

# The artificial hand of the free market: Algorithms and collusion

*The implementation of self-learning algorithms and our changing notions surrounding tacit collusion*



Tilburg University

Master thesis EU Economic and Competition Law

Student: Jasper van den Boom

SNR: 2001049

Master: EU economic and competition law.

Coordinating professor: professor I. Graef

Second reader: professor F. Alves Da Costa-Cabral

Thesis defence date: 18 June 2018



## Acknowledgements

Writing this thesis has been a great pleasure to me. With special thanks to my supervisor Inge Graef and sparring partner professor Francisco Alves Da Costa-Cabral for helping me along the way. With this thesis I will conclude my Master at Tilburg University in European Economic and Competition law. During my Master I have worked with a magnificent faculty and have always felt fully supported by Tilburg University. Moreover, I have had the pleasure of working with a class of engaged students, with many of which I have built close working relationships and friendships. Finally, I'd like to thank my parents and girlfriend who have convinced me to go back to studying, to whom I owe these great two years.

## Contents

1. Introduction .....	1
1.1. Problem description.....	1
1.2. Research purpose .....	3
1.3. Research question.....	4
1.4. Methodology and ‘State of the Art’ .....	4
2. Collusion under European Union law .....	6
2.1. Parallel behaviour, tacit collusion and concerted practices under EU law.....	6
2.1.1. EU case law on parallel behaviour and collusion.....	8
2.2. Oligopolies and tacit collusion; explaining the oligopoly problem .....	10
2.3. Conclusion.....	13
3. Algorithms and algorithmic theories of harm.....	15
3.1. What are algorithms and how do they learn? .....	15
3.1.1. Machine learning .....	16
3.1.2 Deep learning.....	17
3.2. Algorithmic theories of harm for tacit collusion.....	18
3.2.1. The predictable agent .....	18
3.2.2 The Digital Eye.....	21
3.3. The effect of self-learning algorithms on market characteristics and tacit collusion.....	25
3.3.1. Algorithms & transparency .....	25
3.3.2. Algorithms & stability.....	27
3.3.3. Algorithms & competitive constraints .....	28
3.4. Conclusion.....	30
4. The consequences of algorithms on the legality of tacit collusion.....	32
4.1. Exploring the rationale behind information exchange as a concerted practice.....	33
4.1.1. The Commission’s notions on information exchange as a concerted practice .....	33
4.1.2. Case law on information exchange .....	36
4.1.3. Interim conclusions on the rationale behind concertation to information exchange and algorithmic collusion.....	39
4.2. Expanding the definition of communication .....	40
4.3. Reconsidering the legality of tacit collusion .....	43

4.4 Prohibiting tacit collusion: Enforceability, evidence and the consequences for competition .....	47
4.5. Conclusion.....	50
5. Conclusion.....	52
6. Bibliography .....	55
Books.....	55
Articles .....	55
Reports.....	56
Case law .....	57
Law and soft law .....	58

# 1. Introduction

This chapter introduces the topic of the research. Chapter 1.1. will introduce the central problem of this research and the relevant actors. In 1.2. the aim of the research will be explained, leading up to the formulation of the research question in 1.3. Finally, in 1.4. the research methods by which the research is conducted will be discussed, as well as a brief explanation about what is known about the topic already.

## 1.1. Problem description

The growth of internet companies which use big data in combination with complex technological tools, such as algorithms, has been tremendous in the past decade.<sup>1</sup> Algorithms have a strong influence in the daily lives of everyone who is active on the internet. Algorithms influence many aspects of life, from the news one reads to the music one would listen to.<sup>2</sup> Algorithms and the harvesting of Big Data provide great benefits to companies and consumers, especially regarding improved automation, efficiency and quality. The needs and wishes of the consumer can be catered to in a quick, low-cost and individualized way by companies.<sup>3</sup> However, besides the positive effects, the use of algorithms also brings risks to fair and effective competition.

Due to algorithms' capacity to process data on a large scale and take decisions on the basis of this data autonomously, the collection of data on consumers and competitors has gained new importance. Besides this, the algorithms also provide a possibility to monitor actions by consumers, competitors and other changes in the market in real-time, and include this information in the price-setting strategy.<sup>4</sup> The capabilities algorithms have in these actions have led to concerns that the use of algorithms may facilitate in tacit collusion between undertakings.<sup>5</sup>

In order to explain tacit collusion, it is important to distinguish between parallel behaviour and a concerted practice; it is logical that undertakings retain the right to adapt intelligently to competition on the market,

---

<sup>1</sup> Lohr S., *the age of big data* [2012], New York Times (online) <<https://www.nytimes.com/2012/02/12/sunday-review/big-datas-impact-in-the-world.html>>, accessed 2 February 2018

<sup>2</sup> Agerholm, H, "Angela Merkel says internet search engines are 'distorting perception' and algorithms should be revealed" [2017], The independent

<sup>3</sup> OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD <[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018, p. 5

<sup>4</sup> Ezrachi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016), p. 61

<sup>5</sup> Petit, Nicolas, *The Oligopoly Problem in EU Competition Law*, Research Handbook in European Competition Law, I. Liannos and D. Geradin eds., Edward Elgar, February 5, 2012, p. 5 - 10

this is one of the principles of the free market. When such intelligent responses lead to a similarity of market conduct but based on decisions which are taken unilaterally on the basis of economic rationale, this is parallel behaviour.<sup>6</sup> Contrarily, undertakings may also exchange information to take decisions in a coordinated manner. When undertakings exchange commercially sensitive information with the aim to replace competition with coordination, this is a concerted practice.<sup>7</sup>

The grey area between parallel behaviour and the concerted practice is tacit collusion. Tacit collusion refers to a form of coordination based on unilateral economic rationale. Competitors may engage in tacit collusion without an agreement at its basis. The competitors create an atmosphere of mutual certainty that when one party raises its price, the other competitor will follow. Due to this, the competitors can maintain a unilateral profit maximization scheme, with a greater amount of certainty that the competition will not undercut them.<sup>8</sup> Tacit collusion is separated from explicit collusion or the concerted practice, since no exchange of information takes place, but may still lead to anti-competitive effects and negative consequences for consumers.<sup>9</sup> Thus, by grey area the author means that this is a legal form of collusion, but collusion nonetheless.

In order for tacit collusion to be effective, the market must have certain characteristics. One of these is high transparency, which allows for the monitoring of competition and easily reaching a mutual understanding on what price should be asked, without communicating. Through this transparency, it must be possible to punish deviations of the set-price. Finally, there must be only limited competitive restraints, such as small players which may intervene in the collusion or new entrants on the market which undercut the prices. These market conditions are currently most prevalent in the oligopolistic market structure, this is why tacit collusion happens mostly in oligopolistic markets. Thus, when tacit collusion happens within an oligopoly this is dubbed to be the ‘oligopoly problem’.<sup>10</sup>

---

<sup>6</sup> Case C-172/80 *Zuchner v Bayerische Vereinsbank AG* EU:C:1981:178 [1981], Ecr. I-2021 (*Zuchner v. Bayerische Vereinsbank*), par. 16

<sup>7</sup> Whish, R., and D. Bailey, *Competition Law* (8<sup>th</sup> edition, Oxford University Press 2015), p. 107

<sup>8</sup> OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD <[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018, p. 19

<sup>9</sup> *Ibid.* p. 22 - 23

<sup>10</sup> Petit, N., *The Oligopoly Problem in EU Competition Law* [2012], Research Handbook in European Competition Law 2012 p. 2 -10; Potters J., S. Suetens, ‘*Oligopoly experiments in the current millennium*’ [2013], *Journal of Economic Surveys* 27(3), p. 439–460.

Algorithms will likely have an effect on these market characteristics. Algorithms increase transparency on a market and cause frequent interactions between competitors on the market.<sup>11</sup> Moreover, algorithms are more efficient at monitoring competitors and punishing deviant behaviour.<sup>12</sup> This provides for a possibility to tacitly collude also outside of the oligopolistic market structure, and to make the collusion more stable than it was traditionally.<sup>13</sup> Algorithms may improve transparency to such an extent that collusive behaviour may always be sustainable, due to combining high transparency with zero lag price-changing capabilities. Moreover, algorithms may possibly adopt a collective strategy, resulting in parallel behaviour which is equally effective as forming a cartel, through excessive monitoring.<sup>14</sup>

Until now, tacit collusion has been seen as legal since it does not happen as much as one would expect from the theory, and the stability of such a collusive scheme is often overstated. Moreover, it can happen in markets with up to three players, but almost never happens when there are four. The question which remains now, is if this rationale still applies when algorithms are implemented, or if tacit collusion might happen in bigger markets, more efficiently and more often through algorithmic collusion.<sup>15</sup> If the latter is the case, this means that tacit collusion may have to be considered as a concerted practice.

## 1.2. Research purpose

The purpose of this research is to discover the effects of self-learning price-setting algorithms on tacit collusion. The research aims to discuss if the existing notions surrounding the legality of tacit collusion still apply. By this the author means notions such as that tacit collusion can only occur in oligopolies, tacit, or that tacit collusion is unsustainable.

