independent (1 Nov. 2011).

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developed.[3] Despite the fact that AI was originally a science-fiction idea, it is not so science-fiction anymore, given that AI is a current reality. The world a hundred years ago did not imagine the present digital reality our generation is experiencing. In this digital age, uncertainty of innovation is a given: due to rapid technological developments, making predictions about the future of the digital world is almost impossible. Despite this difficulty, two things are almost certain: the digital economy is going to be even more digital and virtual, with its essential feature, algorithms, becoming even more autonomous and sophisticated, and their usage will continue to increase.[4] This poses challenges for the law, including competition law.

Algorithms used in the digital world, which process big data and involve big analytics, encompass one of the most significant areas of concern for competition law.[5] Although it is easy to point to the benefits that big data and algorithms have introduced for businesses, consumer welfare, efficiency and the economy,[6] these digital-world tools can also be used by a particular entity to, for instance, exclude others from the market or facilitate collusion among competitors.[7]

Anticompetitive collusion, primarily cartels, is among the top priorities for many competition authorities across the world.[8] The features of the digital world represent challenges for the enforcement of anti-cartel laws, many of which are discussed in Ezrachi and Stucke's book 'Virtual Competition – The Promise and Perils of the Algorithm Driven Economy'.[9] The authors claim, among other things, that it is the tacit collusion driven and maintained by algorithms that is

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3 Arthur Samuel, *Some Studies in Machine Learning Using the Game of Checkers*, 3(3) IBM J. Res. & Dev. 210 (1959).

4 *See* e.g. Kenneth Bamberger & Orly Lobel, *Platform Market Power*, 32(3) Berkeley Tech. L.J. 32, 36 (2017); European Commission, *Final Report on the E-commerce Sector Inquiry*, COM(2017) 229, paras 13, 33, 54.

5 *See* e.g. Michal S. Gal, *Algorithms as Illegal Agreements*, Berkley Tech. L.J. (forthcoming); A. Ezrachi & M. E. Stucke, *Virtual Competition – The Promise and Perils of the Algorithm Driven Economy* (Harvard University Press 2016).

6 *See* e.g. Gal, *supra* n. 5.

7 *See* e.g. Ezrachi & Stucke, *supra* n. 5.

8 *See* for instance Australian Competition and Consumer Commission, *Compliance & Enforcement Policy & Priorities 2019*, https://www.accc.gov.au/about-us/australian-competition-consumer-commission/compliance-enforcement-policy-priorities#2019-priorities; European Commission, *Cartel Statistics 2015–2019*, http://ec.europa.eu/competition/cartels/statistics/statistics.pdf, US Department of Justice and the Federal Trade Commission, *Antitrust Guidelines for International Enforcement and Cooperation* (13 Jan. 2015), at 49, https://www.ftc.gov/system/files/documents/public_statements/1049863/international_guidelines_2017.pdf (accessed 16 Dec. 2018).

9 In this book, Ezrachi and Stucke divide collusion in the digital world into four scenarios: (1) 'Messenger', where algorithms are used by humans as tools to execute their explicit will to collude and maintain cartels; (2) 'Hub and Spoke', which is the use of a single algorithm by numerous competitors to determine the market price; (3) 'The Predictable Agent', where competitors unilaterally use individual pricing algorithms and (4) 'Digital Eye', which involves self-learning algorithms.

the most problematic and challenging for the application of competition law.[10] They explain that:

> *[T]he use of advanced algorithms … transforms the "normal", pre-existing market conditions. Before algorithms, transparency was limited; conscious parallelism could not sustained. To facilitate the use of the pricing algorithms, firms increase their transparency, which in turn makes tacit collusion likelier. … one may ask whether the creation of such a dynamic, though "artificial", means should give rise to antitrust intervention.*[11]

This question of antitrust intervention regarding algorithmic collusion has recently started to be explored by others in the field. For example, the Organization for Economic Co-operation and Development (OECD) observed that algorithms can lead to 'conduct in what looks *very much like conscious parallelism*',[12] which, as they claim, '*is not illegal under competition rules*'.[13] Indeed, they state that this 'raises more difficulties because the current legal standard does not allow intervention with the traditional rules on anti-competitive agreements between competitors'.[14] Thus, the OECD, together with some other experts, has called for revisiting the antitrust/competition-law concept of 'agreement',[15] arguing for the expansion of the provisions on anticompetitive collusion to conscious parallelism arising from an oligopolistic market.[16]

In this article, I build on this recent discussion and challenge the argument for changing competition law. By analysing the current competition law and economic concepts, in particular 'concerted practice' and 'oligopoly', I explain that there are situations with algorithms leading to parallel conduct that differ from traditional conscious parallelism, because of the *artificial* character of algorithms, already highlighted by Ezrachi and Stucke, and the fact that algorithms provide or lead to '*communication*' in the digital world.

In the non-digital world, conscious parallelism, also called 'parallel conduct', occurs in cooperative and non-cooperative oligopolies (hereinafter 'natural

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10 Ezrachi & Stucke, *supra* n. 5, at 35–81.

11 Ezrachi & Stucke, *supra* n. 5, at 66 (emphasis added).

12 OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* 51 (2017) http://www.oecd.org/daf/competition/Algorithms-and-colllusion-competition-policy-in-the-digital-age.pdf (accessed 16 Dec. 2018) (emphasis added).

13 *Ibid* (emphasis added).

14 OECD, *supra* n. 12, at 51.

15 The terminology differs in different jurisdictions. *See* the text on 'oligopolies' below (fn. 17).

16 OECD, *supra* n. 12; *see* e.g. Salil K. Mehra, *Antitrust and the Robo-Seller: Competition in the Time of Algorithms*, 100 Minn. L. Rev. 1323, 1340–43 (2016). Gal, on the other hand, recognizes that the current US antitrust law and its interpretation could capture various forms of algorithmic 'coordination': Gal, *supra* n. 5. Although she shows that various situations where algorithms lead to 'coordination' can be captured under and prove the existence of an agreement (Gal, *supra* n. 5, at 26–28), she advocates for re-thinking the existing US antitrust law in order to capture conscious parallelism created by algorithms in a way which would focus on consumer welfare, without the need to prove the concept of 'an agreement' (Gal, *supra* n. 5, at 43–44).

oligopolies')[17] where, by simply observing the market, competitors independently and unilaterally decide to, for instance, charge the same price, so-called 'parallel pricing'. Arguably, there is no legitimate reason to prohibit such conduct under competition law. First, this is not a joint action but rather a group of unilateral business decisions and, second, there is nothing inherently wrong with this conduct if the purpose of competition law is to protect the competitive process. A mere unilateral decision, which is not an abuse of a dominant position and does not restrict others from competing, is not, in its nature, anticompetitive, even if it leads to anticompetitive results. Adapting to market conditions intelligently in order to increase profit without restricting others from competing is part of the competitive process.

The concept of oligopoly has an essential feature in common with the digital world and algorithms, namely *interdependency*, meaning that the business decision of one competitor will have an impact on other competitors in the relevant market. This interdependency is not the same in the digital world as in the traditional concept of an 'oligopoly'. In an oligopolistic market, competitors observe each other's behaviour and react to the changed strategies of their competitors. For instance, if one competitor increases her price, others will follow and also increase their price because such a business decision is more profitable for all of them.[18] Indeed, this interdependency can lead to parallel behaviour.[19] In oligopolies, the interdependency arises from the concentration and transparency of the market, the homogeneity of the relevant product and other characteristics of the oligopolistic market,[20] while in the digital world interdependency exists due to algorithms, which create transparency[21] and dependency in digital ecosystems.[22] The algorithmic-digital interdependency has no quantitative limit on competitors. In other words, the market does not have to be oligopolistic for interdependency facilitated

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17 I use the term 'natural oligopoly' for various forms of both cooperative and non-cooperative oligopolies, which cannot be captured by EU competition law and US antitrust law under the concepts of a 'concerted practice' or an 'agreement'. One of the oldest discussions on how unilateral practices in an oligopolistic market can lead to parallel conduct was described by Augustin Cournot in his model of non-cooperative oligopoly: Augustin Cournot, *Researches Into the Mathematical Principles of the Theory of Wealth* (1838). Other include, for instance, George J. Stigler, *Theory of Oligopoly*, 72 J. Pol. Econ. 44 (1964); Dennis Yao & Susan DeSanti, *Game Theory and the Legal Analysis of Tacit Collusion*, 38 Antitrust Bull. 113 (1993). For further information and overall discussion, *see* Herbert Hovenkamp, *Federal Antitrust Policy: The Law of Competition and Its Practice* 159–173 (3d ed., Thomson West 2005).

