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'Legal Sci-Fi'

Interaction between algorithms, AI systems and competition law in the e-commerce sector

How can algorithms foster illicit conduct, what are the current legal constraints in the law of the US and the EU towards imposing liability on algorithm users and which workable regulatory solutions seem plausible to address this problem?

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ABSTRACT

The new digital world has snowballed in past years, from simple computers and algorithms to Artificial Agents which can make business decisions. These Artificial Agents have caused a lot of legal, political and societal debate. However, competition authorities argue that the antitrust laws are up to the task. This thesis will provide a critical assessment of this statement while introducing the reader to the world where algorithms and artificial agents fix the prices without human intervention through four different scenarios identified by Ezrachi and Stucke. Those scenarios are the Messenger, Hub-and-Spoke, the Predictable Agent and the Digital Eye.

The question which follows is, who do we hold liable when the prices on the market become supra-competitive, for example when the usual Uber ride fares become four times higher? The answer is ambiguous, and it depends on the exact type of illicit conduct. However, liability cracks in both the US and the EU jurisdiction have created 'impunity' for some Artificial Agents. The findings of the thesis further indicate that only in the Messenger and Hub-and-Spoke scenario, the existing legislation in the US and the EU is sufficient enough to capture liability.

Price-fixing may be only a click away which implies that workable regulatory solutions are needed for bridging the gap between algorithms and competition enforcers. Therefore, three possible solutions are proposed which attempt to contribute to the overall debate which questions if reform of the law is necessary. Some solutions require a 'change in perspective' while others require 'change in law'. The findings of the analysis indicate that change is necessary and that the mix of two solutions, one focusing on the Artificial Agent as the employee and another constructed as a mix of ex-ante and ex-post regulation would be optimal in theory, but full regulation is not realistic at this moment in time. However, it is time to embrace the algorithmic v. competition law battle of the 21st century.

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List of Abbreviations

AAA- Autonomous Artificial Agent

AA- Artificial Agent

AI- Artificial Intelligence

AP- Algorithmic pricing

CMA- Competition and Markets Authority

DOJ- Department of Justice

EC- European Commission

EU- European Union

FTC- Federal Trade Commission

ML- Machine Learning

OECD- Organisation for Economic Co-operation and Development

TFEU- Treaty on the Functioning of the European Union

TPPS- Third-party pricing strategist

CJEU- Court of Justice of the European Union

US- The United States of America

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"There is nothing permanent except change."

-Heraclitus

Introduction

In March 2017, EU Competition Commissioner Margrethe Vestager said: *"[w]e certainly should not panic about the way algorithms are affecting markets"*, but added that, *"[w]e should keep a close eye on how algorithms are developing"*.[1] Contrary to Commissioner Vestager, however, some scholars assert that this is the *"end of the competition as we know it"*.[2] Despite the variety of opinions on the topic, it is certain that the competition authorities in the European Union (EU) and the United States (US) are currently struggling with the complications that algorithms bring to competition policy.[3]

The questions concerning algorithms, artificial intelligence (AI) and self-learning computers seem more apt for a conversation about films, such as about the HAL 9000 computer from 2001: A *Space Odyssey*, and not a legal inquiry.[4] Nonetheless, the importance of algorithms and the digital environment, in general, is becoming significantly noticeable in daily life.

AI is a relatively new field, which started around the 1940s with the birth of the modern computer.[5] However, algorithms have been known since antiquity. Already in the third century BC, Euclid wrote about an algorithm which finds the most significant standard division of two ingredients.[6] Later,

[1] Nicolas Petit, 'Antitrust and Artificial Intelligence: A Research Agenda' (2017) 8 Journal of European Competition Law & Practice 361, 362.

[2] ibid 361.

[3] Ariel Ezrachi and Maurice E Stucke, 'Virtual Competition' (2016) 7 Journal of European Competition Law & Practice 585, 585.

[4] Ariel Ezrachi and Maurice E Stucke, 'Artificial Intelligence & Collusion: When Computers Inhibit Competition' (2017) 2017 University of Illinois Law Review 1775, 1775.

[5] Dan W Patterson, *Introduction to Artificial Intelligence and Expert Systems* (Prentice-Hall of India 1992) 1–2.

[6] Christos Papadimitriou, 'Algorithms, Complexity, and the Sciences' (2014) 111 Proceedings of the National Academy of Sciences 15881, 15881.

around, the 1950s, humans became impressed with the remarkable ability of a simple computer to store large amounts of information and process it with high speed. Software and hardware systems have since developed to exceed human abilities for information processing. Similarly, they have become integrated into our everyday life.[7] Nowadays, algorithms can monitor prices and respond to market changes more quickly and accurately than any human might ever endeavour to do.[8]

One of the most notable examples of the new-age algorithm is the Uber algorithm which 'manages' a multinational ride-hailing company. Many users have wondered why on New Year's Eve the prices for a ride are five times higher than the 'usual fare'. The explanation for this comes from "surge pricing".[9] This practice resembles basic market economics, which entails, that, if many users want a ride, prices are pushed up by market demands. This leads more drivers to join the network, and a more expensive price per ride is reached.[10] One would assume, that Uber might be determining the market price, but according to Uber's CEO: *"We are not setting the price, the market is setting the price […] we have algorithms to determine what the market is"*.[11] Even if it is assumed that Uber does not set the price, the drivers, which should be competing between each other because they are independent contractors, have instead agreed to have their prices determined by a company.[12] Whether this can be a twenty-first-century cartel or something in a similar vein can be answered by examining the functioning of the algorithm.[13]

There is an on-going *Uber* case in the US initiated by Spencer Meyer in 2015 alleging that Uber Technologies Inc engaged in an illegal conspiracy with its drivers to fix prices through charging

[7] Patterson (n 5) 1.

[8] Inge Graef, 'Algorithms and Fairness: What Role for Competition Law in Targeting Price Discrimination towards End Consumers' (2018) 24 Columbia Journal of European Law 541, 541.

[9] Salil K Mehra, 'Antitrust and the Robo-Seller: Competition in the Time of Algorithms' (2015) 100 Minnesota Law Review 1323, 1323.

[10] ibid; Jacob Saulwick, 'Is Cab App Just an Uber Cartel?' (*The Sydney Morning Herald*, 9 January 2015) <https://www.smh.com.au/business/is-cab-app-just-an-uber-cartel-20150109-12ktd5.html> accessed 18 June 2020.

[11] Mehra (n 9) 1324; Yves Smith, 'Matt Stoller: How Uber Creates an Algorithmic Monopoly to Extract Rents' (*naked capitalism*, 11 April 2014) <https://www.nakedcapitalism.com/2014/04/matt-stoller-how-uber-creates-an-algorithmic-monopoly.html> accessed 18 June 2020.

[12] Mehra (n 9) 1324.

[13] ibid.

"surge pricing" fares by agreeing to have the prices set by an algorithm.[14] Even though Uber believed that the law was on their side, there has been a plot twist. The appointed arbitrator, Les Weinstein, who in February 2020 ruled in Uber's favour, has now stated that he was acting out of fear. This makes the ruling potentially 'nugatory', and a request was forwarded to a federal judge to overturn the decision on 22 May 2020.[15] This decision will be a landmark precedent for the legal field because it will answer a question whether a case like that should be arbitrable in the first place.

This example clearly illustrates one of the uncertainties which these smart algorithms bring into the competition law field. The image of so-called 'Gary dinners' and bosses sitting in a smoke-filled room and setting prices is outdated. The increasing power of computers, algorithms and self-learning machines have caused a radical change in how we should imagine such a process occurring. Many of the pricing decisions are made only by algorithms, and not through any form of human decision making.[16]

Algorithmic decision-making and its possible collusive outcome have been on the radar for numerous scholars and organisations. Ezrachi and Stucke have laid down a baseline for every discussion about algorithmic collusion because they have *inter alia* identified four possible scenarios of algorithmic collusion.[17] Scholars like Mehra, Harrington, Beneke and Mackenrodt have scrutinised the topic of algorithmic collusion and have identified the existing cracks in current legislation.[18] Mehra and

[14] 'Uber Customer Claims Company Won Price-Fixing Suit Because Arbitrator Was Scared' (*Financial Post*) <https://business.financialpost.com/pmn/business-pmn/uber-customer-claims-company-won-price-fixing-suit-because-arbitrator-was-scared> accessed 22 July 2020; *Meyer v Uber Technologies, Inc,* No. 16-2750 (2d Cir. 2017).

[15] 'Uber Customer Claims Company Won Price-Fixing Suit Because Arbitrator Was Scared' *Reuters* (23 May 2020) <https://www.reuters.com/article/us-uber-lawsuit-idUSKBN22Y2ZZ> accessed 6 July 2020; 'Uber Customer To Judge: Overturn Price-Fixing Rule' (*PYMNTS.com*, 26 May 2020) <https://www.pymnts.com/legal/2020/uber-customer-asks-judge-to-overturn-price-fixing-ruling/> accessed 6 July 2020.

[16] Mehra (n 9) 1324.

[17] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4).

[18] Mehra (n 9); Joseph E Harrington, 'DEVELOPING COMPETITION LAW FOR COLLUSION BY AUTONOMOUS ARTIFICIAL AGENTS' (2018) 14 Journal of Competition Law & Economics 331; Francisco Beneke and Mark-Oliver Mackenrodt, 'Artificial Intelligence and Collusion' (2019) 50 IIC - International Review of Intellectual Property and Competition Law 109.

Schwalbe further focused on the numerous problems with oligopolistic theory and collusion.[19] Furthermore, the impact of the data-driven innovation on competition has been documented in OECD papers, specifically addressing various issues such as the risk of collusion and algorithmic regulation.[20] Both, the Department of Justice (DOJ) and the Federal Trade Commission (FTC) in the US, and the European Commission (EC) in the EU, have published guidelines, and reports expressing concerns and raising awareness on this topic.[21] Although the topic has been discussed in the literature, this thesis will evaluate if the existing cracks in the laws in the US and the EU allow the imposition of liability on algorithmic users of a twenty-first-century cartel.[22] However, it aims to spark the debate and go further as it looks to fulfil the gaps in the literature by predicting workable regulatory solutions to address problems with liability imposition in an analytical matter whilst proposing innovative solutions and critically assessing some which are already mentioned in the literature. The proposed solutions are: conceptualisation of the Artificial Agent as an employee, regulation and full prohibition. This thesis advocates a mix of solutions to empower both the competition authorities and private undertakings. Although the cases available at the moment are limited and pending, shortly, they will be one of the most prominent problems with which the Courts will have to deal with. Lastly, this paper aims to answer a more practical research question which reads: *How can algorithms foster illicit conduct, what are the current legal constraints in the law of the US and the EU towards imposing liability on algorithm users and which workable regulatory solutions seem plausible to address this problem?*

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[19] Mehra (n 9); Ulrich Schwalbe, 'Algorithms, Machine Learning, And Collusion' (2018) 14 Journal of Competition Law and Economics 568.

[20] 'Algorithms and Collusion: Competition Policy in the Digital Age - OECD' (2017) 5–7 <https://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm> accessed 18 June 2020.

[21] 'AI and Algorithms: FTC Issues Guidance for Companies Amid Heightened Scrutiny' <https://www.cooley.com/news/insight/2020/2020-04-23-ai-and-algorithms-ftc-issues-guidance-for-companies-amid-heightened-scrutiny> accessed 16 July 2020; 'Using Artificial Intelligence and Algorithms' (*Federal Trade Commission*, 8 April 2020) <https://www.ftc.gov/news-events/blogs/business-blog/2020/04/using-artificial-intelligence-algorithms> accessed 16 July 2020; OECD, 'Algorithms and Collusion - Note from the European Union DAF/COMP/WD(2017)12' <https://one.oecd.org/document/DAF/COMP/WD(2017)12/en/pdf>; OECD, 'Algorithms and Collusion - Note by the United States DAF/COMP/WD(2017)41' <https://www.justice.gov/atr/case-document/file/979231/download>.

[22] Niccolo Colombo, 'Virtual Competition: Human Liability Vis-a-Vis Artificial Intelligence's Anticompetitive Behaviours' (2018) 2 European Competition and Regulatory Law Review (CoRe) 11, 11–12.