In order to do so the research is divided in three stages: First, by discussing parallel behaviour and concerted practices, tacit collusion can be defined and explained. Secondly, it will be discussed how algorithms affect the conditions which facilitate tacit collusion. Finally, it will be discussed what the future of tacit collusion will be in markets where algorithms set prices. Thus, the aim of this research is to revisit

---

<sup>11</sup> Petit, Nicolas, *The Oligopoly Problem in EU Competition Law*, Research Handbook in European Competition Law, I. Liannos and D. Geradin eds., Edward Elgar, February 5, 2012, p. 5 - 10

<sup>12</sup> OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD <[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018, p. 23

<sup>13</sup> Ezrahi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016), p. 16

<sup>14</sup> OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD <[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018, p. 23

<sup>15</sup> *Ibid.*, p. 34



the rationale behind the legality of tacit collusion and redefine the thresholds between legal parallel behaviour and a concerted practice when algorithms are implemented.

However, the purpose of the research also excludes certain elements from the scope of the research. Firstly, the research will not focus on the discussion if the effects of algorithms are generally more pro- or anti-competitive, this research focuses on the parallel between the possibility to tacitly collude and the established anti-competitive effects of algorithms. Moreover, this research only focuses on the capacity of algorithms to facilitate tacit collusion. This also means that explicit collusion or price discrimination through the use of algorithms will not be discussed.

### 1.3. Research question

*“Does the implementation of price-setting algorithms by competitors lead to concerns about the legality of tacit collusion and to what extent should the treatment of tacit collusion under 101 TFEU be affected?”*

### 1.4. Methodology and ‘State of the Art’.

The research will consist of a literature study. There will be research in books and articles by academia, technical documents, policy documents, case law and soft law to explore the view on algorithms in competition law from different angles. In order to explore the added value of this research the author will first explain the current State of the Art.

The debate on algorithmic collusion has gained academic relevance due to Ezrachi & Stucke. In their book *Virtual Competition* and the accompanying articles, Ezrachi and Stucke have set out the theories of harm for algorithmic collusion, in which especially their theories on the predictable agent and Digital Eye are interesting.<sup>16</sup> These two self-learning algorithms would have enhanced capabilities to collude tacitly; Ezrachi and Stucke have described the phenomenon as tacit collusion on steroids.<sup>17</sup>

Ezrachi & Stucke explain that the introduction of these algorithms will force competition law to evolve in the field of tacit collusion. In economic theory currently, tacit collusion has been discussed as being relevant mostly in an oligopolistic market structure and its existence in oligopolies has thus been dubbed

---

<sup>16</sup> Ezrachi, A, and Stucke, .E., *Artificial Intelligence & Collusion: When Computers Inhibit Competition* [2015], University of Illinois Law Review, Vol. 2017; Ezrachi A. & Stucke M.E., *How pricing bots could form cartels and make things more expensive* [2016], Harvard Business Review; Ezrachi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016) etc.

<sup>17</sup> Ezrachi A. & Stucke M.E., *How pricing bots could form cartels and make things more expensive* [2016], Harvard Business Review

the oligopoly problem.<sup>18</sup> However, according to Ezrachi & Stucke, the possibility to tacitly collude will become available outside oligopolistic market structures as well, in markets which would normally be deemed sufficiently competitive.<sup>19</sup> Moreover, the stability and efficiency of tacit collusion would also improve greatly.<sup>20</sup>

This had led to discussion in the OECD, which has held multiple roundtable on the topic, to which the European Union has submitted a contribution. In these documents the consequences of algorithms on the market characteristics in market in which these are implemented have been discussed.<sup>21</sup> In its Note to the OECD on algorithms and collusion, the European Union has coined four ways forward on their response to algorithmic collusion. It will either wait to quantify the effects, wait for countermeasures, consider algorithms as concertation through information exchange or prohibit tacit collusion completely.<sup>22</sup>

The aim of this research is to contribute to the discussion by exploring these routes set out by the European Union, in light of the effects of algorithms on tacit collusion as established by the OECD and Ezrachi & Stucke. These routes will be explored through the existing considerations of the Commission and the Court on the definitions of parallel behaviour, tacit collusion and concerted practices under EU law.

---

<sup>18</sup> Potters J., S. Suetens, 'Oligopoly experiments in the current millennium' [2013], *Journal of Economic Surveys* 27(3), p. 439–460.

<sup>19</sup> OECD, *Algorithmic Collusion: Problems and Counter-Measures - Note by A. Ezrachi & M. E. Stucke* [2017], DAF/COMP/WD(2017)25, par. 14 and 15

<sup>20</sup> Ezrachi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016), p. 61 - 80

<sup>21</sup> OECD, *Algorithms and collusion – note from the European Union* [2017], DAF/COMP(2017)12; OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD <[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018; OECD, *Algorithms and collusion – background note by the secretariat* [2017], DAF/COMP(2017)4; OECD, *Algorithmic Collusion: Problems and Counter-Measures - Note by A. Ezrachi & M. E. Stucke* [2017], DAF/COMP/WD(2017)25; OECD, *Roundtable on information exchange between competitors under competition law* [2010], DAF/COMP/WD(2010)118

<sup>22</sup> OECD, *Algorithms and collusion – note from the European Union* [2017], DAF/COMP(2017)12, par. 30 - 34

## 2. Collusion under European Union law

Article 101 of the Treaty for the Functioning of the European Union (TFEU) prohibits agreements, decisions by associations of undertakings and concerted practices that restrict competition.<sup>23</sup> When undertakings enter into an agreement to restrict competition, this is explicit collusion.<sup>24</sup> An agreement relies on a ‘concurrence of will expressed by the undertakings, no matter the form’.<sup>25</sup> This research however, does not focus on explicit collusion where an agreement is at the basis of the collusive behaviour. Instead the focus lies on coordinated behaviour, such coordination between market conduct may lead to another form of collusion; the concerted practice.<sup>26</sup> A concerted practice is defined as conduct which is not attributable to an agreement or decision but may nevertheless amount to an infringement.<sup>27</sup>

Like an agreement, a concerted practice can restrict competition by object or by effect. When a restriction by object is identified, this is *de jure* illegal under 101 TFEU.<sup>28</sup> When a restriction by effect is identified, the Commission will have to argue that the effects of the collusion harm competition through an extensive analysis of the agreement and its economic effects.<sup>29</sup> When the collusion exists in the form of price-setting, like discussed in this research, it is defined as restriction by object. Price-setting agreements are explicitly prohibited under article 101 TFEU.<sup>30</sup>

The difference between parallel behaviour, concerted practices and the role of tacit collusion will be highlighted in this chapter. Chapter 2.1. will elaborate on the difference between coordination and concertation by exploring EU case law on the subject. Chapter 2.2. will pay special attention to one type of coordination, namely tacit collusion. Tacit collusion will be discussed in the context of the oligopoly problem, to understand the existing notions surrounding it. Finally, the conclusion on these definitions will be given in chapter 2.3.

### 2.1. Parallel behaviour, tacit collusion and concerted practices under EU law

Collusion commonly refers to any form of co-ordination or agreement between competing firms with the objective of raising profits to a higher level than attained through competition on merits. This joint profit

---

<sup>23</sup> *Consolidated version of the Treaty for the functioning of the European Union* [2012] (2012/C 326/01) (TFEU), article 101; Whish, R., and D. Bailey, *Competition Law* (8<sup>th</sup> edition, Oxford University Press 2015), p. 85

<sup>24</sup> *Ibid.*, p. 103

<sup>25</sup> Case T-41/96, *Bayer AG v. Commission* EU:T:2000:242, [2000], Ecr II-03383(*Bayer v. Commission*)

<sup>26</sup> Whish, R., and D. Bailey, *Competition Law* (8<sup>th</sup> edition, Oxford University Press 2015), p. 107

<sup>27</sup> *Ibid.*, p.117

<sup>28</sup> *Ibid.*, p. 124

<sup>29</sup> *Ibid.*, p. 133 - 136

<sup>30</sup> Article 101 (1) (a) TFEU

maximization scheme is likely to hurt consumers. The start and maintaining of a collusive scheme is based on a structure that is put in place by the parties that enables them to agree on a common policy, that enables them to monitor the adherence to this common policy and that allows them to punish any deviation from the common policy by one of the parties.<sup>31</sup>

First, it is important to distinguish the definitions of explicit collusion, tacit collusion and the concerted practice. Explicit collusion is defined as anti-competitive conduct that is maintained through an agreement or series of agreements, which can be written or oral, which lead to a collusive outcome, like the joint setting of prices, market sharing or other outcomes that are caught under 101 TFEU. Tacit collusion on the other hand, refers to forms of anti-competitive co-ordination which can be achieved without any explicit agreement being made, but which competitors are able to create upon a mutual understanding or mutual interdependence. Each undertaking decides its profit-maximizing strategy seemingly unilaterally, but the outcome hurts customers or consumers anyway.<sup>32</sup> When coordination is achieved by exchanging information to replace competition with coordination, this is an illegal concerted practice.<sup>33</sup>

Tacit collusion can be achieved without exchanging information and is not caught as an illegal behaviour. This is because it consists of supra competitive prices that are the outcome of rational economic behaviour of the parties, based on the available data and market structure. Meanwhile, that same economic behaviour can drastically reduce or limit output or raise prices to the detriment of customers and consumers.<sup>34</sup> However, it is important to make a distinction between parallel behaviour of firms, and concerted practices. Tacit collusion within an oligopoly is a grey area in between parallel behaviour and a concerted practice or explicit tacit collusion.<sup>35</sup> Tacit collusion without communication is considered to be parallel behaviour, even when the outcome hurts consumer welfare. However, when undertakings create co-ordination in their behaviour through means such as communication, in order to facilitate in the

---

<sup>31</sup> OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD <[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018, p. 19

<sup>32</sup> Ibid., p. 19

<sup>33</sup> Kühn, K., *Fighting Collusion by Regulating Communication between Firms* [2001], *Economic Policy*, Vol.16, No.31, p. 183

<sup>34</sup> Ibid., p. 19 -20.