18 *See* discussion in Part III, in particular fn. 48.

19 Also referred to as conscious parallelism or tacit collusion. *See* e.g. *Brooke Group Ltd. v. Brown & Williamson Tobacco Corp*, 509 U.S. 209 (1993), at 227, where the Court states: '[t]acit collusion, sometimes called oligopolistic price coordination or conscious parallelism … is not in itself unlawful'.

20 *See* e.g. the features of the oligopolistic market in *Wood Pulp II*, ECLI:EU:C:1993:120. *See* Alison Jones, *Woodpulp: Concerted Practice and/or Conscious Parallelism?*, 6 Eur. Competition L. Rev. 273 (1993).

21 *See* e.g. European Commission, *supra* n. 4, at 11.

22 *See* e.g. Lina M. Khan, *Amazon's Antitrust Paradox*, 126 Yale L.J. 710, 754–55 (2017).

by algorithms to occur in the digital world. Thus, the parallel conduct that can occur, in the digital world is not restricted to oligopolies, it can happen in markets with many competitors without geographical limitations. I call this phenomenon a 'digital polyopoly', which is a situation in the relevant market in the digital world that leads to parallel conduct.

How competition law should perceive a digital polyopoly is an essential question of this article. Despite recent scholarly works and policy discussions on algorithmic collusion,[23] what algorithms are for the purposes of anti-cartel law, and whether and how they fit within the existing concepts of competition law, have remained significant subjects for discussion. It is unlikely that various jurisdictions will introduce completely new competition law, notwithstanding that this is not, as I explain in this article, absolutely necessary. What is essential at this stage, given the relevant new features of the digital economy and the prediction of increased occurrences of parallel conduct created and/or facilitated by algorithms in the future, is to rethink the existing concepts and interpret the law effectively to ensure a readiness to enforce the law with regard to digital polyopolies. Some minor amendments tailored for the digital world can further maximize the effectiveness of competition law to capture digital polyopolies.

I commence with characterizing and discussing a number of the features of the digital economy. Within this, I explain, amongst other things, that, in the digital world, competition occurs in ecosystems, which involve diagonal and vertical relationships and interactions, and thus horizontal collusion includes non-horizontal elements and relationships. I then move to answering the essential question of this article by applying an analogy between explaining the concepts of a 'natural oligopoly',[24] and 'concerted practice',[25] which occurs in a concentrated/oligopolistic market, on one hand, and a digital polyopoly on the other hand. I first explain these concepts and the way EU competition law applies to them, while making a few references to US antitrust law, and then apply these concepts to digital polyopolies and the various ways algorithms lead to parallel conduct. I then determine whether competition law can apply to digital polyopolies and under what conditions. In the final part, I make remarks on the question of liability.

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[23] For instance, Gal, *supra* n. 5; OECD, *supra* n. 12, at 51; Ezrachi & Stucke, *supra* n. 5; Mehra, *supra* n. 16.

[24] In the case of a natural oligopoly, the oligopolistic market leads to conscious parallelism without reaching an agreement and/or concerted practice. *See* Part III.

[25] *See* the discussion on concerted practice in Part III.

2 COMPETITION AND ALGORITHMS IN THE DIGITAL ECONOMY

The digital economy has changed how firms compete and also how they collude. In order to determine how firms collude in the digital world, it is essential to commence with explaining how the digital world has changed the competitive process and outlining the crucial features of the digital economy, most importantly, algorithms.

Competition in the digital economy can make it easy to directly address consumers,[26] while at the same time making the whole process more complex. On the one hand, the digital world offers a direct way of competing by, for instance, giving producers the ability to place their products on their own website. In doing so, they vertically integrate as they not only produce their products but also sell them directly to the consumers. Thus, the digital world facilitates vertical integration.[27] On the other hand, competing in the digital world is more complex than in the pre-digital-economy because competing in the digital space involves interacting in digital ecosystems. A digital ecosystem creates *interdependency* between users, who can be competitors, customers, suppliers, related industry partners and consumers. This interdependency can facilitate collusion.

Typically, a platform is part of an ecosystem or it creates it.[28] By creating digital ecosystems, various platforms, such as search engines and comparative and review platforms, do not occur on the traditional vertical and horizontal chains, instead their relationship with the suppliers of various goods and services is *diagonal*. Others, such as Amazon, can be placed on the traditional vertical and horizontal chains. However, the relationship between such a platform and a particular entity is more complex than in the non-digital world due to its multi-sided-market characteristics. For instance, Amazon, in addition to acting as an agent-buyer on the vertical chain, is a marketing platform, delivery and logistics network, payment service, credit lender, auction house, major book publisher, TV/film producer, fashion designer, hardware manufacturer, provider of cloud server space and computing power.[29] Many of its rivals are also its customers.[30]

Once an entity enters the digital world, it automatically becomes a part of the digital ecosystem, including various platforms, or the entity can also choose to use specific platforms. Platforms have a significant impact on the entity's business and

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[26] *See* e.g. European Commission, *supra* n. 4, para. 14.
[27] *Ibid*., para. 15.
[28] Some ecosystems are more open than others. Generally, the Open Web is more open than Facebook, which is controlled and recorded by its Application Programming Interfaces (APIs). For the arguments for perceiving the Open Web as a platform, *see* Jean-Christophe Plantin, Carl Lagozel, Paul Edwards & Christian Sandvig, *Infrastructure Studies Meet Platform Studies in the Age of Google and Facebook*, 20(1) New Media & Soc'y 293 (2018).
[29] Khan, *supra* n. 22, at 713.
[30] *Ibid*., at 754–55.

its success. They have different forms and purposes assisting producers and suppliers with succeeding and competing for consumers in a certain way. They can assist with selling products and making businesses more visible, reachable and attractive for consumers and suppliers, for example, a search platform such as Google can make a particular producer more or less visible to consumers.[31] The placing of the producer on the list of search results has a direct effect on its profit and success with regards to competition.

The diagonal player in the market – a platform – can also utilize or assist with the facilitation and monitoring of potential collusion via the various algorithms it uses. This has a number of implications for competition law and competition itself, including the fact that it is not only horizontal competitors but also diagonal players who can significantly contribute to horizontal collusion in the digital world.

2.1 Algorithms

Specific algorithms, which can be part of a platform, can lead to anticompetitive collusion in the digital world. Algorithms are sets of mathematical steps designed to solve specific problems or perform specific tasks.[32] They are the essential building blocks of the digital world, allowing for all of its fundamental functions, all of which are related to information. In particular, they allow us to share, search for, store and analyse information. These 'information' functions created by algorithms make the market more transparent than it was in the pre-digital age. In the digital economy, it is significantly easier to find and collect information than it was for a 'brick and mortar' shop before the internet and digitalization,[33] at speeds and amounts previously unthinkable. This change leads to obvious positives for competition and the economy but can also facilitate negative anticompetitive behaviour such as anticompetitive collusion. Indeed, algorithm parameters are coded to be set in accordance with the specific task it is designed to perform, which can potentially have an anticompetitive objective. In the literature, it is usually price algorithmic collusion that is discussed.[34] Such algorithms analyse information via

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[31] Some companies have set up entire businesses to improve the position of its customers in Google's search results. *See* e.g. Plantin, Lagozel, Edwards & Sandvig, *supra* n. 28, at 305.