The first section of the thesis will establish basic concepts and define algorithms. It will explain how these magical creatures operate in practice, with the predominant focus resting on algorithmic pricing. After introducing the reader to general principles and definitions, the second part of this thesis will examine the change that algorithms have brought to market dynamics, focusing on the four spectrums of possible illicit conduct identified by Ezrachi and Stucke and other scholars. Additionally, the subsection of each scenario of possible illicit conduct will explore the darker side of algorithms, their 'impunity' and lack of enforcement tools in the US and EU which would help with liability imposition. After the gaps in law are identified, this thesis will propose three possible workable regulatory solutions to problems identified in the previous Chapter, and the thesis will address the sub-question which deals with whether competition law reform is necessary.

I. The Age of Algorithms

As a preliminary point, there is no single definition of an algorithm. Nonetheless, one can imagine an algorithm as a recipe made of ingredients, which correspond to numbers.[23] They are fundamentally about finding solutions, in the quickest and the easiest way. However, with the rise of computers, a divide has manifested itself between the old algorithms used by Isaac Newton and modern algorithms used in private research, for example.[24] After all, algorithms do not necessarily depend on a computer — they can be solved manually by a human, but this is complicated and often prohibitively time-consuming.[25] Therefore, the focus of this section is on 'modern algorithms', which we first analyse alongside AI systems (see below 1.1). Furthermore, we discuss algorithmic pricing, which raises various competition law challenges (see below 1.2).

[23] Sumit Singh Bhadauria and Lokesh Vyas, 'Algorithmic Pricing & Collusion; The Limits of Antitrust Enforcement' (2018) 8 Nirma University Law Journal 87, 90.

[24] John Paul Mueller and Luca Massaron, *Algorithms For Dummies* (John Wiley & Sons 2017) 10.

[25] ibid.

I.1. What are algorithms and AI systems?

When dealing with an algorithm, one needs to think about the input, desired output, and sequence of actions ('a process') used to obtain the desired output from a given input.[26] This means that a creator needs to think about what she will get at the end of what she has put in, in other words, the creator must understand the problem, before she can solve it.[27]

This thesis will use the following definition of an algorithm: *"a sequence of steps used to solve a problem*".[28] These sequences present a unique method of addressing an issue by providing a particular solution.[29] Next to this, the whole process, which represents an algorithm, has three main characteristics. It must be finite (it must solve a problem), well-defined (the series of the steps used must be precise and understandable), and it must be effective (must solve all problems for which someone defined it).[30]

Another important type of algorithms are AI algorithms.[31] Compared to the previous algorithm type, they are very diverse, and often not clearly defined.[32] Nonetheless, according to the features which represent it, AI can be defined as: "*a system capable of performing tasks that would normally require human intelligence, such as recognition, decision-making, creation, […]* ".[33] They are capable of identifying objects or automatically classifying them similarly to how humans would.[34] Moreover, algorithms follow the process of human perception, from being presented with examples and the

[26] ibid.

[27] ibid 24.

[28] ibid 11.

[29] Aleksandra Lamontanaro, 'Bounty Hunters for Algorithmic Cartels: An Old Solution for a New Problem Notes' (2019) 30 Fordham Intellectual Property, Media & Entertainment Law Journal 1259, 1265.

[30] Mueller and Massaron (n 24) 11; 'Algorithm | Mathematics' (*Encyclopedia Britannica*) <https://www.britannica.com/science/algorithm> accessed 23 July 2020.

[31] Shlomit Yanisky-Ravid, 'Generating Rembrandt: Artificial Intelligence, Copyright, and Accountability in the 3A Era: The Human-like Authors Are Already Here: A New Model Visionary Article in Intellectual Property Law' (2017) 2017 Michigan State Law Review 659, 672.

[32] ibid 672–673.

[33] ibid 673.

[34] ibid 676.

correct classification, to training and learning through experience and from data surrounding them.[35] The system is continuously evolving as a result of the input of new data.[36] For example, if one would want it to fix prices on the market, then the system would regularly be exposed to market conditions and competitors' prices. An AI algorithm would find interconnections (e.g. through price links and other control variables) between prices and if programmed to do so, start algorithmic pricing (AP).

I.2 Algorithmic pricing

AP is the focal point of concern for competition authorities and regulators because it has raised various challenges in the competition law field and beyond. For example, AP enlarges the scope for price discrimination, it may lead to consumer poaching, and it can facilitate collusion without human intervention.[37]

There are two most important classes of pricing algorithms: adaptive and learning algorithms.[38] Adaptive pricing algorithms are the so-called 'first generation' pricing algorithms, and they are a *"set of rules that dictate optimal responses to specific contingencies".*[39] They are characterised by two sets of activities which they perform: estimation and optimisation.[40] The former activity estimates market demand using past volumes and prices and other control variables, while the latter one, chooses the optimal price given the demand estimate and observed past behaviour of rivals.[41] Thus, when market conditions are known, adaptive algorithms set a firm's price as a function of rival's past prices.[42] Nonetheless, adaptive algorithms cannot collude unless they are designed by the programmer to do so.[43]

[35] ibid 676–677.

[36] ibid 677.

[37] Emilio Calvano and others, 'Algorithmic Pricing What Implications for Competition Policy?' (2019) 55 Review of Industrial Organization 155, 156–157.

[38] ibid 158.

[39] ibid.

[40] ibid.

[41] ibid; Paul Milgrom and John Roberts, 'Rationalizability, Learning, and Equilibrium in Games with Strategic Complementarities' (1990) 58 Econometrica 1255, 1258–1260.

[42] Calvano and others (n 36) 158.

[43] ibid 159.

On the other hand, learning algorithms are linked to the fields of AI and Machine Learning (ML). With ML, the software learns to solve the task from experience.[44] They are focused on the "active" type of learning, and they experiment to achieve the optimal price. Nonetheless, the programmer still chooses the variables that determine the strategy.[45] The programme focuses on learning, from its own experience, how to produce the optimal outcome.[46] Compared to adaptive pricing algorithms, they are more costly, and the learning process may be lengthy, but in the long term, they can give more advantages than adaptive pricing algorithms in changing environments. Moreover, they may learn by themselves how to collude (if it is profitable) even without being designed to do so, and this will be illustrated in the following Chapter.[47]

II. The rise of algorithms and the change in market dynamics

The focus of this Chapter will be on four categories which are identified by Ezrachi and Stucke and others.[48] Those are the *Messenger* (see below 2.1), *Hub and Spoke* (see below 2.2), *Predictable Agent* (see below 2.3), and *Digital Eye* (see below 2.4).[49] Each of these brings significant enforcement challenges for competition law authorities and presents legal and ethical issues.[50] As a general point, one should keep in mind that coordination concerning prices is considered very harmful since prices are one of the essential competition parameters.[51] Moreover, the US and the EU jurisdictions will be discussed together because both of them have similar problems when one tries to impose liability on algorithms.

[44] Ethem Alpaydin, *Introduction to Machine Learning* (MIT Press 2020) 3.

[45] Calvano and others (n 36) 160.

[46] ibid 161.

[47] ibid.

[48] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4); Colombo (n 22).

[49] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1781–1782.

[50] ibid 1782–1784.

[51] Beneke and Mackenrodt (n 18) 112.

One of the issues is that algorithms (so-called: 'Robo-sellers') increased the power of the oligopolists. They can charge supra-competitive prices and create 'durable' cartels with the help of an algorithm.[52] As said by Ezrachi and Stucke: *"Unlike humans, computers do not fear detection, possible financial penalties, or incarceration, and they do not respond in anger".*[53] How do you then impose liability on them? Which problems occur when one wants to impose liability? To answer this question, the focus will be on the term 'agreement' because it is an integral part of defining liability.[54]

II.1. First Scenario: Executor 'the Computer as a messenger'

This category can be seen as a smoke-filled room in a digital version.[55] Here, the computers execute and monitor the human will to collude.[56] Therefore, under *the Computer as a messenger* scenario (so-called: '*Executor'*) humans who agreed to collude and form a cartel use a computer as assistance to implement or monitor the cartel.[57]

Imagine that there are ten companies on the market in an imaginary country Cartelisa. All those companies produce and distribute toilet paper and are in direct competition with one another on the same market. Mr Trumpeta runs company one called White, and Ms Anfela runs company two called Extra White. Both companies realise that their sales are not going as expected, and they decide to form a cartel. Both of them have recently heard that many companies have started using more and more algorithms in their daily production to achieve better results. Therefore, they decide to implement an algorithm which serves to estimate how many people in the following month are likely to buy toilet paper from their company. While deciding on how to collude and agree on the price of toilet paper, they come up with an idea to use a computer for this. If they use a computer, they do not need to do anything directly but can simply designate a computer to execute their wishes.

[52] Salil Mehra, 'Antitrust and the Robo-Seller: Competition in the Time of Algorithms' (2015) 100 Minnesota Law Review Forthcoming; Temple University Legal Studies Research Paper No. 2015-15. Available at SSRN: https://ssrn.com/abstract=2576341, 19.

[53] Colombo (n 22) 14; Ariel Ezrachi and Maurice E Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (Harvard University Press 2016).

[54] Harrington (n 18) 377; Beneke and Mackenrodt (n 18) 112.

[55] Colombo (n 22) 12.

[56] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1782; Colombo (n 22) 12.

[57] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1782.

Consequently, they decide to use a medium (a computer algorithm: X) which serves as a messenger. Both Mr Trumpeta and Ms Anfela instruct their programmers to implement this algorithm which helps to effectuate the cartel, monitors and punishes any deviation. This 'implies' that they only colluded at the beginning but throughout the rest of the cartel the computer monitors and enforces the agreement.[58] The question is, how would one impose liability in such a scenario?

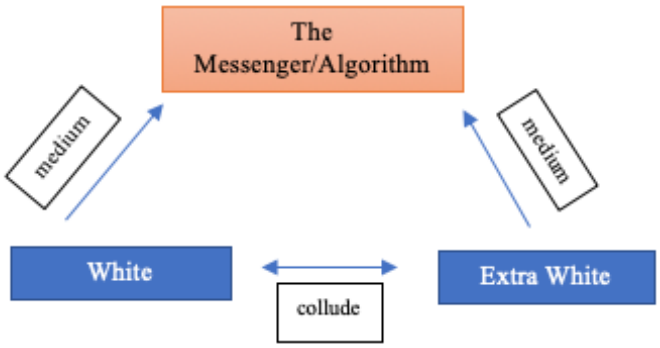

Figure 1. the Executor scenario

II.1.1 *Merits of Potential Antitrust arguments*

In this case, competition enforcers would probably find the existence of an agreement or concerted practice.[59] The rules are infringed in the same manner as in the 'old times' because the meeting of minds has occurred.[60] The rules are determined and written down in the algorithm's code, which means it can be accessed, and it is possible to get 'inside the head' of the price-setting agent.[61]

[58] ibid 1784.

[59] ibid. Article 101 of the Treaty on the Functioning of the European Union [2012] OJ C 326.

[60] Colombo (n 22) 12.

[61] Harrington (n 18) 350.

Moreover, the firms will not escape liability if they say that the machines determined or adjusted the prices.[62] From a legal point of view, it does not change the 'human prism'.[63] Therefore, once the competition authority established the existence of an agreement or concerted practice, it will be easy for them to establish the object of restricting competition.[64] The main criterion for 'object' requirement is finding *"that such coordination reveals in itself a sufficient degree of harm to competition"*.[65] The term 'object' refers to the meaning and the purpose of the agreement.[66] Furthermore, the subjective intention of restricting competition when entering into the agreement is not required.[67]

Article 101(1) TFEU explicitly prohibits directly or indirectly fixing purchase or selling prices.[68] Price-fixing is therefore specifically cited as an example of an anti-competitive agreement.[69] Moreover, the Court held in the *T-Mobile* case that the *"exchange of information between competitors is tainted with an anti-competitive object if the exchange is capable of removing uncertainties concerning the intended conduct of the participating undertakings"*.[70] Next to this, the Commission in its *Guidelines on Horizontal Cooperation Agreements* stated that *"the exchange of information between competitors of individualised data regarding intended future prices or quantities to be restrictive of competition by object"*.[71]

[62] Colombo (n 22) 12.