<sup>35</sup> Norton Rose Fullbright, *OECD workshop addresses algorithms and collusion issues* [2017], NRF, <<http://www.nortonrosefulbright.com/knowledge/publications/149481/oecd-workshop-addresses-algorithms-and-collusion-issues>>, accessed 6 May 2018

detection of deviation which makes the punishment of deviations easier, tacit collusion can turn into a concerted practice.<sup>36</sup>

In order to distinguish the three concepts from each other the following sub-chapters will provide an analysis of the case law set out by the Court of Justice of the European Union, followed by the soft law by the European Commission.

### 2.1.1. EU case law on parallel behaviour and collusion

The first case where the Court acknowledged the separation between an agreement, concerted practice and decision by an association of undertakings was in *Consten v. Grundig*. The Court held that the drafters of the Treaty had separated three forms of anti-competitive conduct and that all three could either restrict competition by object or by effect. The Court acknowledges that the use of the word practice was placed there intentionally by the drafters as to catch the collusive behaviour in the form of concerted practices as well.<sup>37</sup>

The landmark case which followed not much later was *Imperial Chemical Industries Ltd v Commission (Dyestuffs)* in 1972 the Court defined a concerted practice as “*a form of coordination between undertakings which, without having reached the stage where an agreement so called has been concluded, knowingly substitutes practical cooperation between them for the risk of competition.*”<sup>38</sup>

In its decision, the Commission relied upon several pieces of evidence, being the similarity, rate and timing of price-changes, as well as the instructions sent by parent companies to subsidiaries and the informal contact between these firms.<sup>39</sup>

This was expanded in *Suiker Unie*, where it was stated that there was no necessity for a plan on how to coordinate, but that coordination must be understood in light of the treaties definition of competition. This means that each trader must determine their policy independently on the common market and under which conditions the trader offers their products to the customer.<sup>40</sup> This meant that any direct or indirect

---

<sup>36</sup> OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD <[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018, p. 20

<sup>37</sup> Joined cases 56 and 58/64, *établissement Consten SARL v. Grundig-Verkaufs GmbH* EU:C:1966:41, [1966], Ecr. I-299 (*Consten v. Grundig*), par. 319,

<sup>38</sup> Case C-48/69, *Imperial Chemical Industries Ltd v Commission* EU:C:1972:70 [1972], Ecr I-619 (*Dyestuffs*), par. 64

<sup>39</sup> Whish, R., and D. Bailey, *Competition Law*, Oxford University Press 2015, p. 117 - 118

<sup>40</sup> Joined Cases 40 to 48, 50, 54 to 56, 111, 113 and 114/73, *Suiker Unie v Commission* EU:C:1975:174 [1975] ECR I-1663, (*Suiker Unie*), par. 1942

contact between competitors, of which the object or effect is to influence the market conduct of another competitor, actual or potential, or to disclose to that competitor the course of conduct which they themselves have adopted or will adopt, was to be prohibited under 101 TFEU.<sup>41</sup>

This was later reiterated in the *T-Mobile* case, where the Court laid down the rule that “*each economic operator must determine independently the policy which it intends to adopt on the common market. Such a requirement of autonomy thus strictly precludes any direct or indirect contact between economic operators of such a kind as either to influence the conduct on the market of an actual or potential competitor or to reveal to such a competitor the conduct which an operator has decided to follow itself or contemplates adopting on the market, where the object or effect of those contacts is to give rise to conditions of competition which do not correspond to the normal conditions of the market in question*”<sup>42</sup>

The general notion flowing from *Suiker Unie & T-mobile* is that when competition is knowingly substituted for cooperation between competitors, this may be seen as a concerted practice.<sup>43</sup> However, even knowingly is subjected to a broad interpretation. In the *Fresh Del Monte* case, the General Court states that it is not necessary to prove a meeting of minds or a common course of conduct. As stated in *Treuhand*, also passive modes of participation into infringement render the undertaking to be liable for collusive behaviour under article 101 TFEU, as long as an undertaking does not distance itself from the collusive behaviour.<sup>44</sup> Thus, the Court seems to take a strict stance on concerted practices.

However, the Court has also accepted that the parallel conduct of companies does not necessarily mean that the undertakings are coordinating their behaviour. The importance of separating simply intelligent responses on the market, based on economic rationale, from concerted practices in the case of *Zuchner v. Bayerische Vereinsbank*.<sup>45</sup> Here the Court stated that parallel behaviour between competitors, does not necessarily mean that there is a concerted practice. In *Zuchner v. Bayerische Vereinsbank*, the defendant could explain the common transfer rate of 0.15% as to correspond with the costs incurred with such a service.<sup>46</sup> However, the Court also explicitly stated that even if there is no motive to coordinate behaviour,

---

<sup>41</sup> Whish, R., and D. Bailey, *Competition Law*, Oxford University Press 2015, p. 118

<sup>42</sup> Case C-8/08, *T-Mobile Netherlands and Others v. Nederlandse Mededingingsautoriteit* EU:C:2009:343 [2009], Ecr I-04529 (*T-Mobile*), par. 32- 33

<sup>43</sup> Case C-8/08, *T-Mobile Netherlands and Others v. Nederlandse Mededingingsautoriteit* EU:C:2009:343 [2009], Ecr I-04529 (*T-Mobile*), par. 39.; Whish, R., and D. Bailey, *Competition Law* (8<sup>th</sup> edition, Oxford University Press 2015), p. 118

<sup>44</sup> Case C-194/14, *AC-Treuhand v Commission* EU:C:2015:717 [2015] (*Treuhand*), par. 31

<sup>45</sup> Case C-172/80 *Zuchner v Bayerische Vereinsbank AG* EU:C:1981:178 [1981], Ecr. I-2021.

<sup>46</sup> *Ibid.*, par. 16

parallel conduct in that sphere may still result in coordination between undertakings which amounts to a concerted practice.<sup>47</sup>

The Court gives some indicators as to when parallel behaviour turns into a concerted practice: The banks must (1) conduct themselves in an alike manner and (2) there are contacts or at least exchange of information on the relevant transactions which (3) have been carried out or planned for the future and (4) there must be regard if the charge imposed is no different than it would be when there is free competition. When the result of the test by the Court is that such a practice is or is capable of significantly affecting conditions of competition in the market connected to such services, then a concerted practice will be established.<sup>48</sup>

Referring back to *Dyestuffs*, the Court also stated that although parallel behaviour is not in itself a concerted practice, it may be considered strong evidence that such a practice exists if the conditions of competition no longer correspond with normal market conditions.<sup>49</sup>

Although this shows that parallel conduct in itself is not illegal, the definition of concerted practices has been defined broadly by the Court when expanding on the topic. In *Argos* the Court stated that concerted practices can take place in many different forms, and that the Court will not define or limit what may amount to a concerted practice.<sup>50</sup> This allows for the Court to include new types of behaviour as a concerted practice, which is relevant when discussing the inclusion of algorithmic collusion as a possible concerted practice. The analysis of when exchange of information will lead to a concerted practice will be expanded on in chapter 4.1. in the context of algorithmic collusion.

## 2.2. Oligopolies and tacit collusion; explaining the oligopoly problem

An oligopolistic market is a market in which there are few players with high market concentration, oligopolies are often limited to two or three players on a market. According to economic theory, this market structure supports the existence of tacit collusion.<sup>51</sup> This chapter aims to explain why the oligopoly and tacit collusion are intrinsically linked to one another.

---

<sup>47</sup> *Ibid.*, par. 17

<sup>48</sup> *Ibid.*, par. 21 & 22.

<sup>49</sup> Case C-48/69, *Imperial Chemical Industries Ltd v Commission* EU:C:1972:70 [1972], Ecr I-619 (*Dyestuffs*), par 66

<sup>50</sup> Whish, R., and D. Bailey, *Competition Law* (8<sup>th</sup> edition, Oxford University Press 2015), pp. 118; Case C-288/94, *Argos distributors Ltd v. Office of Fair Trading v. Commissioners of customs & excise* EU:C:1996:398 [1996], Ecr I-5311 (*Argos Ltd.*), par. 22

<sup>51</sup> Potters J., S. Suetens, 'Oligopoly experiments in the current millennium' [2013], *Journal of Economic Surveys* 27(3), p. 439–460.

There are multiple economic theories describing the rationale behind the behaviour of oligopolistic markets. The theory of the Cournot-Nash equilibrium assumes two firms of equal efficiency and the competition is based on production output instead of price. This model shows that after a series of actions and reactions to change the input and market strategy at certain point an equilibrium will be reached, where neither of the companies still has the desire to change anything in their market behaviour.<sup>52</sup>

The Bertrand model assumes the same circumstances as the Cournot-Nash equilibrium, however, here the competition is based on price instead of output. In this theory the equilibrium becomes established as well; after a series of actions and reactions the price will be established, then, if one company would raise its prices it would lose its customers to its competitor, and if one of the undertakings would lower their prices they would both sell at a loss of profit.<sup>53</sup> There are more complex theories describing oligopolistic behaviour. However, these two theories are suitable to explain the oligopoly problem.