[32] There are various definitions for algorithms. For instance, the OECD defines an algorithm as 'an instance of logic that generates an output from a given input, whether it is a method to solve a mathematical problem, a food recipe or a music sheet': OECD, *supra* n. 12, at 9.

[33] *See* e.g. European Commission, *supra* n. 4, para. 56.

[34] *See* e.g. *Ibid*., para. 33; Ezrachi & Stucke, *supra* n. 4, at 35–81; Paolo Palmigiano & David Foster, *Pricing Algorithms and Competition Law*, paper presented at the Advanced EU Competition Law Conference, Brussels, 21 Nov. 2017.

predictive analytics.[35] However, algorithms can facilitate other forms of cartels, such as output and customer allocations.[36]

Because algorithms are usually mathematically precise, involving mathematical guessing games, welfare economics and economic game theories can be easily incorporated into them. The task the algorithm is set to do can be simple or complex. More complex algorithms[37] can provide a self-learning process, machine learning, where AI can learn through its own experiences,[38] including learning 'through trial and error', or so-called 'deep-learning'.[39] Deep-learning algorithms are some of the most sophisticated, and are coded to imitate the structure of the biological neurons needed for human decision-making. Such algorithms possess some independency from pre-set parameters as they can develop their own strategies based on observing existing patterns – hence, self-learning.[40]

Machine-learning algorithms have become more and more common, meaning that humans have been losing control over various processes in the digital world. This development has to be considered when determining whether and to what extent current competition law is fit for the purpose of addressing algorithmic collusion in the digital world.

I distinguish three general situations where algorithms can generate collusion[41]:

(1) Direct: the algorithms are designed to create collusion.
(2) Indirect: the algorithms are not designed for anticompetitive purposes but it is reasonable to assume they could lead to collusion.
(3) Indirect/no knowledge: the algorithms are not designed for anticompetitive purposes but they lead to collusion accidently and/or through algorithmic AI, without the existence of a reasonable prediction that they could have done so.

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35 *See* e.g. Bamberger & Lobel, *supra* n. 4, at 25; European Commission, *supra* n. 4, paras 3, 13.

36 For instance, the allocation of customers or territorial restrictions as forms of collusion are easily done in the digital world. *See* Plantin, Lagozel, Edwards & Sandvig, *supra* n. 28, at 305; Min Jiang, *Search Concentration, Bias and Parochialism: A Comparative Study of Google, Baidu, and Jike's search results from China*, 64 J. Comm. 1088 (2014).

37 In the rest of the article, the term 'algorithm(s)' is used very broadly and can also mean a group of algorithms, including software such as automatic software programs. It is usually not one but a group of algorithms which are used for complex tasks in the digital world. Given that recent literature on algorithmic collusion refers to algorithms and not software programs (for instance, Gal, *supra* n. 5; Ezrachi & Stucke, *supra* n. 5), I maintain consistency with the emerging scholarly works by doing the same.

38 One of the first theoretical works in the field of machine learning which introduced this concept is Samuel, *supra* n. 3, at 535.

39 OECD, *supra* n. 12, at 9.

40 Their mechanisms and relevance to anticompetitive collusion is well explained in Francisco Beneke & Mark-Oliver Mackenrodt, *Artificial Intelligence and Collusion*, 50(1) IIC-Int'l Rev. Intell. Prop. & Competition L. 109, 111–12 (2019); OECD, *supra* n. 12, at 11.

41 How algorithms operate with regards to facilitating parallel conduct is well described by Gal: Gal, *supra* n. 5, at 9–23.

Thus, either the algorithms form a direct tool with the purpose of creating and/or maintaining a cartel[42] or concerted practice, or they create parallel conduct, such as parallel pricing, because the environment created by the algorithms leads to parallel conduct, as is the case in situations 2 and 3. Such an environment that leads to parallel conduct forms a 'digital polyopoly'. Digital polyopolies also involve situations based on direct collusion without the existence of an explicit, non-algorithmic agreement on cartel (the direct way – situation 1). These include instances where algorithms are deliberately designed to exchange information on business strategies such as future prices among competitors. In this way, the algorithms eliminate uncertainties about strategies and create conditions in the market which differ to the normal market conditions leading to parallel, anticompetitive conduct. Such conditions and the objective of these algorithms are not to increase competition but, on the contrary, to distort it.

We will see in the next part of the article that, like an oligopolistic market which can lead to parallel conduct in the form of a natural oligopoly or concerted practice, a digital polyopoly can either have some similarities with a natural oligopoly or constitute concerted practice depending on the circumstances and attributes of the specific situation.

3 OLIGOPOLIES, CONCERTED PRACTICES AND DIGITAL POLYOPOLIES

Digital polyopolies share some common features with oligopolies, namely interdependence and transparency. Unlike the concept of a digital polyopoly, the term 'oligopoly', as well as its related features and theories, are well established in competition law, its policy and economics. In this part of the article, I will show that, due to common features shared by digital polyopolies and oligopolies, the way competition law deals with oligopolies can be crucial for determining how competition law should perceive digital polyopolies. I commence with explaining the concepts of 'oligopoly' and 'concerted practice' and proceed to explain and apply these concepts to digital polyopolies.

[42] There are some cases which deal with explicit human cartels, where part of the anticompetitive agreement is to facilitate the cartel via algorithms. Such cases do not generally represent a difficulty to the traditional way of applying competition/antitrust law. *See* e.g. *United States v. David Topkins*, case settled via plea agreement (30 Apr. 2015), https://www.justice.gov/atr/case/us-v-david-topkins (accessed 16 Dec. 2018).

3.1 Oligopoly and concerted practice

In the oligopolistic market, a business decision made by each competitor, such as a decision on future price, has an imminent impact on other competitors. This is due to characteristics of an oligopolistic market, including:

- high market concentration
- homogenous products
- barriers to entry
- inelastic demand; and
- transparency.[43]

These characteristic create interdependency among competitors, which can lead to parallel behaviour[44] in the form of, for instance, parallel pricing. Parallel pricing means that the prices charged by competing entities are the same in the relevant market, and these are above the competitive level. This has an anticompetitive effect similar to a direct agreement to fix prices. It occurs either due to the mere nature of the relevant market (hereinafter 'natural oligopoly') or because an oligopolistic market facilitates anticompetitive cooperation among competitors in the market, which goes beyond unilateral conduct. Various jurisdictions use different legal terminologies to capture the second scenario. For instance, EU and Australian competition laws refer to 'concerted practice', while US courts use the broad term of 'an agreement'.[45] References have also been made to other terms such as 'facilitating practices'[46] or 'coordination'.[47] Because the following part focuses on the EU approach, I use the term 'concerted practice'.

A natural oligopoly and, to a certain extent, concerted practice in a concentrated market lead to the *interdependence* between firms that occurs due to the transparency and concentration of the market and the homogenous nature of the product or service in question. In a natural oligopoly, firms recognize their interdependence. They decide unilaterally – independently – that they will, for instance, charge the same prices. This phenomenon of parallel conduct, in this case

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43 *See* e.g. Price Waterhouse/Coopers & Lybrand (M.1016) [1998] OJ C376, paras 95 and 96.

44 Also referred to as conscious parallelism or tacit collusion. *See* e.g. *Brooke v. Brown & Williamson, supra* n. 19, at 227, where the Court states: '[t]acit collusion, sometimes called oligopolistic price coordination or conscious parallelism … is not in itself unlawful'.