[63] Ezrachi and Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (n 52) 42.

[64] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1784.

[65] Richard Whish and David Bailey, *Competition Law* (Ninth Edition, Oxford University Press 2018) 123.; Case C-67/13 P *Groupement des cartes bancaires (CB) v European Commission* [2014] ECLI:EU:C:2014:2204, para 57.

[66] ibid.; Cases 29/83 and 30/83 *Compagnie Royale Asturienne des Mines SA and Rheinzink GmbH v Commission of the European Communities* [1984] ECLI:EU:C:1984:130, paras 25-26.

[67] ibid.

[68] Article 101(1) TFEU.

[69] Whish and Bailey (n 64) 128.

[70] ibid.; Case C-8/08 *T-Mobile Netherlands BV, KPN Mobile NV, Orange Nederland NV and Vodafone Libertel NV v Raad van bestuur van de Nederlandse Mededingingsautoriteit* [2009] ECLI:EU:C:2009:343, para 43.

[71] ibid.; Commission Notice 2011/C of 14 January 2011 on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements [2011] OJ C 11/01, para 74.

The US cases, such as *Topkins* and *Airline Tariff Publishing* illustrate this category. The *Topkins* case highly resembles Mr Trumpeta and Ms Anfela's scenario.[72] In the *Topkins* case, the undertakings forming the cartel agreed to fix and stabilise the prices of certain posters sold on Amazon marketplace.[73] Therefore, as a form of 'implementation' of an agreement, they adopted specific pricing algorithms intending to coordinate changes in their respective prices.[74] Could the liability be based on a *per se* prohibition of specific pricing algorithms?[75] *Per se* illegality captures agreements among competitors that tamper with the price structure.[76] Here, the scope of the agreement and its harm can be reflected by the computer which implemented and monitored the agreement.[77] In a similar vein, the stronger is the evidence supporting the anti-competitive agreement is, the lesser is the need for the intent evidence.[78]

[72] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1786; 'Algorithms, Artificial Intelligence And Joint Conduct - Anti-Trust/Competition Law - United States' <https://www.mondaq.com/unitedstates/antitrust-eu-competition-/598940/algorithms-artificial-intelligence-and-joint-conduct> accessed 18 June 2020.; Press Release, Dep't of Justice, Former E-Commerce Executive Charged with Price Fixing in the Antitrust Divion's First Online Marketplace Prosecution (Apr. 6, 2015), <https://www.justice.gov/opa/pr/former-e-commerce-executive-charged-price-fixing-antitrust-divisions-first-online-marketplace> accessed 18 June 2020; *United States. V. Airline Tariff Publishing Company*., 836 F. Supp. 9 (D.D.C.1993).

[73] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1786; 'Algorithms, Artificial Intelligence And Joint Conduct - Anti-Trust/Competition Law - United States' (n 71).; Press Release, Dep't of Justice, Former E-Commerce Executive Charged with Price Fixing in the Antitrust Divion's First Online Marketplace Prosecution (Apr. 6, 2015), <https://www.justice.gov/opa/pr/former-e-commerce-executive-charged-price-fixing-antitrust-divisions-first-online-marketplace> accessed 18 June 2020.

[74] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1786; 'Algorithms, Artificial Intelligence And Joint Conduct - Anti-Trust/Competition Law - United States' (n 71).; Press Release, Dep't of Justice, Former E-Commerce Executive Charged with Price Fixing in the Antitrust Divion's First Online Marketplace Prosecution (Apr. 6, 2015), <https://www.justice.gov/opa/pr/former-e-commerce-executive-charged-price-fixing-antitrust-divisions-first-online-marketplace> accessed 18 June 2020.

[75] Harrington (n 18) 350.

[76] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1785.; *United States v. Socony-Vacuum Oil Co*., 310 U.S. 150, 221 (1940).

[77] ibid.

[78] ibid.

On the other hand, even if the intent evidence is needed for offences which are *per se* illegal, such as price-fixing, the evidence threshold for intent is modest.[79] In the US, the lower courts ruled that for an activity which is *per se* illegal, the prosecutors need only to prove the existence of an agreement and that the defendant knowingly agreed.[80] This is beneficial for prosecutors who deal with cases involving computers and algorithms because the motives of the defendant are 'irrelevant' when the conduct is *per se* illegal.[81] Thus, if the strategy of an algorithm can be directly observed, collusion can be effectively prosecuted.[82]

Consequently, liability will hardly be escaped because anti-competitiveness of the agreement is *in per ipsa* and will be classified as an 'infringement' of antitrust rules.[83] As seen from *T-Mobile* and *Topkins* case, the approach in the US and the EU can be seen as 'converging' because the exchange of confidential information between competitors was enough to establish some degree of intent which is equivalent to the US *per se* violation. Consequently, competition authorities in the two respective systems are equipped to prosecute cases which fall under the *Messenger* category. This is a focal point for future cases because the main problem lies with the algorithms being outside the scope of the competition law enforcement.

The essential matter is what the desire and the intention of the creator/operator of the algorithm were, i.e. were algorithms designed to facilitate collusion or not. After all, these algorithms are a neutral force, they are just '*messengers*', and depending on how one uses them, may prove to be a positive force or a negative one.[84] However, the implementation process and the decision regarding which pricing algorithms should be prohibited is a more complicated matter. Furthermore, sometimes it is not possible to trace the necessary 'steps' from the algorithmic code which can establish an agreement. One would then need to rely on the algorithm output.[85]

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[79] ibid.

[80] ibid.; *United States v Gillen*, 599 F.2d 541, 545 (3d Cir. 1979).

[81] ibid.

[82] Harrington (n 18) 350.

[83] Colombo (n 22) 12.

[84] Ezrachi and Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (n 52) 45.

[85] Harrington (n 18) 351.

II.2 Second Scenario: Hub-and-Spoke

The second category concerns the use of one algorithm to determine the market price charged by numerous users.[86] A classical *Hub-and-spoke* conspiracy occurs in a situation where there are multiple similar vertical agreements with many of the industries' competitors. The developer (as the hub) helps the industry-wide collusion, which consequently leads to the price increase.[87] Competitors use the same algorithm in order to react to market changes or to determine the market price.[88] The following examples will illustrate two *Hub-and-Spoke* scenarios.

To illustrate the first *Hub-and-Spoke* scenario, imagine an *Uber* case wherein the imaginary country Cartelisa *inter alia* taxi services are very much in demand. We will adhere to the Uber example because it is an on-going case in the US, and it will have world-wide implications.[89] Uber, as a ride-hailing company, offers services such as peer-to-peer ridesharing and service ride-hailing.[90] Moreover, Uber describes itself as *"a technology platform"* where *"smartphone apps connect driver-partners and riders"*.[91] When one wants to drive (work) for Uber, she becomes an "independent contractor" which joins the platform under the illusion that she is her "own boss". Although Uber indeed does not control the behaviour of the drivers on their job, the app assigns them pickup requests, suspensions, it incentivises them to work at particular times or places ('surge pricing'), it urges them to work on particular days, and it sends them various surveys. All of this can be described by saying that Uber performs *"algorithmic management"*.[92] Such a business strategy leads to the question of how much the market decides on the prices, and how much, on the other hand, Uber *"acts as a neutral intermediary that connects supply and demand with an automated mechanism"*.[93]

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[86] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1782.

[87] ibid.; *JTC Petroleum Co. v. Piasa Motor Fuels, Inc*., 190 F.3d 775, 778 (7th Cir. 1999).

[88] ibid 1787.

[89] *Meyer v. Uber Technologies, Inc.,* (n 14).

[90] 'Uber Revenue and Usage Statistics (2019)' (*BuildFire*, 11 March 2019) <https://buildfire.com/uber-statistics/> accessed 8 July 2020.

[91] 'How Does Uber Work?' (*Uber*) <https://help.uber.com/riders/article/how-does-uber-work> accessed 8 July 2020.

[92] 'When Your Boss Is an Uber Algorithm' (*MIT Technology Review*) <https://www.technologyreview.com/2015/12/01/247388/when-your-boss-is-an-uber-algorithm/> accessed 8 July 2020.

[93] ibid.

The Uber algorithm has a dynamic pricing model which *"adjusts rates based on a number of variables, such as time[…]distance[…]traffic[…]demand"*.[94] Consequently, the price is not determined by the independent drivers who use the app, but by the algorithm. Both the drivers and the owners of an algorithm can be content with this because the algorithm quickly pushes the fare up 'according to the market price' which ultimately leads to higher income for both of them. On the other hand, many "competitors" (and scholars) are concerned about the algorithm, and they refer to it as 'algorithmic monopoly' because it mimics the perceived competitive price and not the actual market price.[95]

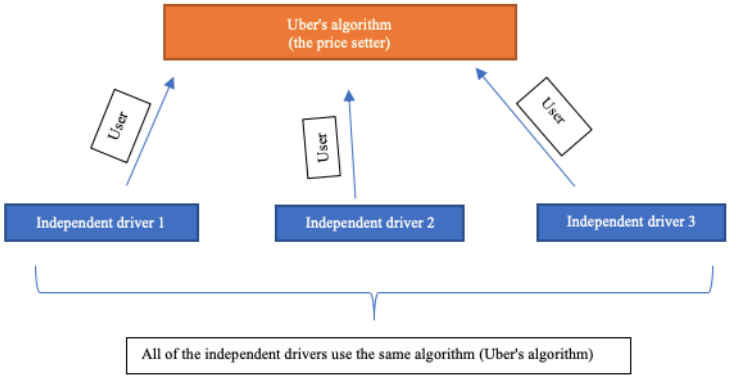

***Figure 2**. The first Hub-and-Spoke Scenario*

We can now return to our hypothetical example in the country Cartelisa. After seeing the success of the Uber algorithm, Mr Trumpeta decides to enter the same business as well. Therefore, he opens another ride-hailing company called Zeusa. Mr Trumpeta decides to pursue a different strategy from Uber and chooses not to use the algorithm, but he hires a third-party pricing strategist (TPPS) which sets the profit-maximising price for their services. Moreover, all the cost data is sent to this strategist not only from Zeusa but also from other companies which use the same third party. Consequently,

[94] 'How Uber's Dynamic Pricing Model Works' (*Uber Blog*, 21 January 2019) <https://www.uber.com/en-GB/blog/uber-dynamic-pricing/> accessed 8 July 2020.

[95] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1788.

numerous times it happens that the same third-party pricing strategist has proposed a similar profit-maximising price which creates a hub-and-spoke conspiracy.[96]

As seen from both scenarios, the parallel use of the same algorithm or the TPPS can open a door for anti-competitive collusion.[97]

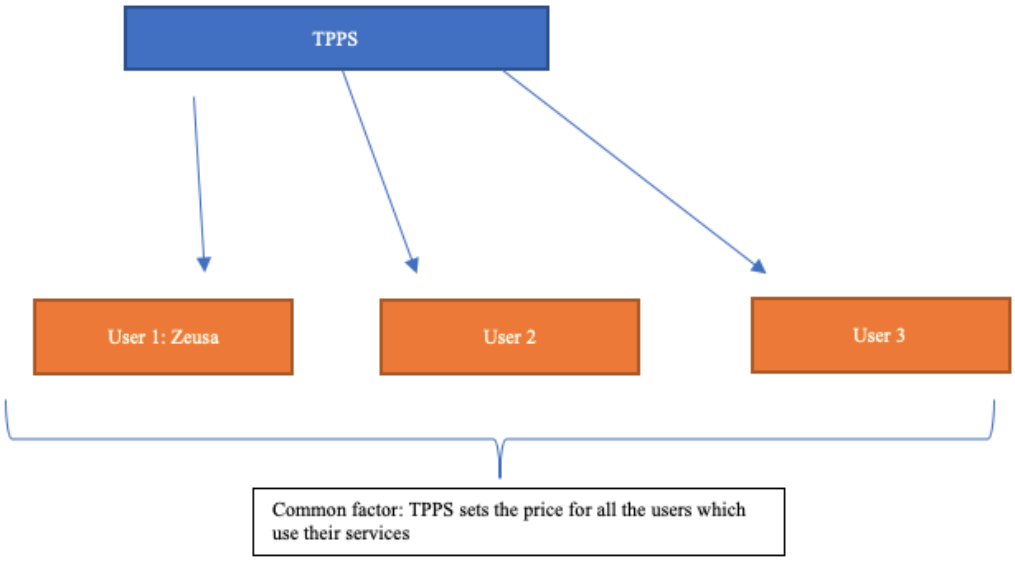

Figure 3. *The second Hub-and-Spoke Scenario*

II.2.1 *Merits of Potential Antitrust arguments*

In order to impose liability in this scenario, one might need to dig into the 'heart' of the algorithm and see whether it was designed to lead to exploitation.[98] When determining liability, the Courts will examine either the firm's intent in using the algorithm (whether it was intended to deliver an illegal result, such as price-fixing) or if the user acted with the knowledge that the illegal result, which occurred was 'probable'.[99] If the algorithm is designed to deliver an anti-competitive outcome, such

[96] ibid.