Tacit collusion is the behaviour which breaks this equilibrium. Tacit collusion refers to a form of coordination based on unilateral economic rationale. Competitors may engage in tacit collusion without an agreement at its basis or communicating with one another. The competitors create an atmosphere of mutual certainty that when one party raises its price, the other competitor will follow. Due to this, the competitors can maintain a unilateral profit maximization scheme, with a greater amount of certainty that the competition will not undercut them.<sup>54</sup> Tacit collusion is separated from explicit collusion or the concerted practice, since no exchange of information takes place. The competitors simply unilaterally adapt their behaviour to the actions undertaken by another competitor, allowing both undertakings an increase in profit.<sup>55</sup>

When tacit collusion occurs in an oligopoly, this is dubbed 'the oligopoly problem'. There are multiple reasons why these two phenomena are intrinsically linked in the classic economic theory. Firstly, since tacit collusion, does not have an agreement as its basis, it does require a certain amount of trust that the other will not deviate from the behaviour. When more players become involved in the collusive scheme, it becomes more difficult for competitors to monitor if everyone on the market is following the collusive

---

<sup>52</sup> Kreps, D., *A Course in Microeconomic Theory* (1<sup>st</sup> edition, Princeton University Press 1990), p. 326

<sup>53</sup> Pindyck, R & Rubinfeld, D., *Microeconomics*, (8<sup>th</sup> edition, Pearson 2001), p. 438

<sup>54</sup> OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD <[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018, p. 19

<sup>55</sup> *Ibid.*, p. 22 - 23



scheme. Therefore, a maxim of tacit collusion is that it frequently happens when there are two players on the market (duopoly), rarely happens when there are three players on the market (triopoly) and almost never happens when there are four players on the market (quadropoly).<sup>56</sup>

The second reason that tacit collusion is prevalent in oligopolies, is because it breaks the equilibrium which oligopolies reach according to the Bertrand model. There are two classic oligopoly situations: the first is where one company will follow the conduct of the other, every time the other lowers its prices. This would not be beneficial to either of the competitors. The other situation is called the 'tit for tat', in which the companies follow each other when one of the parties slowly but steadily raises prices.<sup>57</sup> By coordinating their prices in the 'tit for tat' situation, undertakings can slowly raise the price on the basis of a mutual understanding that the other will follow. Through this, the concept of the equilibrium of the Bernard model does not hold true, since undertakings now have the mutual understanding that if one of the parties raises their prices, the other one will follow, so neither will lose their customers to the other.<sup>58</sup>

Thus, tacit collusion is facilitated by the oligopolistic market structure and provides a possibility to increase profit in the oligopolistic market structure. However, tacit collusion is not always an effective option within oligopolies. According to Petit, there are four conditions for tacit collusion to be effective within the oligopoly. Firstly, there must be a mutual understanding on the level by which the price must be raised. Secondly, a punishment for deviating behaviour must be possible. Thirdly, the competitors must have an effective way of monitoring each other's behaviour. Finally, there must be the possibility to create barriers of entry for other firms.<sup>59</sup> Once the oligopoly has market characteristics which fulfil these conditions, it is possible for the oligopoly to achieve supra-competitive prices, for example through the 'tit-for-tat' approach.<sup>60</sup>

Wish and Bailey explain how these market characteristics facilitate tacit collusion. In their analysis they have stated that the possibility to punish deviations increases the stability of the tacit collusion. The ability to raise barriers of entry to prevent new players from entering the market, creates an absence of

---

<sup>56</sup> Potters J., S. Suetens, '*Oligopoly experiments in the current millennium*' [2013], *Journal of Economic Surveys* 27(3), p. 439–460.

<sup>57</sup> Chamberlin E,H, "*Duopoly: value where sellers are few*" [1929], 44<sup>th</sup> ed. *Quarterly Journal of economics*, p. 63 - 100

<sup>58</sup> Chamberlin E,H, "*Duopoly: value where sellers are few*" [1929], 44<sup>th</sup> ed. *Quarterly Journal of economics*, p. 63 - 100

<sup>59</sup> Petit, N., *The Oligopoly Problem in EU Competition Law* [2012], *Research Handbook in European Competition Law 2012*, p. 2

<sup>60</sup> Chamberlin E,H, "*Duopoly: value where sellers are few*" [1929], 44<sup>th</sup> ed. *Quarterly Journal of economics*, p. 63 - 100

competitive restraints and raises the sustainability and profitability of the collusive behaviour. Finally, the ability to come to a mutual understanding between competitors, as well as the possibility to monitor competition effectively, is based on the transparency of the market.<sup>61</sup>

The transparency of a market is essential for tacit collusion. Transparency allows competitors to engage in parallel behaviour, since there is an enhanced understanding of the conduct of competition on the market.<sup>62</sup> Although transparency is the main driver, other factors may facilitate tacit collusion as well. The frequency of interaction between undertakings, homogeneity of the product market and market concentration are all factors which allow for easier and more sustainable tacit collusion.<sup>63</sup>

Tacit collusion is not illegal under EU law, even though the outcomes of tacit collusion are often undesirable from a consumer perspective. Wish and Bailey have given four reasons for this in their literature in 2012: firstly, according to Wish & Bailey the interdependence as stated in the oligopoly problem is often overstated in terms of how often the oligopoly actually occurs and to what extent oligopolies are sustainable, Secondly, oligopolies often do have heterogeneous conditions in the market, regarding production costs, brand loyalty, different market shares and cost levels, making tacit collusion harder. Third, existing small players may offer competitive constraints. Finally, a successful collusion would attract new players to the market, unless there are significant barriers to entry.<sup>64</sup>

### 2.3. Conclusion

In this chapter the difference between parallel behaviour, concerted practices and tacit collusion has been explained from an economic perspective and through case law by the CJEU. Parallel behaviour can happen within markets, however it will turn into a concerted practice when the conditions that competitors (1) conduct themselves in an alike manner and (2) there are contacts or at least exchange of information on the relevant transactions which (3) have been carried out or planned for the future and (4) the price which is charged is different from the price which would be asked if the concertation had not taken place.<sup>65</sup>

---

<sup>61</sup> Wish, R., and D. Bailey, *Competition Law* (8<sup>th</sup> edition, Oxford University Press 2015), p. 598

<sup>62</sup> Harrington J.E.J., "A theory of tacit collusion" [2011], Economics Working Paper Archive, The Johns Hopkins University, Department of Economics, p. 4

<sup>63</sup> Wish, R., and D. Bailey, *Competition Law* (8<sup>th</sup> edition, Oxford University Press 2015), p. 598

<sup>64</sup> OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD <[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018,, p. 34

<sup>65</sup> *Ibid.*, para. 21 & 22.

Concerted practices are broadly defined and will take place when parties knowingly substitute competition with cooperation, or if competitors no longer decide their conduct on the market unilaterally.<sup>66</sup>

Tacit collusion is a unilateral behaviour by competitors on a market, however, competitors are acting on with some degree of mutual assurance of their conduct. Although this form of collusion may have negative effects for competition and consumers, tacit collusion requires no agreement or exchange of information and is based on unilateral economic rationale.<sup>67</sup> Thus, tacit collusion is the grey area between concertation and parallel behaviour; the behaviour is coordinated to on the actions of others to some extent, but there is no exchange of information or substitution of competition by cooperation, there is however an intelligent adaption which allows the competitors to raise price between themselves to the detriment of consumers.<sup>68</sup> However, due to the limited possibilities to effectively tacitly collude, tacit collusion has remained legal under 101 TFEU.<sup>69</sup>

---

<sup>66</sup> Case C-48/69, *Imperial Chemical Industries Ltd v Commission* EU:C:1972:70 [1972], Ecr I-619 (*Dyestuffs*), par. 63 - 66 Case C-8/08, *T-Mobile Netherlands and Others v. Nederlandse Mededingingsautoriteit* EU:C:2009:343 [2009], Ecr I-04529 (*T-Mobile*), para. 32- 33; Joined Cases 40 to 48, 50, 54 to 56, 111, 113 and 114/73, *Suiker Unie v Commission* EU:C:1975:174 [1975] ECR I-1663, (*Suiker Unie*), para. 1942; Whish, R., and D. Bailey, *Competition Law* (8<sup>th</sup> edition, Oxford University Press 2015), p. 118; Case C-288/94, *Argos distributors Ltd v. Office of Fair Trading v. Commissioners of customs & excise* EU:C:1996:398 [1996], Ecr I-5311 (*Argos Ltd.*), para. 22

<sup>67</sup> OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD <[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018, p. 19, 20 and 23

<sup>68</sup> Chamberlin E,H, “*Duopoly: value where sellers are few*” [1929], 44<sup>th</sup> ed. Quarterly Journal of economics, p. 63 - 100

<sup>69</sup> Ivaldi et al, “*The economics of tacit collusion* [2003], Report for DG Comp, IDEI 2013; Harrington J.E.J., “*A theory of tacit collusion*” [2011], Economics Working Paper Archive, The Johns Hopkins University, Department of Economics, p. 4; OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD <[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018, p. 34

### 3. Algorithms and algorithmic theories of harm

To explain in which way algorithms can have anti-competitive effects, this chapter will first explain what an algorithm is, as well as how algorithms learn in 3.1. This aims to improve readability of the chapter 3.2. where the algorithmic theories of harm are discussed. This chapter explains the workings of the Predictable agent- and the Digital eye algorithms. Finally, the effect on the characteristics of the market and on the notions surrounding parallel behaviour by implementation of these algorithms will be discussed in chapter 3.3.