45 The US legislation, the Sherman Act 1892, refers to terms 'combination' and 'conspiracy' which could be used to cover, to a certain extent, what the term 'concerted practice' covers in the EU. The US courts commonly use the terms 'an agreement' or 'collusion'. *See* e.g. *United States v. Trans-Missouri Fright Assn.*, 166 U.S. 290 (1897); *United States v. Addyston Pipe & Steel Co.*, 85 F. 271 (6th Cir. 1898), affirmed, 175 U.S. 211 (1899); *United States v. Topco Associates*, 405 U.S. 596 (1972); *Arizona v. Maricopa County Medical Society*, 457 U.S. 332 (1982).

46 Hovenkamp, *supra* n. 17, at 169.

47 Gal, *supra* n. 5.

parallel pricing, is explained by economic game theories,[48] which show how, in an oligopolistic market, firms follow their collective interests rather than their individual interests.

To illustrate, in a natural oligopoly, if one of the competitors increases its price, both its customers and competitors will have that information due to the transparency and concentration of the market. As suggested by game theories, its competitors may make the same decision and increase their price, as in doing so they will increase their profit because all competitors will eventually follow and increase their prices as well, while maintaining their output due to the homogeneity of the relevant product.[49] Despite the fact that this leads to parallel pricing, there is nothing illegal in this scenario, as the competitors are making individual strategic price decisions based on observing the market and their competitors and deciding what is best for them within that oligopolistic market structure. They do not collude and they do not go beyond what the nature of the market allows them to do. Indeed, unilateral business decisions based on merely observing the oligopolistic market but leading to parallel conduct are legal because, as the Court of Justice of the European Union (CJEU) puts it, competition law 'does not *deprive economic operators of the right to adapt themselves intelligently* to the existing and anticipated conduct of their competitors'.[50]

A number of cases provide good examples of when the nature of an oligopolistic market leads to parallel behaviour, one of them being *Wood Pulp II*.[51] This case involved a homogenous product, bleached sulphate pulp, used in the manufacture of article. The market consisted of a group of oligopolies and oligopsonies[52] with high barriers to entry due to, for instance, the large capital investment required for opening a new pulp mill. The market was transparent because the nature of the market required an advanced announcement of prices made to customers and potential customers.[53] These natural market conditions led to

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48 *See* in particular the work of Antoine A Cournot, Joseph LF Bertrand & John F Nash. A non-cooperative Nash-Cournot equilibrium will result in higher prices and lower output than would be the case in a fully competitive game, but lower prices and higher output arise in a fully cooperative game. *See* generally F. M. Scherer & David Ross, *Industrial Market Structure and Economic Performance* (3d ed., Houghton Mifflin Company 1990), Ch. 6; Avanish Dixit, Susan Skeath & David H. Reiley Jr, *Games of Strategy* (3d ed., W. W. Norton & Co 2010); Roger D. Blair & David L. Kaserman, *Antitrust Economics* (OUP 2009), Ch. 11. *See also* Robert C. Marshall & Leslie M. Marx, *The Economics of Collusion: Cartels and Bidding Rings* (MIT Press 2012).

49 By maintaining the same output while increasing prices, they do not lose their customers. This is only possible if all them recognize that this strategy maximizes their profit and therefore is a better strategy than not increasing their price.

50 Cases C-89/85, C-104/85, C-114/85, C-116/85, C-117/85, C-125/85 – C-129/85 *A. Ahlström Osakeyhtiö and others v. Commission*, ECLI:EU:C:1993:120, at ¶ 71 ('*Wood Pulp II*'); *see also* e.g. US case: *Matsushita Elec. Indus. Co., Ltd. v. Zenith Radio Corp.* 475 U.S. 574 (1986), at 588; *Brooke v. Brown & Williamson*, *supra* n. 19, at 227.

51 *Wood Pulp II*, ECLI:EU:C:1993:120. *See* Jones, *supra* n. 20.

52 Oligopsony refers to the concentration of the downstream/buyer market.

53 *Wood Pulp II*, ECLI:EU:C:1993:120, at 430–37; 574–76, 578–79.

parallel pricing, with prices rising at a time of over-capacity. Thus, the parallel price announcements, and the parallelism of the prices themselves, did not constitute illegal anticompetitive collusion in the form of concerted practice but were explained by the economic factors of a natural oligopoly.[54]

In the case of a concerted practice in a concentrated market, collusion is facilitated where firms seek to replace truly independent decision-making with forms of coordination. This can happen, for instance, in the situation where one of the competitors decides to decrease its price in the hope of gaining more customers and thus selling more products. This situation could lead to intensive price competition. At some point, the market players might want to correct this by communicating amongst each other and coordinating their price strategies. This could happen in the form of direct price fixing agreements – cartels – or in a less direct form, where competitors communicate amongst themselves by exchanging information on price and/or other business conduct that is not available in the market itself. This would constitute a concerted practice. This situation requires some form of direct or indirect communication among competitors that goes beyond the nature of the market and which increases the transparency of the market. Parallel pricing arising from the exchange of information among competitors rather than just the nature of the market can constitute a concerted practice.

Indeed, the common piece of evidence pivotal for proving a concerted practice, besides the parallel conduct itself, is *communication*.[55] The evidence of communication that goes beyond the nature of the market is usually direct but it can also be detected from the structure of and the conditions in the market.[56] Mere

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54 *Ibid*., at 578–83.

55 *See* for instance examples in, cases 48, 49, and 51–57/69 *Imperial Chemical Industries Ltd v. Commission of the European Communities* ECLI:EU:C:1972:70 (*Dyestuffs*), paras 66–123; Cases 40 to 48, 50, 54 to 56, 111, 113 and 114/73 *European Sugar Cartel, re; Coöperatieve Vereniging 'Suiker Unie' UA v. Commission* [1975] ECR 1663, paras 148–55. The EU competition law is applied in a way, which uses the term 'communication' in abroad way. *See* e.g. Cases T-25–26/95 etc. *Cimenteries CBR SA and Others v. E.C. Commission*, ECLI:EU:T:2000:77, para. 87. Communication(s) means an exchange of information either directly or by using some medium. It also means the transmission of information via e.g. telephone, radio or computers. (*See Macquarie Dictionary* (online ed., at 30 Apr. 2019) 'Communication'; *Merriam Webster* (Richard Boucher ed., online ed., at 30 Apr. 2019) 'Communication'.) The Merriam-Webster Dictionary refers to communication as 'a process by which information is exchanged between individuals through common system of symbols, signs or behaviour'. There has also been other circumstantial evidence. The US refers to this kind of evidence as 'plus factors' and, besides communication, it has included, for instance, the creation of an unreasonable product standards [*National Macaroni Mfrs. Association v. FTC*, 345 F.2d 421 (7th Circ.1965)] or identical sealed bids against all probability when tenders have been invited [*FTC v. Cement Institute*, 333 U.S. 683 (1948)].