[97] ibid.

[98] ibid.

[99] Ezrachi and Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (n 52) 52–53.

as price-fixing, then it qualifies as *hub-and-spoke* conspiracy and liability is established in a similar way as in scenario one.[100] On the other hand, if the design of an algorithm was not aimed to produce anti-competitive conduct, then one might need to look at the effect of these vertical agreements.[101]

The second option, however, can lead to issues when the Court tries to determine if the users acted with the knowledge of the illegal result. For example, if all the Uber drivers 'understood' that they have the same rate and conditions, did they just become a part of a *hub-and-spoke* conspiracy?[102] After all, rivals use the same hub (the algorithm) which can soften the competition and lead to higher prices.[103] Moreover, the effects on the market are the same, but the conditions for establishing liability are now absent.[104] Parallel use might seem to be sufficient to impose liability.[105] It is still unclear whether any liability steps should be taken when the algorithm price becomes the (now higher) market price.[106]

Firstly, it is not enough that information flows through the hub for one to be held liable. The participants should be aware of the effect of their intent of communication through the hub. This information is strictly required.[107] The EU approach can be illustrated through the *Eturas and Others* case.[108] The issue, in this case, was an online system and a hub-and-spoke conspiracy.[109] The administrator of the online booking system posted a notice, declaring a newly imposed technological restriction which imposed a cap on travel discounts.[110] The ruling is landmark because the Court adopted a strict approach by stating that agents who knew the content of the message sent via the

[100] ibid 53.

[101] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1789.

[102] Ezrachi and Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (n 52) 53.

[103] ibid 52.

[104] ibid 54.

[105] ibid.

[106] ibid 55; Lea Bernhardt and Ralf Dewenter, 'Collusion by Code or Algorithmic Collusion? When Pricing Algorithms Take Over' (2020) 0 European Competition Journal 1, 8.

[107] Ezrachi and Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (n 52) 52.

[108] ibid.; Case C-74/14 *"Eturas" UAB and Others v Lietuvos Respublikos konkurencijos taryba* [2009] ECLI:EU:C:2016:42.

[109] ibid.; *Eturas* (n 108).

[110] ibid.; *Eturas* (n 108).

system and which have not *"publicly distanced themselves from that message or reported it to the administrative authorities"* could be presumed to have participated in illegal collusion while emphasising 'awareness'.[111] Consequently, the question arises, whether in the case of Uber, drivers would be considered to have participated in illegal collusion unless they have publicly distanced themselves or if the Court would be more lenient. There is no certain answer to the case of *Uber* under EU law because it is unclear whether the Court could establish an 'agreement' or 'concerted practice', and even if it would, it is still to be determined whether Court could then rely on restriction by object, such as price-fixing or effect.

The approach in the US regarding a cluster of similar agreements can be illustrated with the *JTC Petroleum Co. v. Piasa Motor Fules, Inc case*.[112] The case concerned multiple pavers and producers of asphalt where JTC Petroleum Company (JTC) alleged that the pavers colluded by refusing to compete against each other on local bids. Moreover, the problem was that there were multiple vertical agreements which could have an anti-competitive effect.[113] If, however, there was a single vertical agreement, then, the effect would not be so detrimental for competition law.[114]

Possible adverse effect of these vertical agreements can, in theory, be discussed under the Rule-of Reason standard. As such, intent evidence comes into play and can be used in favour to establish liability while assessing the nature of the agreement, namely assessing if it is a hard-core offence or not.[115] Consequently, the antitrust enforcers will consider the intent on the one hand, and on the other, they will consider if the algorithm was programmed to deliver an illegal result. Also, the enforcers will explore if the firms were acting with knowledge of illegal results which occurred and if these results were 'probable'.[116] The on-going case in the US between Uber drivers will give an interesting answer on how the Court deals with the *Hub-and-Spoke* liability because Uber is being sued on the

[111] ibid.; *Eturas* (n 107), para 45.

[112] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1782; 'JTC Petroleum Co. v. Piasa Motor Fuels, Inc. - Case Brief' (*Quimbee*) <https://www.quimbee.com/cases/jtc-petroleum-co-v-piasa-motor-fuels-inc> accessed 18 June 2020.; *JTC Petroleum Co. v. Piasa Motor Fuels, Inc*., 190 F.3d 775, 778 (7th Cir. 1999).

[113] 'JTC Petroleum Co. v. Piasa Motor Fuels, Inc. - Case Brief' (n 111); Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1782.

[114] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1782.

[115] ibid 1783, 1788.

[116] ibid 1788–1789.

ground that they have engaged in a price-fixing agreement violating Section 1 of the Sherman Act. However, it is unknown how will the Court balance *the intent evidence v. illegal algorithm programming*.[117]

II.3 Third Scenario: Predictable Agent

Contrary to the previous two categories, in the third category, humans unilaterally design the machine to deliver predictable outcomes and react in a given way. Therefore, each operator is developing the machine unilaterally, and industry-wide adoption of similar algorithms may lead to the anti-competitive effect.[118] Moreover, this type of unilateral behaviour may be used as a strategy to enhance market transparency and predict behaviour which when coupled with the industry-wide use of algorithms may change the market dynamics and consequently enable conscious parallelism and higher prices.[119]

Once the new market conditions occur, the pricing algorithms can coordinate in two ways. In the first one, algorithms do not explicitly negotiate but still reach a common understanding. The computer learns how to punish and detect rivals' price-cutting, and the computer will not deviate from the supra-competitive price.[120] In the second option, the computer can engage in parallel collusion where rivals raise prices. They do that not for deterrence, but because price increase is encouraged and competitive incentives for lowering the price are not.[121] In both scenarios of the *Predictable Agent* category, the undertakings have not agreed to collude because each undertaking had an independent economic interest and algorithms did not 'agree' to fix prices. The following example will illustrate the problem with this category more clearly.[122]

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[117] Colombo (n 15) 13; Nicholas Passaro, 'How Meyer v. Uber Could Demonstrate That Uber and the Sharing Economy Fit into Antitrust Law' (2018) 7 Michigan Business & Entrepreneurial Law Review 259, 259.; *Spencer Meyer v. Travis Kalanick* 1:15-cv-09796 (2016).

[118] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1783; Paolo Siciliani, 'Tackling Algorithmic-Facilitated Tacit Collusion in a Proportionate Way' (2019) 10 Journal of European Competition Law & Practice 31, 31–35.

[119] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1789.

[120] ibid.

[121] ibid 1790.

[122] ibid.

Let us consider a simple oligopolistic market setting where in addition to the Uber business, there are few more companies on the ride-hailing market which use computer decision-making. In that case, undertakings operating on the ride-hailing market shifted pricing decision from humans to computers which ultimately lead to an increase in price transparency. Now both the rivals and competitors can observe the prices on the market more easily than before. Moreover, the market is stabilised, and strategic uncertainty is low. Consequently, tacit collusion may be sustained, and supra-competitive prices are likely to arise.[123] However, this is not a result of express collusion, but it is an outcome of natural tacit collusion. Therefore, it is not *per se* illegal. However, the question of whether it should still be regulated piques attention because it is imperative to ascertain how legal this creation of the market through artificial means is.[124]

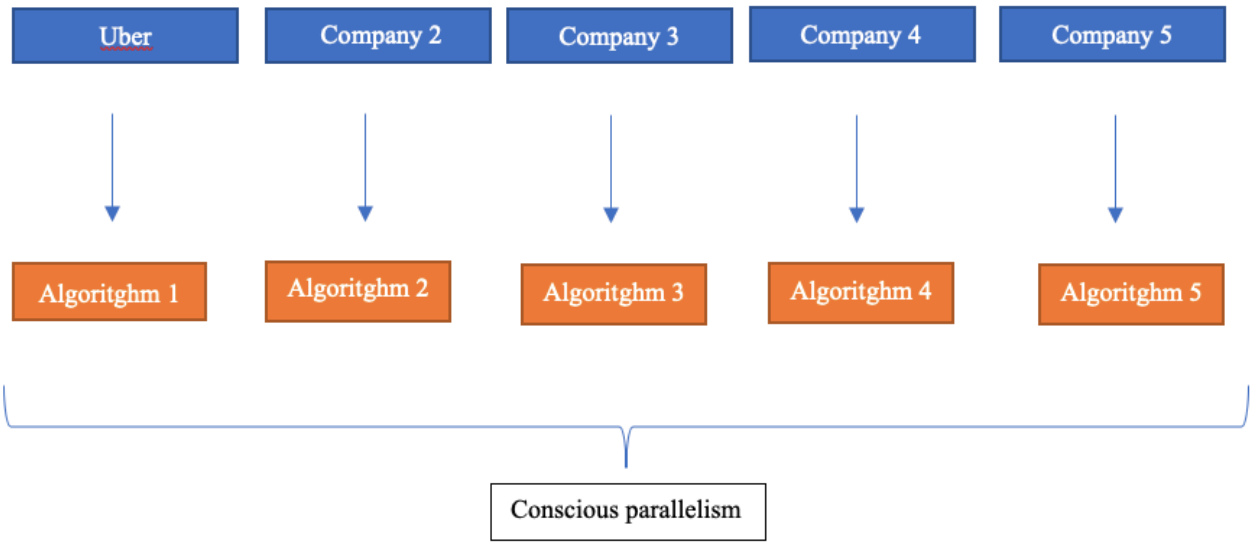

Figure 4. Tacit Algorithmic Collusion

[123] Michal S Gal, 'Algorithms as Illegal Agreements' (2019) 34 Berkeley Technology Law Journal 67, 70–71.T

[124] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1790.

II.3.1 *Merits of Potential Antitrust arguments*

The *Predictable Agent* category raised concerns from may authors who stress that it is uncertain if the existing legal framework in Europe can capture liability in these scenarios.[125] Ezrachi, Stucke and Schwalbe state that the use of machine learning may escape liability because of a lack of evidence of an anti-competitive agreement.[126] In a study for the OECD, Capobianco stated that in: *"cases where algorithms allow firms to align business conduct in what looks very much like conscious parallelism", "the current legal standard does not allow intervention with the traditional rules on anti-competitive agreements between competitors"*.[127]

Unlike in the first two categories, the firms have not jointly agreed to anything nor have the computers 'agreed' to fix prices.[128] However, tacit collusion could not have been sustained without computers.[129] The company's pricing authority resides in the form of an autonomous artificial agent (AAA) instead of in a software programme.[130] Computer usage in this scenario can be compared to the black-jack table. First of all, to be able to compete, you need a computer ('betting units'). Ultimately, this leads to more market players switching to computers which brings the market closer to conscious parallelism. However, this is a natural outcome of tacit collusion, which is legal, and that is the reason why it imposes various enforcement challenges.[131]

From an enforcement perspective, conscious parallelism takes place at two levels.[132] Firstly, when configuring the machines, each human is independently aware that if other firms opt-out for a similar program, then an equilibrium may be established above competitive levels.[133] This conscious

[125] Stefan Thomas, 'HARMFUL SIGNALS: CARTEL PROHIBITION AND OLIGOPOLY THEORY IN THE AGE OF MACHINE LEARNING' (2019) 15 Journal of Competition Law & Economics 159, 170.