#### 3.1. What are algorithms and how do they learn?

Defining algorithms is mathematically challenging, they have been described as *abstract computers*, being mathematical models of computers, although others claim it's a mathematical formula based on recursive equation.<sup>70</sup> Algorithms are in fact, complex formulas which follow a set of possibilities and alternate between choices depending on the data presented.<sup>71</sup> For the purpose of this research, algorithms will be defined as computer that executes a sequence of rules that should be performed in an exact order to carry out a certain task.<sup>72</sup>

When identifying price-setting algorithms, different categories can be identified. The first is the *heuristic algorithm*, this software will set its prices based on the information it has about the market in a particular moment in time. This algorithm is used to match the prices of competitors, or to automatically raise or lower prices based upon the market.<sup>73</sup> The second type is the *analytical algorithm*, which, unlike the heuristic algorithm, will base prices on all information it has gathered. It will base the prices on historical data and will be static from that point onwards.<sup>74</sup> The third type is the *autonomous algorithm*, which combines the heuristic and analytical algorithm. This algorithm bases its prices on historical data but will continue to evaluate the current situations, updating itself on the observed outcome.<sup>75</sup>

In companies where algorithms are used, there is often still some level of human intervention, to correct errors or to assess the progress made by algorithms. However, some algorithms themselves are capable

---

<sup>70</sup> Moschovakis Y.N., *What is an Algorithm?* [2001], Mathematics Unlimited, Springer, p. 1

<sup>71</sup> *Ibid.*, p. 13

<sup>72</sup> OECD, *Algorithms and collusion – background note by the secretariat* [2017], DAF/COMP(2017/4), para. 8

<sup>73</sup> Oxera, *When algorithms set prices: winners and losers* [2017], Oxera discussion paper of 19 June 2017, p. 5

<sup>74</sup> *Ibid.*, p. 5.

<sup>75</sup> *Ibid.*, p. 5.

of learning. There are different types of learning methods, the two main types are *machine learning* and *deep learning*, these algorithms learn by using data presented to them.<sup>76</sup>

### 3.1.1. Machine learning

Machine learning is a development in Artificial Intelligence (AI) that allows intelligent machines, or *algorithms*, to learn without being explicitly programmed. Through the use of algorithms, the abstract computer learns from experience and the data presented. Machine learning can be classified into three broad categories, depending on the pattern they use to learn.<sup>77</sup>

The first form of learning is *supervised learning*, in which the algorithm gets presented clear (labelled) data and learns the general rule for improved input or output. The second form is *unsupervised learning*, where the algorithm gets presented unlabelled data (which is unclear, often not prepared for the algorithm by humans), to identify hidden structures and patterns. The third form is *reinforcement learning*, which works through trial and error by placing the algorithm in a dynamic environment.<sup>78</sup>

A good way to demonstrate algorithms learning capabilities is through the game experiments. Here algorithms use reinforced learning to learn complex games.<sup>79</sup> One example is the algorithm Libratus, was used to play poker against professional players. In 2017, it played over 120.000 hands against these players, through a method of trial and error, it improved its strategy overnight. At the end of the tournament, Libratus had won \$1.776.250, where the professional players were left with negative balances.<sup>80</sup> This shows the ability of these algorithms to use complex reasoning in an uncertain scenario, and to interpret even possible false information (bluffing) to rapidly improve its strategy.<sup>81</sup> A major story in the field of deep learning, was when an algorithm beat the world champion in Go, often referred to as the most complex board game in the world, solely by learning to play against itself and human players. Only the rules of the game were programmed by humans.<sup>82</sup>

To support machine learning, features will be extracted before running the data into the machine. This process is called ‘feature engineering’. Features that are extracted from raw data can be numerical

---

<sup>76</sup> Spice, B., *Carnegie Mellon artificial intelligence beats top poker pros* [2017], Carnegie Mellon University: <<https://www.cmu.edu/news/stories/archives/2017/january/AI-beats-poker-pros.html>>, accessed at 3 February 2018; OECD, *Algorithms and collusion – background note by the secretariat* [2017], DAF/COMP(2017/4), par. 7

<sup>77</sup> Ibid., par. 11

<sup>78</sup> Ibid., par. 7

<sup>79</sup> Ibid., par. 7

<sup>80</sup> Ibid., par. 7

<sup>81</sup> Ibid., par. 7

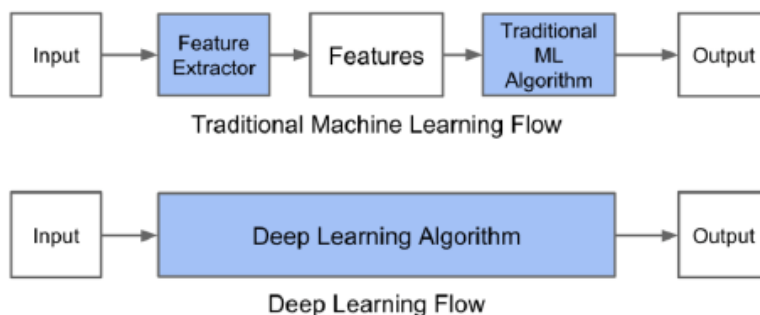
<sup>82</sup> Koch C., *How the Computer beat the Go master* [2016], Scientific American

variables or strings that identify a certain subset of data or the use of a combination variables that create a construct for the algorithm to work with. Feature engineering is done by human engineers and is often time consuming and costly. The alternative to this is the use of a *deep learning* algorithm.<sup>83</sup>

### 3.1.2 Deep learning

This type of learning is a subfield of machine learning but deserves special attention. Deep learning allows the computer system to learn through the use of complex software that mimics the activity of human neurons by creating an artificial neural network.<sup>84</sup> Deep learning algorithms structure the formulas in hierarchy of complexity and abstraction, and therefore learn faster and more accurately than machine learning algorithms, which instead uses a linear model. Moreover, no human intervention is necessary after programming the fundamentals.<sup>85</sup>

However, deep learning also comes with a disadvantage. Due to the fact that the deep learning process is fully autonomous, there is no way to know which features or information were used by the algorithm to decide the output from the given input. The deep learning algorithm does not provide insights into its workings to the programmer or the company which uses it.<sup>86</sup> Figure 1 demonstrates the difference between these models:



Source: Moujahid (2016).

Figure 1- Learning flows of the deep learning algorithm<sup>87</sup>

<sup>83</sup>OECD, *Algorithms and collusion – background note by the secretariat* [2017], DAF/COMP(2017/4), para.7

<sup>84</sup> Ibid. par., 8

<sup>85</sup> Ibid. par., 8

<sup>86</sup> Ibid. par., 8 – 9

<sup>87</sup> Moujahid A., *A practical Introduction to deep learning with Caffe and Python* [2016], (online: <<http://adilmoujahid.com/posts/2016/06/introduction-deep-learning-python-caffe/>> Accessed on 13 March 2018; OECD, *Algorithms and collusion – background note by the secretariat* [2017], DAF/COMP(2017/4), para. 7

The role of big data, has a substantive influence in the possibility for these algorithms to use machine learning or deep learning processes. The greater the amount and quality of the data presented into the algorithms, the greater the results of the algorithms learning process will be. Therefore, also price-setting algorithms are a part of the *data-driven marketplace*, buying and exchanging data can lead to efficiency gains.<sup>88</sup>

## 3.2. Algorithmic theories of harm for tacit collusion

*Ezrachi & Stucke* have defined multiple theories of harm for algorithms, explaining how price-setting algorithms may engage in anti-competitive behaviour. However, since this research aims to discuss problems in relation to tacit collusion, not all of these algorithms will be discussed. Algorithms which are used for explicit collusion, like the *messenger algorithm*, or algorithms which are used for price discrimination will not be discussed in this paper. The predictable agent and the Digital eye are self-learning algorithms. These algorithms are capable of adjusting their behaviour to other algorithms, causing an increase in coordinated behaviour. The manner by which these algorithms do this will be discussed in the upcoming subchapters.

### 3.2.1. The predictable agent

The predictable agent is an unsupervised machine learning algorithm. It is a price-setting algorithm set by firms unilaterally, with the objective of profit maximization. The undertaking which implements this is aware that, once there are multiple predictable agent algorithms used industry-wide, these will facilitate tacit collusion. There is no agreement at the basis of the coordinated behaviour that these algorithms then engage in.<sup>89</sup>The algorithm functions as follows: Each company programs its algorithm with the strategy to maximize profits. The profit maximizing strategy exists in the same fashion as the standard oligopoly problem. When one of the players in the market lowers their prices, the algorithm will quickly follow, making a discount less attractive. When players raise their prices, the algorithms will follow as well, if the increase is sustainable for the rest of the market to follow.<sup>90</sup> These actions will be repeated until there is a mutual understanding on what the desirable price is between competitors. Normally, this

---

<sup>88</sup> OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD <[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018, p. 21

<sup>89</sup> Ezrachi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016), p. 56

<sup>90</sup> *Ibid.*, p. 61

type of strategy can only be attained when there is a small market, hence the oligopoly problem.<sup>91</sup> However, with the use of predictable agents the algorithms can align their behaviour quickly and on a broad scale. The algorithms will ensure that their pricing conduct follows a predictable pattern in their pricing strategy and the way in which it reacts to deviating prices of competitors.<sup>92</sup> Then, through mutual observation the algorithms will decode each other's conduct and align it to tacitly collude.<sup>93</sup> Due to the fact that all price changes can be observed simultaneously by an algorithm, the algorithms can decode how the competitors' predictable agent is responding and to what it is responding.<sup>94</sup> Due to the profit maximization strategy, the algorithms will eventually align their behaviour with the most efficient price setting algorithm. The process of the *predictable agent* by itself is shown in figure 2a.