56 Typically, a situation where parallel conduct exists but the conduct cannot be explained by the nature of the oligopoly because the market is missing some characteristics of an oligopolistic market, such as transparency. Such a market structure would indicate the existence of concerted practice. *See* e.g. *Cimenteries*, ECLI:EU:T:2000:77, para. 87. This was the case in the US case of *American Tobacco Co. v. U.S.*, 328 U.S. 781 (1946). *See* fn. 57.

parallel pricing could be crucial evidence for proving an infringement of competition law if the economic factors do not support the claim that the parallel pricing exists due to a natural oligopoly.[57]

Communication between competitors can, therefore, be *direct or indirect*.[58] It can either be two-sided, such as the exchange of relevant information between competitors, or it can be unilateral, such as a unilateral disclosure of information, which can result in anticompetitive collusion if that information is accepted by a competitor who then acts upon it. For instance, in *US v. Foley*,[59] it was held that an announcement of an intended action can be an invitation to competitors to agree to a similar action, and that if competitors did in fact undertake such action the courts could infer the existence of an agreement.[60]

In the EU, the object or effect of this communication must be 'to create conditions of competition which *do not correspond to the normal conditions of the market* in question, regard being had to the nature of the products or services offered, the size and number of the undertakings and the volume of the said market'.[61] Other features of this anticompetitive communication are *the removal of uncertainties* and *a lack of independent acting*. In other words, communication, which leads to conditions of the market which differ to the normal conditions of the market, also removes uncertainties and results from a lack of independent acting. For instance, in *Dyestuffs*, the CJEU held that advanced announcements utilized by the competitors in the market led to prohibited parallel conduct in the form of concerted practice. It stated that '[b]y means of these advance announcements the various undertakings *eliminated all uncertainty* between them as to their future conduct and, in doing so, also *eliminated a large part of the risk usually inherent in any independent change of conduct* on one or several markets'.[62] Communication can constitute an anticompetitive object under Article 101(1): if it 'directly or indirectly fix[es] purchase or selling prices or any other trading conditions'[63] by

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57 Economic evidence is important. Situations where parallel actions do not make economic sense in the absence of a cooperative strategy could constitute a prohibited anticompetitive agreement or concerted practice. This was the case in the US case of *American Tobacco*.
Regarding EU law, *see* e.g. *Wood Pulp II*, ECLI:EU:C:1993:120, para. 71; in *Dyestuffs*, ECLI:EU:C:1972:70 the CJEU stated at para. 66 that '[a]lthough parallel behaviour may not by itself be identified with a concerted practice, it may however amount to strong evidence of such a practice if it leads to conditions of competition which do not correspond to the normal conditions of the market'.

58 *See* e.g. *Cimenteries* ECLI:EU:T:2000:77, para. 87.

59 598 F.2d 1323 (4th Circ. 1979).

60 Also *see* e.g. EU: *Cimenteries*, ECLI:EU:T:2000:77; US: *National Macaroni*, 345 F.2d 421; *In re Coordinated Pre-trial Proceedings in Petroleum Products Antitrust Litigation*, 906 F.2d 432 (9th Circ. 1990).

61 *Cimenteries*, ECLI:EU:T:2000:77, para. 87 (emphasis added). *Also see* e.g. Case C-8/08, *T-Mobile Netherlands BV v. Raad van bestuur van de Nederlandse Mededingingsautoriteit*, ECLI:EU:C:2009:343, para. 33; 114/73 *Suiker Unie*, ECR 1663, para. 4.

62 *Dyestuffs*, at 101, emphasis added, *also see* at 112, 119.

63 *T-Mobile Netherlands*, ECLI:EU:C:2009:343, at 37.

'*removing uncertainties* concerning the intended conduct of the participating undertakings, in particular as regards the timing, extent and details of the modifications to be adopted by the undertaking concerned'[64]

With regard to the feature of concerted practice of a lack of independent acting, the CJEU held that Article 101 TFEU concerning 'coordination' and 'cooperation' requires that:

> each economic operator must determine independently the policy which he intends to adopt on the common market
>
> Although it is correct to say that *this requirement of independence* does not deprive economic operators of the right to adapt themselves intelligently to the existing and anticipated conduct of their competitors, it does however *strictly preclude any direct or indirect contact between such operators*, 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.[65]

Therefore, the exchange of information that goes beyond the nature of the market and which leads to a reduction in uncertainty and a lack of independent acting would constitute concerted practice. Whereas parallel conduct that arises from a natural oligopoly lacks these elements.

3.2 The concept of digital polyopoly

Digital algorithms can create conditions which bring competitors into anticompetitive cooperation. Similar to an oligopolistic market, which can lead to concerted practice or natural oligopolies, the digital world can align competitors in parallel conduct in both forms. An oligopolistic market requires a small number of competitors in order to lead to the parallel conduct; however, the parallel conduct that originates in the digital world and is driven by algorithms, named 'digital polyopoly' in this article, is not limited by the number of competitors. Despite this principal difference and other features of the digital world that significantly change the manner and conditions under which parallel conduct can be achieved, digital polyopolies share some essential features with oligopolies, namely interdependence and transparency.

Interdependence is the essential connector among competitors in oligopolies and also in digital polyopolies (despite coming in different forms). We have seen that the interdependence of the oligopolistic market can lead to parallel conduct either in the form of a natural oligopoly or concerted practice. As in the

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[64] *Ibid*., para. 3 (emphasis added); *also see* e.g. *Dyestuffs*, ECLI:EU:C:1972:70, para. 3.

[65] *Suiker Unie*, ECR 1663, paras 4, 173; *also see* e.g. *Dyestuffs*, ECLI:EU:C:1972:70, para. 10; C-49/92 P, *Commission v. Anic Partecipazioni*, EU:C:1999:356, para.116.

oligopolistic markets, the digital world leads to interdependency, which can then lead to parallel conduct. However, the conditions leading to this interdependency are not the same. While in the oligopolistic market, it is the small number of competitors and the transparency of the market that align competitors, in the digital world, interdependency is created by and within digital ecosystems and their algorithms, as we saw in Part II. These ecosystems with their algorithms then also lead to transparency in the digital world.

The global connectivity and interoperability of the digital world makes information highly transparent[66] at all levels (e.g. among competitors and buyers and sellers),[67] creating an environment that is even more transparent than non-digital oligopolies. The digital world not only makes information transparent and available but, at the same time, it allows for the analysis of huge amounts of data, creating collaborative and other links at different levels of a digital ecosystem. This is possible due to algorithms. Data collection and data analytics built in to algorithms create another layer of interdependency and transparency in the digital world by storing, collecting, using and processing the available information. The processing performed by algorithms includes optimizing models, which can take into consideration the impact that competitors' future prices will have on the user of the particular algorithms.[68] These processes occur at enormous speeds that were unimaginable before the digital age, and this speed forms another essential factor of the digital world, given that algorithms can allow for competitors to learn of each other's prices, sales and other variables within seconds.[69] The more transparent the market is, the quicker the algorithms react to adjust prices accordingly. They can even adjust prices before a price change occurs, simply through precise predictions.[70] The rapid speed can also eliminate the need for high barriers to entry typical of oligopolies because algorithms can detect any market change even before it occurs and adjust to it immediately. However, in order to establish a stable polyopoly, high barriers to entry are needed.[71]

The significant transparency that exists in the digital world includes price transparency,[72] and it is this price transparency and price parallel behaviour that

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66 This significant shift towards transparency in the digital world can be limited by the usage of algorithms, especially in situations where specific platforms are involved. In particular, the use of APIs by platforms is decreasing transparency and access to data by creating 'walled gardens'. This is because the API locks both users and app developers into a landscape defined and controlled by the platform, such as Facebook, whereby, the increasing use of APIs by platforms has been removing information from the Open Web. *See* Plantin, Lagozel, Edwards & Sandvig, *supra* n. 28, at 302–04.

67 *See* e.g. European Commission, *supra* n. 4, para. 11.

68 Joseph Harrington, *Developing Competition Law for Collusion by Autonomous Artificial Agents*, Department of Business Economics & Public Policy, University of Pennsylvania, at 59 (2018).

69 *Ibid*., at 55.

70 *See* e.g. Ezrachi & Stucke, *supra* n. 5, at 72–73.

71 *See also* Gal, *supra* n. 5, at 12–19.