[126] ibid; Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1796; Schwalbe (n 19) 597–598.

[127] Thomas (n 124) 170; 'Algorithms and Collusion: Competition Policy in the Digital Age - OECD' (n 20) 51.

[128] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1790.

[129] ibid.

[130] Harrington (n 18) 341.

[131] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1790.

[132] ibid.

[133] ibid 1790–1791.

parallelism leads machines being programmed to be aware of possible conscious parallelism at the market level. The computer is programmed to monitor the market without entering into a concerted illegal practice. However, it may be programmed to punish deviations from a possible tacit agreement.[134]

For all this to be possible, there must be a change in the market dynamics because firms are more vulnerable to coordinated conduct when there is price transparency and when competitive markets are highly concentrated.[135] Nonetheless, this change is not necessarily a positive one because pricing algorithms can foster greater transparency which implies that it is more comfortable then to sustain parallel behaviour. After all, computers can calculate the myriad of moves and apply strategies to punish deviations.[136] Next to this, if the goods are homogenous, the customers may easily switch between suppliers and the rivals may be deprived of sales because the greater the transparency, the quicker the competitive response and less likely the first-mover benefit will be.[137] However, a rational reaction by competitors is not illegal.[138] Does this mean that if Uber operates under the *Predictable Agent* category it can escape liability? The answer is uncertain. However, what can be said with certainty is that it will be more difficult for competition authorities to prosecute under this scenario.

In this category, the agreement cannot be established. Hence, the focus is on the notion of concerted practice, which is currently defined as a *"form of coordination between undertakings by which, without it having reached the stage where an agreement properly so-called has been concluded, practical cooperation between them is knowingly substituted for the risks of competition".*[139] Even though the definition is broad, it still raises challenges when faced with oligopoly theory.[140] An oligopolistic market is a market with few competitors where competition is already reduced.

[134] ibid 1791.

[135] ibid; Kaylynn Noethlich, 'Artificially Intelligent and Free to Monopolize: A New Threat to Competitive Markets around the World Comment' (2018) 34 American University International Law Review [i], 927.

[136] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1791.

[137] ibid 1792.

[138] ibid 1793.

[139] Thomas (n 124) 180.; Case 48-69 *Imperial Chemical Industries Ltd. v Commission of the European Communities* [1972] ECLI:EU:C:1972:70, para 64.

[140] ibid.

However, when an oligopolistic market setting is puzzled with pricing algorithms then oligopolies' salient feature, high transparency, is emulated.[141]

Computers assist possible concerted practice and this makes the practice more durable, stable and easier.[142] On the other hand, if the practice is not defined as 'concerted practice', then one cannot punish a firm for behaving rationally and independently.[143]

Furthermore, there is no difference between the economic effects of explicit collusion and tacit collusion because none of the variables involve enforceable contracts.[144] Even though under EU law, there are other 'means' to establish liability under Article 101(1) TFEU, such as concerted practice and tacit collusion, there is no law which clarifies the distinction between those two. Practical cooperation has such limited conceptual force because it can be 'individually rational' or 'parallel individually rational' conduct which can be conceived as a type of 'collaboration' or 'cooperation'.[145] For example, if firms want to achieve a new collusive equilibrium by applying the 'grim trigger strategy', a firm will start an action which maximises total profits, and it will hold it until other firms joint the game. If some firm deviates, the punishment is triggered.[146] In the end, final consumers have higher prices. Nevertheless, in an oligopolistic setting, this is not labelled as 'cooperation', but as an 'individual rational strategy'.[147]

To sum it up, algorithms cause the inevitable outcome, but one cannot link causality *per se* to intent because then any type of tacit collusion would be intentional.[148] On the other hand, if one relies on the designer and the user of the agreement or concerted unlawful practice, then the analysis would fail if the person behind it was unaware of the effects.[149] Furthermore, finding whether the market

[141] Alexander Stewart-Moreno, 'EU Competition Policy: Algorithmic Collusion in the Digital Single Market' (2020) 1 York Law Review 49, 66.

[142] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1793.

[143] ibid.

[144] Thomas (n 124) 180–181.

[145] ibid.

[146] ibid 181–182.

[147] ibid; Noethlich (n 134) 927–928.

[148] ibid.

[149] ibid 183–184.

outcome in an oligopolistic setting is, as Adelman states, a *"natural economic force or if it comes from a conspiracy is useless hair-splitting"*, and thus will not be examined.[150] At the moment, we only know what does not fall within Article 101(1) TFEU, and that is information which is *"directly related and necessary to the implementation of the main operation"*.[151] Of course, imposing a criminal or private antitrust liability is ruled out because of the lack of negligence or intent. So, what then can the antitrust authorities do?[152] The corollary question is still not answered, and the law still struggles to find a difference between illicit collusion and lawful interdependent conduct.[153] On a positive note, the merger control could effectively deal with these types of challenges because it is an *ex-ante* enforcement mechanism.[154]

In the US, the approach is different because the proof of intent to change market dynamics becomes incredibly important.[155] According to Section 1 of the Sherman Act, collusion is not prohibited *per se*, but the process behind it is, namely, the communication among firms which are trying to limit competition is illegal. However, is there any communication in this category, any mutual understanding?[156] The answer is no. AA's do not violate Section 1 of the Sherman Act because there is no agreement. AA's have access to information which would be present under regular competition, and they do not 'post' any information which could be classified as that one AA conveying a message to another AA.[157] Another argument is that computers do not possess proper 'understanding' as illustrated by Searle's Chinese Room Argument.[158] Imagine a room full of boxes of Chinese symbols (a database) together with a book of instructions for manipulating the symbols (the program). Now,

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[150] ibid 184.; MA Adelman, 'Effective Competition and the Antitrust Laws' (1948) 61 Harvard Law Review 1289, 1322.

[151] ibid 185.; Case T-111/08 *MasterCard, Inc. and Others v European Commission* [2012] ECLI:EU:T:2012:260, para 77; Case T-112/99 *Métropole télévision (M6), Suez-Lyonnaise des eaux, France Télécom and Télévision française 1 SA (TF1) v Commission of the European Communities* [2001] ECLI:EU:T:2001:215, para 104.

[152] ibid 184.

[153] ibid.

[154] Ezrachi and Stucke (n 4) 1794.

[155] ibid 1783.

[156] Harrington (n 18) 346.

[157] ibid.

[158] Barry Smith, *John Searle* (Cambridge University Press 2003) 214 <http://login.ezproxy.ub.unimaas.nl/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=120778&site=ehost-live&scope=site>.

imagine that in that room, there is a native English speaker with no knowledge of Chinese. He continually receives more Chinese symbols from outside the room, which are questions (the input). By following the instruction in the program, the man can pass out Chinese symbols which are correct answers to the questions (the output). The man exits the room having passed the test for understanding Chinese thanks to the program, yet still with no understanding of Chinese.[159] Similarly, while AAs may coordinate and restrain competition, they might not understand that they are doing so. Without this mutual understanding or just understanding, there is no meeting of minds, no agreement and no violation of Section 1 of the Sherman Act.[160] Consequently, firms do not satisfy the court's definition of a liability.[161]

On the other hand, the Chinese Room Argument does not go without detractors.[162] One may establish that there is an understanding between AA, but is there a mutual understanding that firm 1 AA will follow firm 2's price setting. Even if there is mutual understanding and an agreement, it is highly unlikely that courts would accept that AAs have agreed to restrict competition in a way similar to the agreements humans make.[163] This view is consistent with the statement from 2017 of the Antitrust Division of the US Department of Justice for the OECD : *"independent adoption of the same or similar pricing algorithms is unlikely to lead to antitrust liability even if it makes interdependent pricing more likely"*.[164] Additionally, the DOJ has stated that the increasing use of the computer-based algorithms to analyse and set prices can promote competition because it allows the competing firms to adjust their prices quickly to competitors movements.[165] On the other hand, the DOJ also stated that when pricing decisions are coordinated, then the use of such algorithms may violate US

[159] Harrington (n 18) 347; David Anderson and B Jack Copeland, 'Artificial Life and the Chinese Room Argument' (2002) 8 Artificial Life 371, 371–372.

[160] Harrington (n 18) 347–348.

[161] ibid 347.

[162] ibid 348.

[163] ibid.

[164] ibid; OECD, 'Algorithms and Collusion - Note by the United States DAF/COMP/WD(2017)41' (n 21) 6.

[165] 'Case Highlights DOJ Focus, Extradition Efforts in Ecommerce Price-Fixing Conspiracy' (*JD Supra*) <https://www.jdsupra.com/legalnews/case-highlights-doj-focus-extradition-44912/> accessed 15 July 2020; OECD, 'Algorithms and Collusion - Note by the United States DAF/COMP/WD(2017)41' (n 21) 2,3,6.

antitrust laws.[166] Since the enforcement agencies in the US police the risk for interdependence through merger control while prosecuting collusion directly, this distinction remains appropriate when evaluating the use of algorithms.[167]

Nonetheless, algorithmic collusion cases are challenging to prosecute and depending on the algorithm used, the interdependence may be impossible to establish. Therefore, only future cases will show how competition authorities will tackle this issue. In a note for the OECD, it is mentioned that *"the FTC in particular has the tools to study and maintain current knowledge on new trends in technology that impact its competition and consumer protection enforcement work"*.[168] This statement brings this thesis to the following point which considers an alternative legal approach to prosecuting such collusion.

In conclusion, absent the evidence of an agreement to change the market dynamics, most agencies will not be able to punish the illegality of these types of agreements. Therefore, one may need to consider other provisions which do not require the proof of an agreement.[169] In the US, the FTC can bring a claim under section 5 of the FTC Act.[170] Although Section 5 of the FTC Act has been mainly used in cartel cases where there was an 'invitation to collude' but no evidence of acceptance of that invitation, some believe that there might be an expanded role for the FTC in the future.[171] One may want to bring a claim under this Act because there is no need to show the existence of an agreement. It is only required to show unfair practice.[172] Section 5 states the following: *"unfair methods of competition in or affecting commerce, and unfair or deceptive acts or practices in or affecting commerce, are hereby declared unlawful"*.[173]

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[166] 'Case Highlights DOJ Focus, Extradition Efforts in Ecommerce Price-Fixing Conspiracy' (n 164); OECD, 'Algorithms and Collusion - Note by the United States DAF/COMP/WD(2017)41' (n 21) 4.

[167] OECD, 'Algorithms and Collusion - Note by the United States DAF/COMP/WD(2017)41' (n 21) 6.

[168] ibid.

[169] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1794.

[170] ibid.; 15 U.S.C. para 45(a) (2012).

[171] Harrington (n 18) 358.

[172] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1794.

[173] Harrington (n 18) 358.; Section 5(a) of the Federal Trade Commission Act (FTC Act) (15 USC §45).

The approach laid down in the recently published guidelines on the use of Section 5 of the FTCs, is in line with the approach of defining pricing algorithms: while not *per se* prohibited, subject to the rule of reason. Either way, the FTC would need to balance any *efficiency benefits from the pricing algorithms v. any proclivity towards collusion*. Consequently, the question is as to what extent the *per se* illegality of the rule of reason is appropriate will depend on the outcome of the research program and the effects of various pricing algorithms.[174]

Unfortunately, while in theory it is possible to bring a claim, in practice, it is unsuccessful as seen from cases such as *Ethyl* and *Boise Cascade,* even though it is a broadly constructed provision and "principle-based" one.[175] The standard from the *Ethyl* case is strict and hard to establish because either the FTC must show that "*a.) 'evidence that defendants tacitly or expressly agreed to a facilitating device to avoid competition', or b.) 'oppressiveness, such as (i) evidence or defendants' anti-competitive intent or purpose or (ii) the absence of an independent, legitimate business reason for defendants' conduct".*[176] In a similar vein, under the current general legal standard, *"the FTC would need to show that an use of an algorithm is unfair either because, a.) it causes or it is likely to cause substantial injury to consumers, b.) it cannot be reasonably avoided by consumers and c.) is not outweighed by countervailing benefits to consumers or to competition".*[177]

To sum it up, the FTC may become the agency most qualified to identify and prosecute collusion in online markets by AAs in the future.[178] According to the US Supreme Court, Section 5 of the FTC

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[174] ibid 358–359; Thibault Schrepel, 'A New Structured Rule of Reason Approach for High-Tech Markets' (2017) 50 Suffolk University Law Review 103, 103–104.