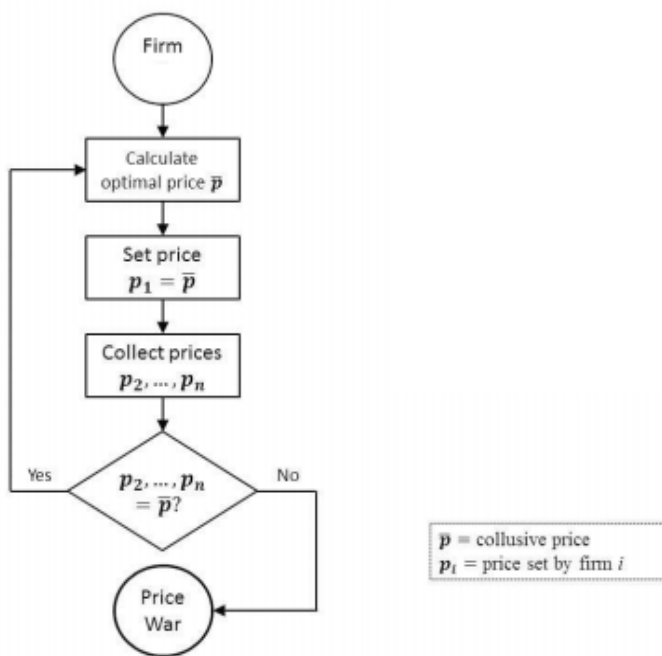


Figure 2, the independent action of a predictable agent algorithm.<sup>95</sup>

It is important to remember that these algorithms make use of machine learning techniques, which provide the algorithm with a certain adaptability. Figure 2 shows that it will be difficult for the algorithms

<sup>91</sup> Ezrachi, A, and Stucke, .E., *Artificial Intelligence & Collusion: When Computers Inhibit Competition* [2015], University of Illinois Law Review, Vol. 2017, p. 1791

<sup>92</sup> Ezrachi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016), p. 61

<sup>93</sup> Ibid., p. 61

<sup>94</sup> Ibid., p. 61

<sup>95</sup> OECD, *Algorithms and collusion – background note by the secretariat* [2017], DAF/COMP(2017/4), par. 64, figure 3



to prevent price wars if the prices are not aligned to a certain extent. This leads to the legitimate concern that one algorithm, in order to make satisfactory use of dynamic pricing, will start communicating with other algorithms. Since their prices are set on the basis of the behaviour of other market players, this creates interdependence.<sup>96</sup> Figure 3 aims to show what happens to the process when algorithms create interdependence between each other, the predictable agent will then make use of parallel algorithms.

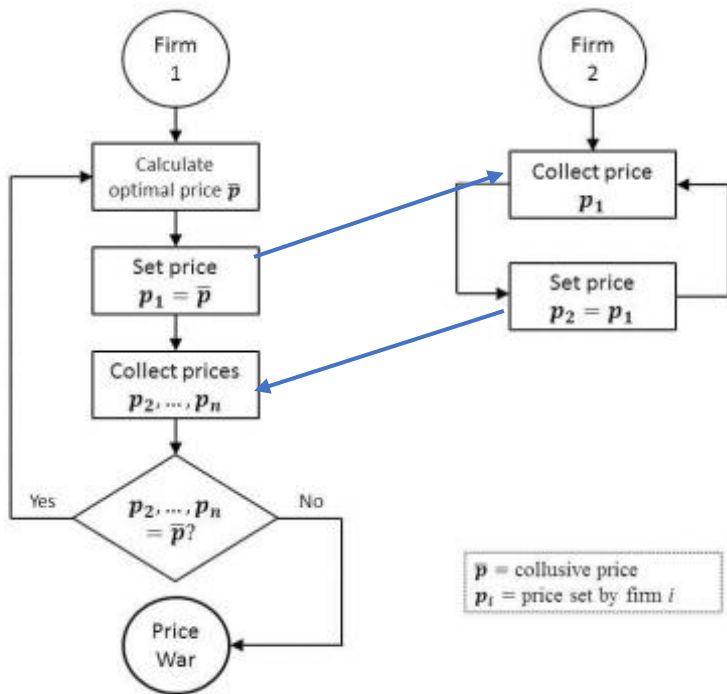


Figure 3. Interdependent predictable agent algorithms.<sup>97</sup>

Figure 3 shows that the algorithm used by undertaking 1, will collect the prices set out by undertaking 2 through its algorithm. To prevent a price war, undertaking 2 will now adapt its prices to undertaking 1, creating interdependence with the pricing strategy of undertaking 1. Although this is not communication in the traditional sense, it does lead to highly similar effects.

The speed with which these algorithms are able to set prices dynamically, will give companies no time to assess if the price chosen by the algorithm should be implemented, since the whole concept of dynamic pricing is based on the speed with which the price can be adjusted.<sup>98</sup> This means that the algorithms, once

<sup>96</sup> Ezrachi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016), p. 61-62

<sup>97</sup> OECD, *Algorithms and collusion – background note by the secretariat* [2017], DAF/COMP(2017/4), par. 69, fig. 4

<sup>98</sup> Ezrachi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016), p. 62

implemented, will work independently, on the basis of real-time data, most of which is provided by competition. Thus, it is hard to prevent the predictable agent from creating interdependence between the used algorithms. The effective data gathering leads to a market with increased transparency, which can monitor, adjust and punish deviations within milliseconds.<sup>99</sup>

According to Ezrachi and Stucke there are five clear consequences of the use of the predictable agent. First, algorithms will provide a quick and efficient method to monitor the market. Second, the greater price transparency is in the market, the more efficient the algorithms will be in disincentivizing discounters. Third, price signalling will change from a matter of days to a matter of seconds. Fourth, the algorithms can use price-changes to create artificial barriers to entry and finally, the algorithms will enhance the stability of the collusion.<sup>100</sup> The effects on the market characteristics and on the notions of parallel behaviour will be discussed in depth in chapter 3.3.

### 3.2.2 The Digital Eye

The Digital Eye is a deep learning algorithm.<sup>101</sup> The Digital Eye is the algorithm on which Ezrachi & Stucke have based the God View scenario of tacit collusion.<sup>102</sup> In order to understand how this algorithm works in the market, the origin of the term God View can provide context. The term God View was derived by Ezrachi & Stucke from an Uber scandal, where two Uber employees told reporters that the company used a tool, named God View, to track all uber cars at all times.<sup>103</sup> In the context of competition, to achieve God view means to achieve a perfect overview of competition on the market based on Big Data and Big Analytics.<sup>104</sup> The Digital Eye is the algorithmic tool to achieve this view. The data can be deferred from the online market, cloud computing, smart-sensors and digital payments. Together, these two factors can provide a real-time panoramic overview of the market, when the processing capability is sufficient.<sup>105</sup> Competitors on the market would then be tracked in the same manner as the cars in Uber's God View. As discussed earlier, deep learning algorithms have the capability of rapidly processing huge quantities of data in order to form strategies and learn simultaneously.<sup>106</sup> Thus, by directing all gathered information directly into the Digital Eye algorithms' database, it will create a strategy and constantly redefine it. Where

---

<sup>99</sup> Ibid., p. 63-64

<sup>100</sup> Ibid., p. 17

<sup>101</sup> OECD, *Algorithms and collusion – background note by the secretariat* [2017], DAF/COMP(2017/4), par. 79

<sup>102</sup> Ibid., P. 71

<sup>103</sup> Morgan R., *Uber settles federal probe over 'God View' spy software* [2017], New York Post

<sup>104</sup> Ezrachi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016), p. 71

<sup>105</sup> Ibid., p. 72

<sup>106</sup> OECD, *Algorithms and collusion – background note by the secretariat* [2017], DAF/COMP(2017/4), par. 79

a human actor is limited to observing only a few actors at once, the Digital Eye algorithm can track all actors at once.<sup>107</sup>

Due to the Digital Eye's deep learning nature, only the fundamentals of the algorithm are programmed by the undertaking. These fundamentals include the objective of profit maximization, as well as possible safeguards so that the algorithm does not engage in illegal behaviour such as price-fixing.<sup>108</sup> In contrast to this; after the fundamental aspects have been programmed, these algorithms rely completely on self-learning methods. They continually analyse the data provided to them and use this to adjust their price maximizing strategy, as illustrated in figure 4 below.