72 *See* e.g. European Commission, *supra* n. 4, para. 11.

tends to be discussed most in connection with the digital world. For instance, when conducting an inquiry into e-commerce in 2015–2016, the European Commission found that two thirds of investigated companies used software programs that automatically adjusted prices based on the prices charged by competitors.[73] Such adjustments are not difficult in the digital world because the digital environment makes monitoring, including price monitoring, much easier, allowing for potential deviations to be more easily detected and corrected faster.[74] Both the transparency and rapid speed also mean that coordination problems, such as cheating, are less of a problem in the digital world because rightly constructed algorithms can detect any deviation immediately.[75]

Price transparency and related price monitoring are also common in oligopolistic markets. However, algorithms can monitor and/or involve countless distributors and competitors at speeds impossible in the non-digital world. Such activities that would take several hours, even days, to achieve in the non-digital world, and could be only achieved in an oligopolistic market, now take seconds to do. Indeed, unlike in oligopolistic markets, in the digital world, horizontal markets do not have to be oligopolistic (in other words, highly concentrated) in order to lead to parallel behaviour. In the digital world, it does not matter how many competitors there are: everyone can be connected, anywhere in the world. There are no numerical or geographical limits[76] for information to be transparent, available, exchanged and evaluated. This means that potential parallel behaviour does not only occur within the limits of the oligopoly, as is the case in the non-digital markets, instead, in the digital world, there can be parallel behaviours in *polyopolies*, where there are no numerical limits on competitors and other participants.

Like in oligopolies, homogenous products and inelastic demand form preconditions for the existence of parallel behaviour in polyopolies. However, even in situations where the products are not homogenous in the relevant market, algorithms can be coded in such a way as to lead to sectoral parallel pricing, thus creating an *illusion of competition*. If the relevant product is not homogenous, various algorithms can arrange various products based on differences. Products which are similar, such as those that have the same functions and quality, will end up with the same price, which would be higher than in a non-digital, competitive environment. This price will then differ from the price of products from another group. In this situation, there will be different prices across the market depending on the

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73 European Commission, *supra* n. 4, at 13.

74 *See* e.g. European Commission, *supra* n. 4, paras 11, 13; Palmigiano & Foster, *supra* n. 34.

75 The speed with which any cheating can be detected is highly important for the existence and the stability of anticompetitive coordination. The slower the participants are able to detect any deviation, the more likely the cheating is. *See* e.g. Stigler, *supra* n. 17.

76 Unless these limits are created by specific algorithms.

group of products, but these prices will be formed by sectional parallelism due to specific algorithms and, therefore, create the illusion of competition.

4 ALGORITHMS AND APPLICATION OF COMPETITION LAW TO DIGITAL POLYOPOLIES

Now that we have seen how the digital world on one hand and oligopolies on the other can lead to parallel behaviour, it is important for the application of competition law to digital polyopolies to combine both aspects, and determine whether the digital polyopoly can be captured by the legal concept of concerted practice. Given that in the digital world, parallel conduct is facilitated, established and/or maintained via algorithms, the essential question for the application of competition law to a digital polyopoly is how competition policy and law should perceive algorithms. In order to determine that, the following questions, which arise from the concept of 'concerted practice', must be answered:

- Do algorithms constitute a form of communication? In other words, do they provide an exchange of information?
- If they do constitute a form of communication, do these particular algorithms
- 'create conditions of competition which do not correspond to the normal conditions of the market'?[77]
- remove the uncertainties of business decisions, which facilitate parallel conduct? and
- lead to a lack of independent acting?

A substantively simplified way of looking at algorithms would be to perceive them as 'natural' elements of the digital economy and thus normal conditions of the relevant market. This view would preclude, or at least hinder, current competition law from finding anticompetitive behaviour in the form of collusion in situations where parallel behaviour occurs in the digital world due to algorithms. The reason for this is that parallel behaviour that corresponds to the normal conditions of the market is, under the concept of a natural oligopoly, legal.

However, the nature of algorithms is more complex and certainly differs from the conditions of the pre-digital era. In particular, algorithms change the concept of communication because, in the digital world, communication happens via algorithms or algorithms allow for non-human communication among various entities, such as interoperability.

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[77] *Cimenteries*, ECLI:EU:T:2000:77, para. 87.

As discussed in Part II, the digital world is about information, and algorithms allow for that information to be collected, transmitted, shared and analysed. In particular, the sharing of information can be perceived as communication[78] and, thus, the function of some algorithms can also be perceived as forms of communication.[79] They do not only provide communication among various entities in the digital world, including competitors, they can also communicate directly amongst themselves via reading parameters. In particular, they can be constructed in such a way as to allow them to read other algorithms[80] and to make a particular business decision after they take into consideration the parameters of these other algorithms.[81] This allows firms and/or their algorithms to know each other's strategic business decisions regarding prices or other future conduct that would otherwise not be available in the market and is not required by the nature of the market. Such knowledge would not have been possible without these algorithms. As Gal puts it, '[w]hen an algorithm is transparent to others, another algorithm can "read its mind" and accurately predict all its future actions when given any specific sets of inputs, including changes in market conditions and reactions to other player's actions'. This is not true with regard to human interaction.[82] Indeed, algorithmic communication encompasses a new way of communicating.

We know from the previous discussion on concerted practice that communication can even include a one-sided expression of information or an announcement of future conduct with the other party acting upon it, as the focus of proving concerted practice is broadly on 'any direct or indirect contact between [entities]'.[83] Certainly, making parameters regarding future business conduct transparent where the market does not require the announcement of future conduct and other entities' algorithms

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78 *See* fn. 54, where the definitions of communication includes exchanges of information 'through common system of symbols, signs or behaviour' directly or 'by using some medium'. It also includes means of communication. Under EU competition law, concerted practice can arise from either 'direct or indirect contact' among competitors (if at the horizontal level). *See Cimenteries,* ECLI:EU:T:2000:77, para. 87.

79 Despite the fact that algorithms are linked to information and provide those functions, including functions typified for communication, transmitting and sharing information, there exists a conflicting perception as to whether algorithms can be perceived as a form of communication. While some claim that they are: Gal, *supra* n. 5, at 22–37, others disagree: Ashwin Ittoo & Nicholas Petit, *Algorithmic Pricing Agents and Tacit Collusion: A Technological Perspective* 2–3 (2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3046405 (accessed 16 Dec. 2018).

80 They were originally set as to be read by other algorithms. *See* Gal, *supra* n. 5, at 15, referring to Von Neumann, *First Draft of a Report on the EDVAC*, reproduced in *Origins of Digital Computers: Selected Papers* 383 (Brian Randel led. 1982). More recent development has seen the rise of hidden parameters. *See* e.g. Plantin, Lagozel, Edwards & Sandvig, *supra* n. 28.

81 Michal S. Gal provides a persuasive argument for perceiving specific algorithms as forms of communication and explains well the technical side of it in: Gal, *supra* n. 5, at 15–17, 22, 37.

82 *Ibid.*, at 15. Michal S. Gal explains this further and provides examples. She also refers to Mosche Tenenholtz, *Program Equilibrium*, 49 Games & Econ. Behaviour 363, 364 (2004).

83 *Cimenteries*, ECLI:EU:T:2000:77, para. 87.

read them and act upon them by forming parallel conduct represents exactly that. For instance, if algorithms, which calculate and set future prices, have their parameters open for others to read and others set their prices in collusion with these parameters then this could constitute concerted practice. Whereas prohibited communication among competitors does not exist where the algorithms only observe the announcements on prices required by the nature of the market and upon those bases make a decision about their client's own price. Like in *Woodpulp II*, this could include future prices if the nature of the market requires that future prices must be known in advance, for instance due to long-term contracts with customers.

Indeed, in situations where the particular algorithms amount to communication, the next step is to determine what information the algorithms contain and exchange in order to decide whether the concept of concerted practice applies to that particular digital polyopoly. For concerted practice to apply, the information must be of a business nature, such as information about future prices; it must remove uncertainties associated with crucial future business conduct and also lead to a lack of independent acting in that regard. Algorithms can certainly *remove uncertainties* (including uncertainties related to business strategies such as future price) by reading each other's parameters, which set, for instance, future prices. Another way of removing uncertainties is by sharing the same algorithms among competitors via a platform or joint software, which determines future business strategic conduct because the parameters for determining such future conduct are the same, thus making the information about this future conduct transparent across the users of the same algorithms.[84] Digital polyopolies established by such algorithms would, understandably, also eliminate risks associated with independent, unilateral acting.[85] Algorithms which share information on future conduct such as prices and then unify them are not in line with independent acting as it is understood for the purposes of non-digital world. The usage of such algorithms does not amount to independent, human decision-making on business conduct on behalf of specific economic entities by observing competitors' conduct.