[175] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1794; OECD, 'Algorithms and Collusion - Background Note by the Secretariat DAF/COMP(2017)4' 37 <https://one.oecd.org/document/DAF/COMP(2017)4/en/pdf>.; *Boise Cascade Corp. v. Fed. Trade Comm'n*, 837 F.2d 1127,1148 (D.D.C. 1988); *Ethyl Corp. v. Fed. Trade Comm'n*, 729 F.2.d 128, 139 (2d Cir. 1984).

[176] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1794.

[177] OECD, 'Algorithms and Collusion - Background Note by the Secretariat DAF/COMP(2017)4' (n 174) 37.

[178] Harrington (n 18) 359; 'The Implications of Algorithmic Pricing for Coordinated Effects Analysis and Price Discrimination Markets in Antitrust Analysis' (*Federal Trade Commission*, 5 December 2017) <https://www.ftc.gov/public-statements/2017/12/implications-algorithmic-pricing-coordinated-effects-analysis-price> accessed 16 July 2020; Terrell McSweeny and Brian O'dea, 'The Implications of Algorithmic Pricing for Coordinated Effects Analysis and Price Discrimination Markets in Antitrust Enforcement' (2017) 32 Antitrust 75, 76.

Act extends beyond the Sherman Act and other US antitrust laws and can to cover conducts with the anti-competitive effects which are otherwise extremely challenging to catch under the 'cartel' provisions.[179] Does this mean a complete change of competition law enforcement and should the liability then be based on a *per se* prohibition of specific pricing algorithms?[180]

Only the future case law in this field will be able to answer these questions, however, there are already hearings and public forums organised by the FTC examining this topic.[181] Moreover, most recently in April 2020, the FTC issued guidance on the use of AI and algorithms.[182] The guidance is based on FTC law enforcement actions. The studies emphasise that the *"use of AI tools should be transparent, explainable, fair, and empirically sound, while fostering accountability"* and should be seen as 'lessons' to companies on how they can manage consumer protection risks of AI and algorithms.[183]

II.4 Fourth Scenario: Reality Check 'The Digital Eye'

The last category is called the *Digital Eye* (so-called: *Reality Check*), and it is described as 'the trickiest' category. In this category, the competitors unilaterally and independently use and create algorithms to achieve the desired target. Furthermore, the computers, through their self-learning process, independently determine the means to optimise the profit.[184] Therefore, the computer decides the optimal strategy based on self-learning and feedback.[185] However, this can lead to enhanced market transparency, and it may sustain conscious parallelism, which is legal. Moreover, if similar-minded agents use it, it may facilitate collusion.[186] Therefore, a profitable command and an AI system

[179] OECD, 'Algorithms and Collusion - Background Note by the Secretariat DAF/COMP(2017)4' (n 174) 37.; See *FTC v. Sperry & Hutchinson Co.,* 405 U.S. 233 (1972); *FTC v. Indiana Federation of Dentists,* 476 U.S. 447 (1986).

[180] Harrington (n 18) 350.

[181] Howard University School of Law 2900 Van Ness St NW Washington and DC 2008 United States, 'FTC Hearing #7: The Competition and Consumer Protection Issues of Algorithms, Artificial Intelligence, and Predictive Analytics' (*Federal Trade Commission*, 29 October 2018) <https://www.ftc.gov/news-events/events-calendar/ftc-hearing-7-competition-consumer-protection-21st-century> accessed 16 July 2020.

[182] 'AI and Algorithms: FTC Issues Guidance for Companies Amid Heightened Scrutiny' (n 21).

[183] 'Using Artificial Intelligence and Algorithms' (n 21).

[184] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1783.

[185] ibid 1783–1784.

[186] ibid 1795–1796.

which is programmed not to collude or engage in other illicit activities is a click away from potential 'legal' price-fixing.

As an example, imagine the scenario which involves the same companies as from the *Predicable Agent* Category. Therefore, following the steps of Uber and other companies, many players on the market switched to AI systems in order to follow the success story and they have duplicated their programmes. Consequently, the market has been created where there are many similar machines which 'understand' one another, have the same goal and which can stabilise collusive outcomes.[187] Nonetheless, in the previous category, it was assumed that the computer had set a target, such as the maximisation of profit. The self-learning machine in this category finds its optimal strategy, which may enhance either market transparency, sustain conscious parallelism or foster price increase. Consequently, collusion is not a human design *per se* but the outcome of evolution.[188]

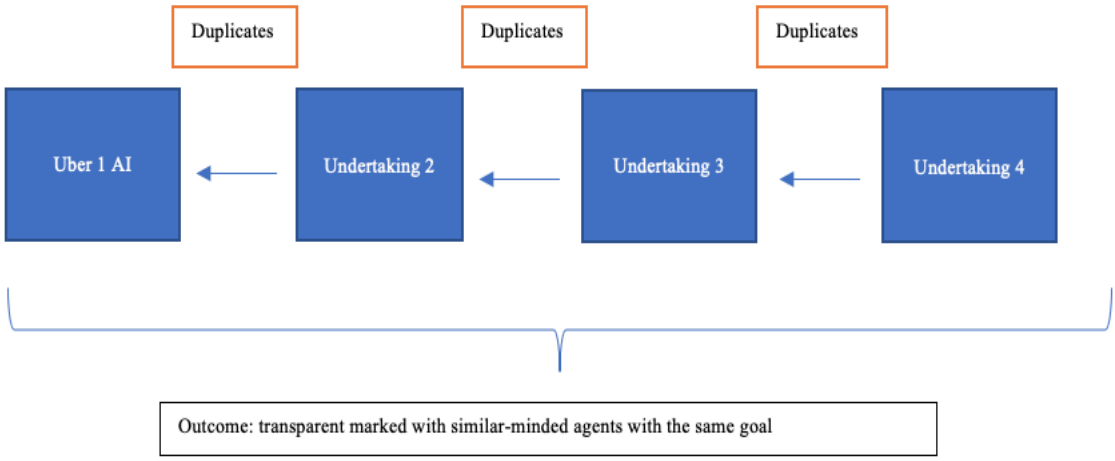

Figure 5. Reality Check

[187] ibid 1795–1796.

[188] ibid 1795.

II.4.1 *Merits of Potential Antitrust arguments*

At first sight, imposing liability in this category may be counterintuitive.[189] The risks identified in this category can be pro-competitive as they might increase transparency which can lower consumers' search costs.[190] This category entirely removes the concept of agreement and intent. Therefore, the toolbox, which is used to impose liability is very limited.[191] Here, the computer developers may foresee tacit collusion as one of the possible outcomes, but it may not be the likeliest outcome. Computers may, of course, reach conscious parallelism, but at the same time it is not a given that they will. Also, the algorithm developers are not necessarily motivated to achieve tacit collusion. Plus, there is no intent by the developers to facilitate conscious parallelism. The firm simply relies on AI.[192] Even if tacit collusion occurs, it is the fruit of evolution and self-learning.[193] However, this category may push competitors with slower algorithms out of the market because they react slowly to market changes.[194] Moreover, similar-minded agents might facilitate collusion, and by being similar, it is easier for them to collude and to duplicate.[195] Those similar machines are more likely to 'understand' each other and stabilise a collusive outcome.[196] Nonetheless, one cannot establish a meeting of minds.[197]

How do you punish a computer which anticipates and reacts to competitive threats well before any pricing change?[198] Algorithms possess this '*Godlike View*' which permits them to see everything; all the data generated on the online environment.[199] This category seems perfect for firms which want to collude because it supports stable, conscious parallelism on the one hand, and on the other, it increases

[189] Ezrachi and Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (n 52) 80.

[190] ibid.

[191] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1795.

[192] Ezrachi and Stucke (n 4) 1795.

[193] ibid.

[194] ibid.

[195] ibid 1795–1796.

[196] ibid 1796.

[197] Colombo (n 22) 14.

[198] Ezrachi and Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (n 52) 72.

[199] ibid.

the instances in which it can be achieved and sustained.[200] The computers' ability to punish rivals' deviations may be *"equivalent of a monopoly controlling 95 per cent of a market"* according to Ezrachi and Stucke.[201] This might mean that if Uber develops a business model reflecting this one, they could potentially control the 'whole' market and competition authorities could not do anything about it because the authorities cannot establish price-fixing.

In the US, expressed optimism dates back to the FTC Chair Ohlhausen's talk at the Concurrences Antitrust in the Financial Sector Conference in 2017 where it was stated that *"from an antitrust perspective, the expanding use of algorithms raises familiar issues that are well within the existing canon"*.[202] Moreover, in the most recent OECD paper, the DOJ and the FTC shared the same optimistic view, as it was stated that antitrust laws are adequate to handle such conduct.[203] Interestingly, whenever the DOJ and FTC analyse whether 'the antitrust laws are up to the task', those authorities rely on old cases, such as *Airline Tariff Publishing Company* and other cases which were mentioned through this thesis, with the latest one dating to 2015 (Amazon retailers), excluding the current *Uber* case.[204] In a similar vein, the former acting chair of the FTC confidently noted: *"[w]hether it is phone calls, text messages, algorithms, or Morse code, the underlying legal rule is the same - agreements to set prices among competitors are always unlawful"*.[205] In the note by the

[200] ibid 76.

[201] ibid 76–77.

[202] 'Are Antitrust Laws Up to the Task? A US/EU Perspective on Anti-Competitive Algorithm Behavior | Hausfeld' <https://www.hausfeld.com/news-press/are-antitrust-laws-up-to-the-task-a-us-eu-perspective-on-anti-competitive-a> accessed 16 July 2020; 'Should We Fear The Things That Go Beep In the Night? Some Initial Thoughts on the Intersection of Antitrust Law and Algorithmic Pricing' (*Federal Trade Commission*, 23 May 2017) 2 <https://www.ftc.gov/public-statements/2017/05/should-we-fear-things-go-beep-night-some-initial-thoughts-intersection> accessed 22 July 2020.

[203] 'Are Antitrust Laws Up to the Task? A US/EU Perspective on Anti-Competitive Algorithm Behavior | Hausfeld' (n 201); OECD, 'Algorithms and Collusion - Note by the United States DAF/COMP/WD(2017)41' (n 21) 6.

[204] 'Are Antitrust Laws Up to the Task? A US/EU Perspective on Anti-Competitive Algorithm Behavior | Hausfeld' (n 201); OECD, 'Algorithms and Collusion - Note by the United States DAF/COMP/WD(2017)41' (n 21); 'E-Commerce Exec and Online Retailer Charged with Price Fixing Wall Posters' (4 December 2015) <https://www.justice.gov/opa/pr/e-commerce-exec-and-online-retailer-charged-price-fixing-wall-posters> accessed 22 July 2020.; *United States. v. Airline Tariff Publishing Company*., 836 F. Supp. 9 (D.D.C.1993).

[205] 'Are Antitrust Laws Up to the Task? A US/EU Perspective on Anti-Competitive Algorithm Behavior | Hausfeld' (n 201); 'Should We Fear The Things That Go Beep In the Night? Some Initial Thoughts on the Intersection of Antitrust Law and Algorithmic Pricing' (n 201) 8–9.

US for the OECD it was stated that: *"the lack of direct communication among the competitors would not be a bar to finding an unlawful conspiracy"*.[206] However, when one looks at the on-going Uber case where competition enforcers are already struggling to impose liability which is a less 'complicated' *hub-and-spoke* example, one can only wonder what can happen when one tries to impose and enforce liability under the *predicable agent* category.[207]

In the EU, as it can be seen from the *Google Shopping* EC decision, the Commission is willing to prosecute unlawful and anti-competitive search engine cases as abuses of dominance cases under Article 102 TFEU.[208] In February 2017, the European Commission opened three separate investigations (mainly on their initiative) in order to assess if the certain online sales practices in the e-commerce sector violate EU antitrust rules.[209] Commissioner Vestager stressed that: *"E-commerce should give consumers a wider choice of goods and services,…"*.[210] Therefore, in the following year, the Commission fined four large consumer electronic manufactures for fixing online resale prices. The top four manufacturers, *Asus*, *Denon & Marantz*, *Philips* and *Pioneer* intervened with the online retailers, who offered their products at the low prices. Like many others, they used pricing algorithms which adapted their price to the price of their competitors and it this way, the impact was broader on overall online prices in the sector of electronic products. These price interventions limited price competition between retailers and ultimately led to higher prices for the end consumers.[211] However, what if these companies used an AI system which effectively set prices in the same way under the

[206] OECD, 'Algorithms and Collusion - Note by the United States DAF/COMP/WD(2017)41' (n 21) 6.