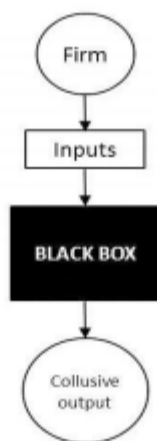


Figure 4, the learning process of the Digital Eye algorithm<sup>109</sup>

It is not possible for humans to steer this process, and the algorithms can decide on routes that override the initially set prohibitions by finding alternative routes with the same outcome.<sup>110</sup> Due to the amount of data that can be tracked simultaneously, the Digital eye is capable of monitoring the behaviour of competitors, potential entrants into the market and customers. It will also be able to detect nearly any

---

<sup>107</sup> Ezrachi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016), p. 72 - 74

<sup>108</sup> Ezrachi, A, and Stucke, .E., *Artificial Intelligence & Collusion: When Computers Inhibit Competition* [2015] University of Illinois Law Review, Vol. 2017, p. 1795 & 1802; Ezrachi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016), p. 74

<sup>109</sup> OECD, *Algorithms and collusion – background note by the secretariat* [2017], DAF/COMP(2017/4), para. 79, fig. 6

<sup>110</sup> Ezrachi, A, and Stucke, .E., *Artificial Intelligence & Collusion: When Computers Inhibit Competition* [2015], University of Illinois Law Review, Vol. 2017 p. 1795 & 1802; Ezrachi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016), p. 74

competitive manoeuvre and prepare a response accordingly.<sup>111</sup> This ability is called ‘the predictive analysis’. Through predictive analysis the Digital eye algorithm will be able to react to a threat on the market even before a price-change actually takes place.<sup>112</sup> The use of this algorithm would allow an undertaking to swiftly adjust their price to the prices of discounters, lower prices to raise barriers of entry for a new competitor or to push small players of the market. It is quite realistic that a deep learning algorithm will gain this capacity in deciding pricing strategies, based on the game theory experiments as seen in chapter 3.1. The algorithms can learn the rules, adapt quickly to a competitor and even recognize behaviour such as bluffing.<sup>113</sup>

However, although the capacity of this algorithm to improve the pricing strategy of one undertaking is substantive, the God View scenario becomes more concerning if all or multiple competitors on a market implement a similar algorithm. When multiple Digital eye algorithms are implemented by competitors simultaneously, these will possibly tacitly collude with one another in an otherwise competitive market.<sup>114</sup> The more similar algorithms are implemented, the easier it will be for these algorithms to create a mutual understanding on what the competitors’ algorithm is doing. The European Commission has dubbed this process ‘mutual decoding of one another’.<sup>115</sup> In the event of a market where all competitors adopt a Digital eye algorithm, then the God View scenario can be truly achieved. The notion that all undertakings in a market would eventually adopt such an algorithm is quite likely due to market rationale. No competitor wants to stay behind on a clearly superior technology implemented by a competitor. Those that do fall behind on this technology, will likely fall behind on competitive efficiency and exit the market at some point.<sup>116</sup>

In the God View scenario the market becomes fully dominated by these algorithms, and the consequences for competition will be dire. In the classic oligopoly problem, the incentive for a discounted price gets reduced when a punishment of that behaviour is likely. Due to the extent to which the Digital Eye algorithms monitor changes in the market, the algorithms will also be able to punish any competitor for achieving an improvement in products, lower prices, entering new markets, or any other competitive

---

<sup>111</sup> Ibid., p. 72- 73

<sup>112</sup> Ibid., p. 72

<sup>113</sup> Chapter 3.1; Koch C., *How the Computer beat the Go master* [2016], Scientific American,

<sup>114</sup> Ezrahi A. & Stucke M.E., *How pricing bots could form cartels and make things more expensive* [2016], Harvard Business Review

<sup>115</sup> OECD, *Algorithms and collusion – note from the European Union* [2017], DAF/COMP(2017)12, para. 33

<sup>116</sup> Ezrahi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016), p. 73

initiative. As soon as it is established that any deviation will be promptly and immediately punished, an atmosphere of certainty is established, even within a market with a fair number of players.<sup>117</sup> Moreover, the algorithms monitoring capabilities will no longer be hindered by a heterogeneous product market, since when the algorithm has learned sufficiently, it is capable of setting the prices of thousands of goods simultaneously.<sup>118</sup>

At the same time, the algorithms that are on the market will become more homogeneous themselves. This happens either because companies commit to joint efforts in tracking and harvesting data, or because the algorithms themselves improve their monitoring of one another and learn from each other. The increased homogeneity can happen either through an exchange of information, or through intense monitoring of one another. Both of these routes result in more similar behaviour of the algorithms on the market.<sup>119</sup> Once these algorithms have achieved a great extent of homogeneity, it is likely that the algorithms will all follow the same strategy and respond to each other in synchrony. This means that when one algorithm undertakes an action to raise or lower prices, punish a deviation, or performs another action, the rest of the algorithms will follow near-instantaneously. This allows the algorithms to behave as if it were a monopoly responding, despite multiple players being involved.<sup>120</sup>

Another important element of the Digital Eye algorithm, is that the question of intent for anti-competitive behaviour is nearly irrelevant. When programming the fundamentals of these machines, the human actors may consider tacit collusion as one of the many possibilities, however, not necessarily as one of the likeliest outcomes.<sup>121</sup> The deep-learning programme can independently decide that collusion or coordination with other similar programmes will optimise profit and choose this direction, yet the programmers of the algorithm cannot foresee to what extent, how long and when the algorithms would decide to do so.<sup>122</sup> The programmers can apply safeguards and limiting principles within the foundation of the algorithm, such as a prohibition to fix prices or share markets, but there is no guarantee that the algorithm will not independently override these safeguards, or find ways around the set limitations.<sup>123</sup>

---

<sup>117</sup> Ibid., p. 73

<sup>118</sup> Ibid., p. 74

<sup>119</sup> Ibid. p. 74

<sup>120</sup> Ibid. p. 77

<sup>121</sup> Ezrachi, A, and Stucke, .E., *Artificial Intelligence & Collusion: When Computers Inhibit Competition* [2015], University of Illinois Law Review, Vol. 2017. p. 1795

<sup>122</sup> Ibid. p. 1792

<sup>123</sup> Ibid. p. 1792 1796

### 3.3. The effect of self-learning algorithms on market characteristics and tacit collusion

This chapter will discuss the effects of algorithms on the market characteristics which facilitate tacit collusion. In 3.3.1. there will be an in-depth discussion on the effect of algorithms on transparency within a market, which allows competitors to monitor each other's behaviour and come to a mutual understanding about the rate at which the price should be increased. In 3.3.2. the effect on stability of the collusive scheme will be discussed, with a focus on the possibility to punish deviations, as well as the likelihood that said deviation will occur and will be profitable. In 3.3.3. the effect on competitive constraints will be discussed in depth, which includes the capability to raise barriers to entry and prevent new players from entering the market.

#### 3.3.1. Algorithms & transparency

The algorithms' effects on transparency in the market have already been touched upon, however this chapter aims to explore in-depth to which extent this increased transparency changes the effectiveness of tacit collusion.

Market transparency is, in principle, considered to be a pro-competitive effect. On the supply-side improved transparency will help solve information asymmetry and allow undertakings to deal with unstable demand, on the demand-side a more transparent market may facilitate informed consumer choices.<sup>124</sup>

However, excessive transparency is a factor which facilitates tacit collusion. With the implementation of algorithms, the collection of data will become central to the business conduct of an undertaking. This business model requires the collection of real-time data that can be automatically analysed and converted into action. The undertakings will be incentivized to gather much larger quantities of information, as well as to develop automated methods to collect, store and process the data. This allows the undertakings to enjoy the capabilities of algorithms to set a pricing strategy and to engage in predictive analysis.<sup>125</sup> The acquiring of this information can be done through cookies, smart bar codes, voice recognition, radio frequency identification and other technologies.<sup>126</sup>

---

<sup>124</sup> OECD, *Roundtable on information exchange between competitors under competition law* [2010], DAF/COMP/WD(2010)118, par. 1 - 2

<sup>125</sup> OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD <[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018,, p. 21

<sup>126</sup> *Ibid.*, p. 21 - 22

When one or a few market players benefit from the competitive advantage that this algorithm brings, the remaining firms will likely do the same, or they would risk being driven out of the market.<sup>127</sup> The result is an industry where competitors are constantly monitoring the choices of consumers, actions of rivals and changes in the market environment in real-time and processing this simultaneously. This results in excessive transparency which facilitates collusion.<sup>128</sup>

Besides the constant monitoring the frequency of interaction between undertakings will also strongly improve. Through automating price-setting decisions by algorithms, price changes will happen on a continuous basis and take into account price-changes of all possible competitors.<sup>129</sup> This, in combination with predictive analysis, will allow the algorithms to tacitly agree upon a supra-competitive price.<sup>130</sup>

In the classic oligopoly model, the mutual understanding by which the price can be raised is critical to achieve a tacitly collusive scheme. The increased monitoring capacity allows this mutual understanding to be reached faster, due to the increased frequency of interactions and the real-time price-setting capacity. Therefore, the price is also adjusted to natural movements of the market more easily.<sup>131</sup> The increased transparency facilitates tacit collusion between a greater number of competitors.