If a lack of independent acting and the removal of uncertainties lead to parallel conduct on this strategic business conduct, in other words, a digital polyopoly, the final step is to determine whether the information exchanged is required by the nature of the market or not. If not, the digital polyopoly is captured by the concept of concerted practice. If yes, the digital polyopoly would have similar features to a

[84] *Also see* Beneke & Mackenrodt, *supra* n. 40, at 126–27. Ezrachi and Stucke discuss a number of examples where the same algorithms were used to facilitate collusion. However, these examples involve humans agreeing to collude (Ezrachi & Stucke, *supra* n. 5, at 39–41.). For instance, this occurred in the airline industry. This was also the case in Case C-74/14, *'Eturas' UAB v. Lietuvos Rspublikos konkurencijos taryba* EU:C:2016:42.

[85] *See* e.g. 114/73 *Suiker Unie*, ECR 1663, para. 4; *Cimenteries*, ECLI:EU:T:2000:77, para. 87 (emphasis added), *T-Mobile Netherlands BV*, ECLI:EU:C:2009:343, para. 33.

oligopoly, which does not amount to the concept of concerted practice. From the text on oligopolies and concerted practice, we can see that the exchange of information between competitors, such as the exchange of information about future strategic plans, future prices or future quantity, is not usually a 'normal condition' of the market. However, the exchange of information, such as providing future prices to customers where the nature of the market requires it, is a normal condition of the market.[86] By applying these concepts to digital polyopolies, we can come to the same conclusion, meaning that the exchange of information in the digital space, in other words the exchange of data, can be either of those depending on the specific situation.

In general, some algorithms can be compared to natural oligopolies while others lead to mutual collusion. One side of the scale involves algorithms which lead to parallel behaviour via mutual communication among competitors. This can happen via numerous algorithms used by individual competitors designed to exchange information amongst themselves. For instance, competitors' algorithms can communicate and exchange information about price. Even unilateral communication linked to a competitor's algorithms, where others act upon it and in that way accept the offer for collusion, can amount to bilateral/multilateral conduct captured by the concept of concerted practice and is certainly not a result of the mere nature of the relevant market.

Mutual communication among competitors can also occur in a Hub and Spoke situation,[87] where a non-competitor assists with the facilitation of horizontal collusion, for instance, where the same algorithms, which are used by a platform connecting numerous competitors directly, leads to parallel behaviour. The platform acts as an intermediate entity at the diagonal or vertical level. Similarly, a number of competitors could use the same software to determine, for instance, their future prices.

One way of understanding the role of such a platform in the digital world could be to perceive it as a competitors' meeting place. In the non-digital environment, the typical way of exchanging information which can lead to collusion is through industry associations and other meetings of the industry.[88] Nowadays, exchange of information can be digitalized and can occur via platforms.

On the other side of the spectrum is the use of algorithms in a similar fashion to unilateral business decision-making in oligopolies, where the nature of the

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86 This was the case in *Wood Pulp II*, ECLI:EU:C:1993:120. See discussion in Part III.

87 One of the recent examples of the Hub and Spoke scenario is the *Eturas*, ECLI:EU:C:2016:42. Although it appeared in the digital world, the parallel conduct resulted from human actions rather than algorithms themselves and their AI. This scenario is explained in, e.g. Ezrachi & Stucke, *supra* n. 5, at 46–50.

88 *See* e.g. T-35/92, *John Deere Ltd v. Commission*, ECLI:EU:T:1994:259; *T-Mobile Netherlands*, ECLI:EU:C:2009:343.

market leads to parallel behaviour without the existence of collusion. For instance, if one software program is used purely by one individual competitor for its own independent business decision-making, even if the software follows the price of another competitor and, indeed, assists with leading to parallel pricing, this amounts to unilateral conduct only. Such unilateral conduct is legal if it occurs in the oligopolistic market, whereas the situation in the digital world differs because of the characteristics of the algorithms. Algorithms can be constructed to substitute unilateral strategic business decisions by utilizing, for example, economic game theories. However, this differs from an oligopoly in that algorithms have an artificial character because they replace human actions and, in some situations, also human decision-making by AI embodied in algorithms. The artificial character means that the conduct is not as independent as they are in the non-digital world, where all of the decisions are made directly by humans. This is because algorithms increase transparency and interdependency within digital ecosystems in a way that did not exist prior to the digital age. The artificial character also does not constitute the normal conditions of a market, as it is different from unilateral human decision-making in individual cases caused by humans observing the markets. It is not humans but algorithms that collect and evaluate the information and make decisions about business conduct. They provide sophisticated means to allow for these functions to occur. This would be impossible without these means and prior to the digital age; humans are not capable of achieving these feats on their own. The artificial nature of the algorithm could lead to new rules, stretch liability and, in particular, establish legal bases for changing algorithms in order to avoid parallel behaviour, as discussed in the next part 'Liability'. This would, most likely, require a change of law.

5 LIABILITY

We have seen that in digital polyopolies it is the algorithms that cause parallel behaviour by subsidizing human actions and decision-making. This lack of human involvement represents a new feature for the purposes of competition law. Under traditional competition law, liability arises from human decision-making and actions, which involves various degrees of intent and, in the case of concerted practice, the existence of an offer and an acceptance, which can have their tacit forms. This human decision-making is usually assigned to specific economic entities. Algorithms, which constitute digital polyopolies, change the decision-making process and actions due to their artificial character, and it is this artificial character that can prove problematic for attributing culpability in two ways: in (1) the *subject* and (2) the *object or aim* of the particular algorithm(s).

Looking at the subject element, algorithms can have their own artificial 'autonomy'. This artificial autonomy is not the same as human autonomy because, in order to conceptualize algorithms, human judgments are necessary. Taking into consideration the master-slave metaphor, a robot, in the case of digital polyopolies, algorithms, will do whatever its master allows it to do. The master-slave metaphor applies to all forms of algorithms, despite whether the autonomy can be detected. If specific algorithms have established autonomy, their artificial autonomy originated in initial, human decision-making by their 'master'. This 'master' element broadens the scope of persons who should or could be liable for anticompetitive digital polyopolies. Put simply, behind every algorithm is a coder, behind every coder is an instructor and/or a manager who gives instructions on what the algorithms have to do. The instructor could be, but does not have to be, the owner.[89]

From the object point of view, the principal question for determining anti-competitiveness, as well as the liability of a particular digital polyopoly, is what the aim of a specific algorithm is: whether their aim is to collude or to compete. For instance, one must consider whether the algorithm that determines prices was designed to determine competitive prices or whether it was designed to match the prices of competitors and thus not compete on price. This leads us to the essential element of liability: *knowledge*.[90] In particular, it must be determined: (1) whose knowledge it is, which takes us back to the subject of attributing culpability; and (2) the degree of this knowledge, which is associated with the object of attributing culpability.

By applying the degree of knowledge of the conduct to a digital polyopoly, algorithms can facilitate parallel behaviour in three general forms: the algorithm is designed to create collusion; it is reasonable to predict that the algorithm can lead to collusion (although it was designed for a different purpose); or the algorithm leads to collusion 'accidently' without the existence of a reasonable prediction. In other words, what has to be considered is whether the aim was to facilitate collusion; if not, whether it was predictable that it could have led to collusion or whether it led to collusion accidently or due to AI (machine learning) without the existence of a reasonable prediction.