[207] Lamontanaro (n 28) 1262.

[208] 'Are Antitrust Laws Up to the Task? A US/EU Perspective on Anti-Competitive Algorithm Behavior | Hausfeld' (n 201); 'Antitrust: Commission Fines Google €2.42 Billion' (*European Commission - European Commission*) <https://ec.europa.eu/commission/presscorner/detail/en/IP_17_1784> accessed 22 July 2020.; *Google Search (Shopping)* (Case AT.39740) Commission Decision C(2017) 4444 final [2017].

[209] 'Are Antitrust Laws Up to the Task? A US/EU Perspective on Anti-Competitive Algorithm Behavior | Hausfeld' (n 201); 'Commission Opens Three Online Sales Antitrust Probes' (*European Commission - European Commission*) <https://ec.europa.eu/commission/presscorner/detail/en/IP_17_201> accessed 16 July 2020.

[210] 'Commission Opens Three Online Sales Antitrust Probes' (n 208).

[211] 'Antitrust: Electronics Manufacturers Fined for Resale Price Fixing' (*European Commission - European Commission*) <https://ec.europa.eu/commission/presscorner/detail/en/IP_18_4601> accessed 16 July 2020.; *Asus* (Case AT.40465) Commission Decision C(2018) 4773 final [2018]; *Denon & Marantz* (Case AT.40469) Commission Decision C(2018) 4774 final [2018]; *Philips* (Case AT.40181) Commission Decision C(2018) 4797 final [2018]; *Pioneer* (Case AT.40182) Commission Decision C(2018) 4790 final [2018].

digital eye category, meaning that the algorithms set prices through self-learning. Would this mean that in this case companies could escape liability?

With the lack of all the elements required to establish liability, what can enforcers do? Theoretically, this category could escape legal scrutiny even though it may harm the market in the same manner as any other category does.[212] Neither Section 1 of the Sherman Act nor Section 5 of the FTC Act can address this category.[213] This is alarming because the accumulation of similarly minded agents may occupy the whole market and find that price coordination is the optional option, regardless of potential safeguards of the creator.[214] Furthermore, collusion is unlikely from the get-go which means that a solid basis for finding an infringement is possibly non-existent.[215] Even if the algorithm is programmed not to violate competition law, it is unknown from a technological perspective if it is possible to programme and prohibit the creation of market dynamics such as conscious parallelism.[216]

This Chapter illustrated and showed that a new form of more durable collusion has manifested itself and that we should be aware of this.[217] Even right at this moment, some AA might be diving the customer scheme now.[218] Is the free-market approach a solution even though we know that greed fuelled by profit maximisation will intensify the use of the best algorithms?[219] The following Chapter will provide several possible solutions to these problems, and answer the question if one should regulate it or not.

[212] Ezrachi and Stucke, 'Artificial Intelligence & Collusion' (n 4) 1796.

[213] ibid 1795–1796.

[214] Ezrachi and Stucke (n 4) 1796.

[215] Ariel Ezrachi, *Virtual Competition* (Harvard University Press 2016) 78; Ezrachi and Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (n 52) 78.

[216] Ezrachi and Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (n 52) 78–79.

[217] ibid 81; Catalina Gonzalez Verdugo, 'Horizontal Restraint Regulations in the EU and the US in the Era of Algorithmic Tacit Collusion' (2018) 7 UCL Journal of Law and Jurisprudence 114, 115.

[218] Ezrachi and Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (n 52) 81.

[219] ibid.

III. Counter Measures and future policy considerations

Commonly asked questions on the topic of AA are: Can they really collude? Can they learn to collude? Can they learn to collude in an actual market setting? The answer to the first two questions is a strong yes. The answer to the last question is that we do not know, but it cannot be dismissed. Should they be able to do so, one should be prudent in finding an appropriate legal response.[220]

The following section focuses on how to bridge this regulatory gap, specifically, in the last two categories since those are where liability can easily be escaped in both the US and EU systems. As Mehra puts it, there are three conceivable possibilities when attributing responsibility: *"either we blame the Robo-seller itself, the humans who deploy it or no one"*.[221] The last category is not acceptable, so this thesis will explore the first two scenarios and propose solutions for problems that occur when imposing liability.[222] Moreover, section III.4 will answer the question of whether reform is necessary.

III.1 The twist: You hired me: *The employee*

One possible solution to this problem could be to treat self-learning pricing algorithms as virtual employees operating under the direction of the one who hired them.[223] However, as said by David Currie, a top official at the UK Competition and Markets Authority (CMA): *"How far can the concept of human agency be stretched to cover these sorts of issues?"*.[224] Already in 2017 in the note from the EU for the OECD, the EU stated that: *"like an employee or an outside consultant working under a firm's "direction or control", an algorithm remains under the firm's control, and therefore the firm*

[220] Harrington (n 18) 346.

[221] Colombo (n 22) 15; Mehra (n 9).

[222] Colombo (n 22) 15.

[223] ibid 14.

[224] ibid.

is liable for its actions".[225] The crucial matter is to establish wrongdoing.[226] However, the issue is that AIs over the years keep developing radically and the links between the Robo-seller and the human being become weaker because AI's ability to price autonomously grows.[227] There is a thin line between tacit collusion and express collusion, and we should not use current provisions to impose liability on tacit collusion.[228] This thesis puts forward that the meeting of minds took place on the machine level and that it was initiated before on the human level, as seen in *the Executor* category, for example.[229] These price booting machines do the same things employees used to do.[230] The fact that the collusion is robotised does not change the nature of price-fixing. Once the companies implement the algorithms, they must be responsible for whatever the algorithms do.[231] According to the case-law, undertakings can be held accountable for the acts of their employees.[232] Algorithms, which we can call 'employees', follow the direction of the undertaking (they are part of the company). Therefore, the one who 'hired' them should be responsible for their anti-competitive conduct on the market.[233]

The CJEU in the case *VM Remonts* held that *"it is possible for the service provider which presents itself as independent to be in fact acting under the direction or control of an undertaking that is using the services"*.[234] In this case, the service provider had little flexibility concerning how the activity was carried out.[235] It can be compared, for example, to a relationship between a parent company and

[225] 'Are Antitrust Laws Up to the Task? A US/EU Perspective on Anti-Competitive Algorithm Behavior | Hausfeld' (n 201); OECD, 'Algorithms and Collusion - Note from the European Union DAF/COMP/WD(2017)12' (n 21) 9.; Joined Cases C-100/80 to 103/80 SA *Musique Diffusion francaise and others v Commission of the European Communities* [1983] ECLI:EU:C:1983:158, para 97; Case C-542/14 *VM Remonts and Others* [2016] ECLI:EU:C:2016:578, para 27.

[226] Colombo (n 22) 15.

[227] ibid 15–16.

[228] ibid 16.

[229] ibid.

[230] ibid.

[231] ibid.

[232] ibid.; Joined Cases C-100/80 to 103/80 SA *Musique Diffusion francaise and others v Commission of the European Communities* [1983] ECLI:EU:C:1983:158; Case C-68/12 *Slovenska sporitela* [2013] ECLI:EU:C:2013:71.

[233] ibid.

[234] ibid.; *Remonts and Others* (n 225), para 27.

[235] ibid.

its subsidiaries, which both have legal personalities.[236] The Court further established that under Article 101(1) TFEU, the undertakings could be held liable for the concerted practice on account of the acts of an independent service provider supplying it with services if one of the following three conditions are met. The first one that the service provider was acting under the control or the direction of the undertaking concerned. Second, that the undertaking was aware of the anti-competitive objectives pursued by the service provider and by its competitors and that the undertaking intended to contribute to them through its conduct. Lastly, that the undertaking was prepared to take the risk and could have reasonably foreseen the anti-competitive acts of the service provider and its competitors. The ultimate possibility is that it applies to algorithms because of the ability to predict the anti-competitive outcome of Robo-sellers.[237] In reality, the 'virtual' employee (the algorithm) remains under the firm's direction or control. Therefore, the firm that employed it is to be held liable.[238]

However, it seems untoward that the CJEU disregarded the Opinion of Advocate General (AG) Wathelet, which recommended the rebuttable presumption of liability regardless of knowledge and consent.[239] The goal is to create liability in situations where the antitrust infringements of third parties cannot be regarded as auxiliary organs forming an integral part of the company.[240] The suggestion of AG is a new type of 'presumption'.[241] However, one cannot forget that 'consent' is required to impose liability. This consent can also be indirect through accepting the risk of wrongdoing on account of AI agents, and of course, the anti-competitive object or effect on the market must be shown.[242] On the other hand, the undertaking can always argue efficiency gains under Article 101(3) TFEU and balance it with the anti-competitive effects. This approach could be a real step forward because 'impunity' of these machines would partially disappear.[243]

[236] ibid 17.

[237] ibid.; Case C-49/92 *Commission v Anic Partecipazioni SpA* [1999] ECLI:EU:C:1999:356, para 87.

[238] ibid.

[239] ibid.; Case C-542/14 *VM Remonts and Others* [2015] ECLI:EU:C:2015:797, Opinion of AG Wathelet.

[240] ibid.; Case C-542/14 *VM Remonts and Others* [2015] ECLI:EU:C:2015:797, Opinion of AG Wathelet, para 63.

[241] ibid.

[242] ibid.

[243] ibid 17–18.

There is also an extensive body of case law in the US that deals with the anti-competitive conduct, which is carried out through agents and employees of the company acting within their scope of the employment.[244] Namely, in cases such as the *United States v Basic Construction Co.,* the Court held that: *"[A] corporation may be held criminally responsible for antitrust violations committed by its employees […] even if […] such acts were against corporate policy or express instructions"*.[245] Even though the software is a product of someone, namely the programmer, who can program the software in compliance with antitrust laws, liability should be imposed on the corporation. Therefore, defences such as that algorithms are autonomous or have learned to execute behaviour unknown to the corporation should not pass because the harm and the principles stay the same whilst technology brings forth simply a new aspect of the liability game.[246]

III.2 Modify: Regulation

For many years now, competition authorities have made use of a '*trial-and-error'* approach in which they implement something to see if it will have a positive outcome.[247] Competition Authorities could follow the same '*trial-and-error'* approach with cartel algorithms as they do with human cartels. For example, they could try an *ex-ante* regulation and *ex-post* regulation.[248]

From an *ex-ante* perspective, they can require mandatory 'compliance by design' where certain safeguarding must be implemented in advance by coders. For example, where there is a high likelihood of tacit collusion, the humans will be notified and will be required to intervene in price-setting to avoid undesired collusion.[249] It will represent a situation where an undertaking should act as 'their own cop', similarly to that in which an undertaking in a dominant position under Article 102

[244] 'Are Antitrust Laws Up to the Task? A US/EU Perspective on Anti-Competitive Algorithm Behavior | Hausfeld' (n 201).; *United States v. Basic Construction Co.*, 711 F.2d 570, 573 (4th Cir. 1983), para 11; *United States v. Hilton Hotels Corp.*, 467 F.2d 1000, 1004-07 (9th Cir. 1972); *United States v. Am. Radiator & Standard Sanitary Corp*., 433 F.2d 174, 204-05 (3d Cir. 1970).

[245] ibid.; *United States v. Basic Construction Co.*, 711 F.2d 570, 573 (4th Cir. 1983), para 11.

[246] ibid.

[247] Colombo (n 22) 20.

[248] ibid.

[249] ibid.