The first scenario, where the algorithm is designed to facilitate collusion, encompasses clear knowledge and a likely intention. It can be competitors themselves who use the algorithm in order to collude, and create and maintain parallel

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89 Who can be liable depends on particular situations, some of which are discussed below.

90 In the EU, a concerted practice arises where the parties '*knowingly* substitute a practical co-operation between them for the risks of competition': *Dyestuffs*, ECLI:EU:C:1972:70, para. 64 (emphasis added). It might be enough that the entities in question *ought to be aware* of the collusion or part of it (the offer to collude). *See* e.g. *Eturas* ECLI:EU:C:2016:42, paras 29, 50.

conduct. However, it does not have to be the competitors' algorithm(s). Taking into consideration the existence of ecosystems in the digital world, it can be a platform's algorithm which leads to collusion, with the platform entity having the knowledge that the algorithm is set in such a way as to create and maintain anticompetitive collusion. Primarily, competitors should be liable for horizontal collusion. However, this situation in the digital ecosystem involves a platform and its algorithms causing parallel conduct. Thus the platform should be held liable. The EU allows for an independent entity, which is not a competitor or a supplier or buyer, in this case a platform, to be held liable under Article 101 TFEU, if it is involved in the anticompetitive conduct in question.[91] For an entity not in a horizontal or vertical relationship with others to be held liable, it is enough if it 'contributed to its implementation, even in a subsidiary, accessory, or passive role, for example, by tacitly approving the cartel and by failing to report it to the administrative authorities'.[92] And it must be in agreement, at least tacitly, with the objectives of the conduct in question.[93]

The second scenario involves situations where the algorithm(s) was not designed to lead to collusion but it is reasonably foreseeable that it could. This leads to the question as to by whom it can or should be foreseen. The platform example used in this article points at three different entities: first, the competitors involved in the parallel conduct; second, the platform using the specific algorithm; and, finally, the designer of the algorithm. Indeed, the platform can design the algorithm itself, for instance Google designs its own algorithms. However, sometimes an IT firm may design the algorithm for the platform or, most likely, for one or all of the competitors involved in the parallel behaviour. It could be one or all of the entities who could reasonably foresee that the algorithm could lead to anticompetitive collusion. In situations where a firm uses an IT firm to create specific algorithms which would subsidize or assist its business decision-making, it most likely does not have the technical capacity and knowledge to do it itself. Under the first scenario, it would ask for algorithms to assist its anticompetitive conduct, but under the second scenario it would not. The question is who should have the capability to reasonably predict that these algorithms could potentially lead to anticompetitive conduct. The IT firm has the technical knowledge and by creating these algorithms it should know that it could lead to anticompetitive conduct, whereas the ordering party does not necessarily have the technical knowledge for such a

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[91] For instance, a consultancy firm can be held liable for conduct taking place in a different relevant market as was decided in *AC-Treuhand*, EU:C:2015:717, paras 9, 30–43; *AC-Treuhand* [2008] ECR II-1501, para. 119. This, indeed, involves also all hub and spoke participants. *See* e.g. T-379/10 and T-381/10 *Keramag Keramishe Werke and Others v. Commission* [2013]EU:T:2013:457, para. 19, appeal Case C-613/13 P, *Keramag Keramishe Werke*.

[92] *AC-Treuhand* [2008] ECR II-1501, para. 133; *see also AC-Treuhand v. Commission*, EU:C:2015:717, para. 31.

[93] *Ibid*., para. 30.

prediction. In some cases, the instructions could be such that the reasonable prediction of potential anticompetitive conduct could follow from them.

Who should be liable and who would be liable under current competition law are two different questions. The IT firms, having the technical knowledge, should be liable as they should reasonably predict that such anticompetitive conduct could occur, while the ordering party would not always have the capacity to do so. The way the current competition law, such as the EU competition regime, is set, IT firms as contractors are not, necessarily, efficiently forced to know competition law and take potential anticompetitive conduct into consideration when designing algorithms for their clients. However, for competition law to tackle digital polyopolies effectively, the law should find all entities with that presumed knowledge liable, including the IT firm, under the principle of *ignorantia legis neminem excusat*.

The most difficult scenario for an entity to be held liable under competition law occurs when an algorithm de facto leads to parallel conduct by accident or due to AI without anyone being reasonably aware that the algorithm could have led to such conduct.[94] The difficulty is encompassed in the fact that this scenario does not contain the element of knowledge. This is also a problem in the EU regime, which requires some degree of knowledge in order to establish liability. In particular, the CJEU confirmed the existence of liability under EU competition law in situations where there is direct knowledge of anticompetitive conduct and also where the entity in question should have known, in other words, where they could have reasonably foreseen the anticompetitive conduct.[95]

Indeed, it is difficult to justify liability in a situation where there is no knowledge. Nevertheless, given the artificial nature of the decision-making provided by algorithms, the law could potentially require a change to the algorithm(s), such as changing its parameters, in order to stop the digital polyopoly without holding anyone liable for the polyopoly itself. Only if the algorithms concerned are not subsequently changed could liability be established. This would most likely require a change of law in order to effectively adapt competition law to competition in the digital economy.

6 CONCLUSION

A digital polyopoly is parallel conduct set up and maintained by algorithms in the digital world. The digital environment created by algorithms shares two essential features with oligopolistic markets: transparency and interdependency. At the same time, digital polyopolies differ from oligopolies in that an oligopolistic market is characterized by high concentration, which, together with other features, can

94 Other scholars also acknowledge this possibility. *See* e.g. Harrington, *supra* n. 68, at 29–30.
95 *See Anic Partecipazioni*, EU:C:1999:356, para. 87.

facilitate parallel conduct. Parallel conduct in digital polyopolies, on the other hand, occurs with or without a concentration of the market.

Algorithms are the essential elements of the digital world. Given that they transmit, exchange and analyse information, they represent forms of communication that are artificial in nature, and replace, or can replace, human decision-making. They create conditions different to the normal, pre-digital-age conditions in the market. The perception that they provide communication and/or communicate amongst themselves, allows existing competition law to tackle some digital polyopolies under existing legal concepts, such as 'concerted practice' in EU competition law. Therefore, there is no absolute necessity to rewrite competition law and policy rules on anticompetitive collusion. However, these do need to be adapted to the new situations that digital polyopolies present for competition and law, and potentially new legal tools and rules could be introduced in order to prohibit and tackle all forms of digital polyopolies.

The interpretation of competition law is key for its effective application and enforcement regarding digital polyopolies. The way the digital economy has been evolving indicates that humans will be able to make algorithms even more sophisticated and autonomous and the usage of algorithms in business conduct will become more and more common. Digital polyopolies will, most likely, become more common too, unless sufficiently tackled by law and effective enforcement. Therefore, if competition law is interpreted and enforced in a way that will allow, and not prohibit, their existence, digital polyopolies will represent a great opportunity for firms to maximize their profit, not by being more competitive but by restricting competition. Enforcers need to be prepared, as this is already happening and the area is developing rapidly.

Competition law and effective enforcement also need to address one of the greatest challenges of the digital world for law in general: establishing liability. In that regard, digital polyopolies involve two key challenges for establishing liability under competition law. The first one is the artificial character of algorithms and the related lack of human involvement in digital polyopolies. The second encompasses the fact that other entities, such as platforms and IT firms, and not only direct competitors, are linked to the ownership and knowledge of the functions of particular algorithms creating digital polyopolies.

Digital algorithms are changing the world we live in, including the way business is conducted. It is about time that the law and its enforcement catch up with this reality. Indeed, the effective enforcement of law in the digital economy needs to go beyond traditional means. It needs to include innovative tools which will keep up with the highly dynamic digital world where, for instance, prices can be changed by algorithms many times a day. If private entities use algorithms, it is time for competition authorities to be allowed to use their own algorithms to detect parallel conduct and, potentially, even correct situations where parallel conduct occurs in the digital world. This should not be the realm of science-fiction but the next future reality.