TFEU must 'control' its position because it *"has special responsibility not to allow its conduct to impair genuine undistorted competition on the common market*".[250]

Undertakings that own AI systems will need to learn how to 'keep a close eye' on the actions of their 'virtual employees' or, similarly to the merger control, certain types of AI's will need to be approved beforehand if multiple large companies want to employ them.[251] As stated in the OECD paper, it would be useful to tackle cases of tacit collusion through merger enforcement.[252] On the other hand, there might be a risk of overregulating the market with this 'Merger-like' option, and technological development could decrease.[253]

From an *ex-post* perspective, one may focus on exploitative conducts that are detrimental to consumers, such as those that can reach supra-competitive tacit equilibrium between sellers.[254] EC and the Antitrust Division could employee an algorithm similar to that used by other significant players on the market. As we know, similarly minded algorithms are more likely to collude than algorithms that are not similar. Therefore, if they use the same 'weapon' as their 'enemies' do, they can fight them effectively on the same level. Consequently, in a scenario such as this one, the algorithms would collude, and the EC would be able to detect the unusual market trend quickly and effectively.[255] Officials would thus have an opportunity to peek directly into the digital cartel. However, they will only look into the company if a) they detect 'illegal or unusual' collusion, or b.) if they have a legitimate reason to believe that the company is doing business that harms consumers. This way, the risk of over-regulating the market is lower than with an *ex-ante* option. The crucial point with this solution is to regulate progressively. A good example to follow would be the step-by-

[250] Roger D Blair and D Daniel Sokol, *The Oxford Handbook of International Antitrust Economics, Volume 2* (Oxford University Press 2014) Section 8.2.4.; Case 322/81 *NV Nederlandsche Banden Industrie Michelin v Commission of the European Communities* [1983] ECLI:EU:C:1983:313, para 57.

[251] Colombo (n 22) 20.

[252] OECD, 'Algorithms and Collusion - Note from the European Union DAF/COMP/WD(2017)12' (n 21) 9.; Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings 2004/C 31/03, from para 39.

[253] Colombo (n 22) 20.

[254] ibid.

[255] ibid 21.

step energy regulation under EU law.[256] However, *ex-post* industry monitoring is not realistic yet. The competition authorities in the US and the EU do not have the resources to do proactive policing. On the other hand, regulators are mindful of the challenges and recognise the need for a better understanding of how algorithms and artificial agents work. For example, the former FTC Commissioner Terrell McSweeney noted in 2017 that the FTC has created an Office of Technology, Research, and Investigation, which now includes technology specialists and computer scientists.[257] This shows that although *ex-post* industry monitoring is not currently realistic because the authorities do not have the time and the resources, gradually, and with the proper resources, *ex-post* regulation can become 'everyday' regulation. Thus, progressive development of a legal framework for algorithms is necessary.[258]

III.3 Radical Change: Full prohibition

Kaplow believes that *"what is rational depends on whether sanctions are imposed"*.[259] He believes that if tacit collusion were illegal, then it would become rational for firms to avoid it.[260] This view is supported by numerous legal scholars in the US and the EU. However, it faces many objections and fallacies, such as that it would be unconvincing to oblige firms to act irrationally.[261] For example, Chamberlin argues that *"when there are only two or a few sellers, their fortunes are not independent […]"*. Therefore, taking rivals' policy into account cannot be constructed as a 'tacit agreement'.[262]

[256] Kim Talus, *Introduction to EU Energy Law* (Oxford University Press 2016) 6.

[257] 'Are Antitrust Laws Up to the Task? A US/EU Perspective on Anti-Competitive Algorithm Behavior | Hausfeld' (n 201); 'Algorithms and Coordinated Effects' (*Federal Trade Commission*, 22 May 2017) 6 <https://www.ftc.gov/public-statements/2017/05/algorithms-coordinated-effects> accessed 22 July 2020; 'BCP's Office of Technology Research and Investigation: The next Generation in Consumer Protection' (*Federal Trade Commission*, 23 March 2015) <https://www.ftc.gov/news-events/blogs/business-blog/2015/03/bcps-office-technology-research-investigation-next> accessed 22 July 2020.

[258] Peter Georg Picht and Benedikt Freund, 'Competition (Law) in the Era of Algorithms' (Social Science Research Network 2018) SSRN Scholarly Paper ID 3180550 4 <https://papers.ssrn.com/abstract=3180550> accessed 23 July 2020.

[259] Thomas (n 124) 188; Louis Kaplow, 'An Economic Approach to Price Fixing' (2010) 77 Antitrust Law Journal 343, 431.

[260] Thomas (n 124) 188.

[261] ibid 187–188.

[262] ibid 188; EH C., 'Duopoly: Value Where Sellers Are Few' (1929) 44 The Quarterly Journal of Economics 63, 65.

This thesis argues that this solution could work if one could define explicit conduct that is prohibited and that can guide the addressee on how to avoid the fine. However, it should not prevent one from acting rationally on the market because that would imply an impossible obligation.[263] However, Kaplow believes that these cases are no different from when someone steals an apple.[264] The sanction makes it irrational to steal an apple, which may be economically rational to steal.[265] On the other hand, Thomas argues that in an oligopolistic setting, an undertaking facing a penalty for tacit collusion will not have an option to rationalise whether or not to escape the sanction because one cannot 'un-know' what they know.[266] Although Thomas' point of view is interesting, everyone has an option to make a rational choice, especially if they want to use algorithms in their everyday business. Therefore, firms in an oligopolistic market potentially 'cannot avoid knowing that their prices are interdependent', but they can choose not to use an algorithm that fixes prices for them and reaches conscious collusion without their help. Therefore, there is a dilemma regarding this solution, but one cannot rule it out as a possible solution if it is well-defined.[267]

III.4 Is reform necessary?

This thesis argues that a change in mindset is necessary, but not necessarily a complete reform of competition law, such as an amendment to Article 101 TFEU because one can solve the shortcomings of current laws in force if one opts for the first ('*the employee'*) and second solution ('*regulation'*). On the other hand, solution three (*'the full prohibition'*) is too radical, and competition law is not yet ready for such a change. This thesis strongly advises competition authorities to start regulating algorithms because the free-market approach is not an acceptable option.

Consequently, a mix of *the employee, ex-ante* and *ex-post* regulation mechanisms could be the key to liability imposition in complex algorithmic cases. Those two solutions can cover myriad problems identified in the previous chapter and by numerous scholars. However, if 'the employee' relationship cannot be established, and if the Court cites with its previous rulings, then 'impunity' gaps will still

[263] Thomas (n 124) 188.

[264] ibid 189; Kaplow (n 258) 431.

[265] Thomas (n 124) 189.

[266] ibid.

[267] ibid 189–190.

exist. Nonetheless, if one monitors the digital cartels from an *ex-ante* and *ex-post* perspective, companies will pay more attention to what their Robo-Sellers are doing and competition authorities can more quickly target digital anti-competitive abuses. This way, many cracks in the law that this thesis identified in all four categories could be solved. Furthermore, if the point comes where one can say with certainty that AI systems are capable of colluding without human intervention, competition authorities will be prepared. Moreover, competition authorities in the US and EU should most certainly explore the world of AA more, and they should implement AI systems in their everyday working because then they will know how these 'fear-free cartels' function. They are already on the right track with the creation of new departments that are exclusively devoted to exploring the most recent technological developments, such as AI systems.[268]

Conclusion

This thesis aimed to answer a pyramid of questions. First, how algorithms can foster illicit conduct. Second, what are the current legal constraints in the law of the US and the EU towards imposing liability on algorithm users. Third, which workable regulatory solutions seem plausible to address this problem. The answers to all these questions are complicated and represent a major battle of the 21st century between algorithms and competition authorities. There is good reason to believe that the image of cartels, of old men sitting in a smoke-filled room, will not exist in the future. This thesis has illustrated that with the development of technology, many striking issues have arisen for which current competition departments in the US and the EU are not prepared. The algorithms Mr Newton used to work with are now far more advanced, digitalised and spread all around the world. In today's society, 'news travels fast', which means prices do too. Even a staunch sceptic cannot deny that supra-competitive prices can be a result of collusion between Artificial Agents.

This thesis, in its first section, explained what algorithms are and what algorithmic pricing is. The analysis illustrated that AP is the primary concern for competition authorities because it can, among

[268] 'BCP's Office of Technology Research and Investigation: The next Generation in Consumer Protection' (n 256); Ariel Ezrachi and Maurice E Stucke, 'Sustainable and Unchallenged Algorithmic Tacit Collusion' (2019) 17 Northwestern Journal of Technology and Intellectual Property 217, 218.

other things, facilitate collusion without human intervention. Moreover, the technical side of pricing algorithms whose focus lies on adaptive and learning algorithms was explored.

The second section focused on four possible scenarios identified by Ezrachi and Stucke under which algorithms can collude: *the Messenger*, *Hub-and-Spoke*, *the Predicable Agent* and *the Digital Eye*. These scenarios have demonstrated two things. The first is that competition enforcers should start worrying about the last two scenarios because once the time comes, they will not be able to impose liability. The second is that the current antitrust law in force, found in Section 1 of the Sherman Act and Article 101(1) TFEU, cannot capture complex AI liability. On the other hand, in the first two categories liability can be imposed if needed under Section 1 of the Sherman Act or Article 101(1) TFEU, if no issues occur, such as that enforcers cannot trace conduct back to the 'human-trait'. Times are changing, technology is developing, but the law stays the same – the old, black-and-white law dating back to the mid-twentieth century. One can follow the adage 'old but gold', but this thesis has shown that it is time for a change. Cracks identified in both Section 1 of the Sherman Act and in Article 101(1) TFEU cannot be patched up without change. If changes are not introduced, undertakings will see this as an opportunity to invest in the best AI systems which may 'collude', since no one can impose liability on them.

In light of the current legal constraints that were highlighted, this thesis in its last section also identified three solutions capable of addressing the ('potential') problem. With these three solutions, the gap between liability, competition law and algorithms can be bridged. The solution varies on a spectrum from a 'no need to change the law' to a complete ban. The first solution, '*the employee'* is plausible because both US and EU jurisdiction possess the necessary tools to prosecute algorithms based on the 'virtual employee' argument. Secondly, one can try to regulate these new 'sci-fi' creatures using the current legal provisions in force, which means that one can try to impose either *ex-ante* or *ex-post* measures that can slowly 'regulate' the undertakings and Artificial Agents. The regulators may opt for a pre-clearance approach to pricing models similar to the one used for Merger Control. However, this option is not currently realistic because the regulators do not possess the resources, knowledge or time. Therefore, at this moment, the merger kind *ex-ante* approach is unrealistic, but it has potential for future growth. On the other hand, slow and steady *ex-post* regulation coupled with the most recently created technology departments seems to be a more plausible solution. Lastly, the competition authorities can impose a total ban on tacit collusion. As

Kaplow said: *"what is rational depends on whether sanctions are imposed"*. This thesis shares some of the scepticism regarding this solution, and it does not anticipate its implementation in the foreseeable future because authorities are struggling to define clearly what is legal and illegal tacit collusion ever since the dawn of competition law.

Thus, this thesis advises that one should approach this topic with prudence and that in an ideal world, the best solution would be to bundle '*the employee'* and an '*ex-ante'* and '*ex-post'* regulation solution to cover as many 'liability cracks' as possible. Consequently, complete competition law reform is not necessary. Regulation should follow the gaps in the law. The core point is then to acknowledge the existence of Robo-Sellers and start a '*trial-and-error*' approach with liability imposition once the time comes. Competition authorities in the EU and the US should continue developing departments that focus on AI because further research will contribute to better enforcement. Furthermore, they should continue making guidelines for companies that employ the AI and should slowly start developing *ex-ante* pre-clearance approach. The authorities should be able to stop Uber from operating this way, even though it might be more convenient not to. They should be able to enforce the possible illegality of this agreement and similar agreements if they deem fit, and they should not let it slide because their hands are tied. If one can manage to impose liability on legal personalities, which used to be 'science-fiction', one can find a way to impose liability on these game-changers.

One should not forget that people once thought self-driving cars were a matter of fiction. Now they represent reality. The time has come when Robo-Sellers (can) collude without human intervention, and the time has come for us to intervene. We need to keep a close eye on them. This legal science-fiction is quickly becoming a reality.

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