However, there are limitations to the extent to which algorithms can facilitate tacit collusion. In highly dynamic markets it would be difficult for algorithms to find a natural focal point from which the tacit collusion is established. Highly dynamic markets are seen as markets where undertakings have distinct sizes, differentiated products and different business strategies.<sup>132</sup> This means that there is heterogeneity in both products and the competitors positions. When cost-levels, utilisation ratios, market shares and products are differentiated, the effectiveness of algorithmic collusion can be debated.<sup>133</sup>

However, despite these restraints, the facilitation of tacit collusion through excessive transparency has regained renewed importance. Through an exercise of collusion in the economic literature the OECD has taken the position that perfect transparency combined with zero retaliation lag will cause for collusion to always be sustained as an equilibrium strategy.<sup>134</sup>

---

<sup>127</sup> Ibid., p. 22

<sup>128</sup> Ibid., p. 22

<sup>129</sup> Ibid., p. 22

<sup>130</sup> Ibid., p. 22

<sup>131</sup> Ibid., p.22

<sup>132</sup> Ibid., p.22

<sup>133</sup> Ibid., annex 1.

<sup>134</sup> Ibid, p. 23

Thus, the condition for competitors to engage in tacit collusion is supported by algorithms. The algorithms provide an efficient method to monitor the competitors, as well as providing assistance in reaching a mutual understanding on the way by which the price should be changed, even when there is a greater number of competitors on the market.<sup>135</sup>

### 3.3.2. Algorithms & stability

The constant monitoring of competition by algorithms is not limited to a real-time evaluation. The capability of algorithms to engage in predictive analysis reduces strategic uncertainty, whereas powerful algorithms will also separate deviations from collusion and natural reactions to changes in the market efficiently, thus preventing unnecessary retaliation.<sup>136</sup> When algorithms collude with one another, human emotions like trust, anger, greed and panic are eliminated from the pricing strategy.<sup>137</sup> The elimination of these human biases from the collusive behaviour increases the stability of the tacit collusion. In classic collusion, even a hardcore cartel needs a ringleader, since a large part of the stability of a cartel is based on trust. Since the algorithms operate on a predictable conduct and in an atmosphere of certainty of competitors' behaviour, such trust is no longer a necessity.<sup>138</sup> Especially in the scenario where Digital Eye algorithms are applied, this atmosphere of certainty will be supported by the elimination of 'misconceptions' which may trigger price wars. The following example illustrates this type of misconception:

In the classic oligopoly, when company A, B and C are tacitly colluding, and company D deviates, a misconception could arise when company A reacts to the deviation. It is possible that company B and C think that A is deviating from the collusion, instead of reacting to D. Due to this misconception, it is possible a price war could occur, since it is unclear for the competitors who is responding to what. However, due to the *Digital Eye*'s capability to monitor the behaviour of parties beyond this extent, in the *God View* scenario, company A, B and C will all conclude simultaneously that it was D that deviated, and consequently punish company D directly and collectively.<sup>139</sup>

---

<sup>135</sup> Petit, N., *The Oligopoly Problem in EU Competition Law* [2012], Research Handbook in European Competition Law 2012, p. 2 – 10

<sup>136</sup> Ezrachi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016), p. 76

<sup>137</sup> Ezrachi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016), p. 76

<sup>138</sup> *Ibid.*, p. 76

<sup>139</sup> *Ibid.* p. 75 - 76



Thus, the punishment of deviations is quick, efficient and hardly subjected to confusion or uncertainty. This disincentivizes discounters, since the increased transparency leads to the discount being noticed near-instantaneously. This, combined with the swift and imminent retaliation, will lead to a smaller window of opportunity for discounters to make a profit from their discounting action. In a situation where one-party discounts as a deviating strategy, the scenario that everyone loses profit becomes far more likely than that the discounter will gain profit.<sup>140</sup> This would allow undertakings to increase profits by raising their prices collectively, but not by competition on price.

Thus, applying this to the conditions for tacit collusion set out by Petit, the undertakings have gained a way of quickly retaliating against deviant behaviour.<sup>141</sup> Moreover, discounting would be generally disincentivized in a market where algorithms are active. This leads to increased stability and sustainability of the tacitly collusive scheme, even in a market where a greater number of competitors are active.

### 3.3.3. Algorithms & competitive constraints

The effect of algorithms on barriers to entry can have either pro- or anti-competitive effects on a market. On the one hand, algorithms might lower barriers to entry for retailers. On the other hand, in a market where undertakings are tacitly colluding through their algorithmic agents, the opposite is far more likely.<sup>142</sup> In the first case, algorithms to which retailers have the possibility to subscribe could allow for lower barriers of entry to retailers in a new market. Because it reduces the amount of knowledge needed about the specific market to create an effective pricing strategy. Furthermore, existing retailers could also use it to broaden their product market, since the algorithm can set prices for a larger number of different products, which would lead to more competition on the market.<sup>143</sup>

In the second case, the ability of algorithms to react swiftly to changes in the markets, as well as the likeliness of algorithms to have a similar response to such changes, allow for an artificial raising of barriers to entry.<sup>144</sup> There are two ways by which the algorithms can raise barriers to entry for new competitors. Firstly, in markets where there is already a high barrier to entry, due to economies of scale or scope and network effects, undertakings will likely already have a strong position in the market and a large collection

---

<sup>140</sup> Ezrachi, A, and Stucke, E., *Artificial Intelligence & Collusion: When Computers Inhibit Competition* [2015], University of Illinois Law Review, Vol. 2017. p. 1792

<sup>141</sup> Petit, N., *The Oligopoly Problem in EU Competition Law* [2012], Research Handbook in European Competition Law 2012, p. 2

<sup>142</sup> OECD, *Algorithms and collusion – background note by the secretariat* [2017], DAF/COMP(2017/4), par. 5

<sup>143</sup> Oxera, *When algorithms set prices: winners and losers* [2017], Oxera discussion paper of 19 June 2017, p. 16

<sup>144</sup> Ezrachi, A, and Stucke, E., *Artificial Intelligence & Collusion: When Computers Inhibit Competition* [2015], University of Illinois Law Review, Vol. 2017. p, 1795-1796

of market data. The latter would allow for the engineering of a more efficient algorithm.<sup>145</sup> This would widen the gap between established undertakings and new entrants, since new entrants would have to start this process of data-collection and the engineering of an algorithm before being able to compete efficiently. This is called the data-driven barrier to entry.<sup>146</sup>

Secondly, the capacity of algorithms to respond quickly to changes on the market allows for a swift and similar reaction to a new entrant onto the market, even in a market with a larger number of players than an oligopolistic market. This allows the algorithms to raise artificial barriers of entry.<sup>147</sup> Through the use of predictive analysis, the algorithms can prepare a response already before the new competitor enters upon the market. This response can work in two ways: the incumbents on the market can either respond by pre-emptively acquire any potential competitors, or by reacting aggressively to the market entry.<sup>148</sup>

However, the possibility to raise artificial barriers to entry, as well the data-driven barrier to entry, are subjected to some limitations. When a market already has low barriers to entry, the algorithms will most likely not be able to effectively refuse players entry to the market.<sup>149</sup> Nonetheless, it is considered highly likely in the literature that the algorithms will have an anti-competitive effect on competitive constraints, instead of a pro-competitive effect for new entrants upon the market.<sup>150</sup>

For competitive constraints by small players, the effects of algorithmic collusion are also twofold. On the one hand, due to the advances in data collection, the engineering and implementation of algorithms, pricing algorithms will become less costly and more accessible for small firms in less concentrated industries.<sup>151</sup> On the other hand, larger firms will be able to invest more money in research and development, data-collection and improving the algorithm. This will allow the larger undertakings to

---

<sup>145</sup> OECD, *Algorithms and collusion – background note by the secretariat* [2017], DAF/COMP(2017/4), par. 42

<sup>146</sup> *Ibid.*, par. 44

<sup>147</sup> Ezrachi, A, and Stucke, .E., *Artificial Intelligence & Collusion: When Computers Inhibit Competition* [2015], University of Illinois Law Review, Vol. 2017, p. 1792, 1795, 1796.

<sup>148</sup> OECD, *Algorithms and collusion – background note by the secretariat* [2017], DAF/COMP(2017/4), para. 42, 47

<sup>149</sup> Li S. & Xie C., *Rise of the machines: Emerging antitrust issues relating to algorithm bias and automation* [2017], The Civil Practice & Procedure Committee's Young Lawyers Advisory Panel: Perspectives in Antitrust, Volume 5, Number 3, p. 3

<sup>150</sup> OECD, *Algorithms and collusion – background note by the secretariat* [2017], DAF/COMP(2017/4), para. 42, 47; Ezrachi, A, and Stucke, .E., *Artificial Intelligence & Collusion: When Computers Inhibit Competition* [2015], University of Illinois Law Review, Vol. 2017. p, 1795

<sup>151</sup> Li S. & Xie C., *Rise of the machines: Emerging antitrust issues relating to algorithm bias and automation* [2017], The Civil Practice & Procedure Committee's Young Lawyers Advisory Panel: Perspectives in Antitrust, Volume 5, Number 3, p. 5

engage in a more efficient pricing strategy.<sup>152</sup> Moreover, as discussed in the previous chapters, the algorithms will allow tacit collusion between a greater number of players, which can also diminish the competitive restraints offered by small players. When small players do not reduce the stability of the collusive behaviour, but instead adopt the same pricing strategy and join the collusive scheme, they will not generate pro-competitive effects.<sup>153</sup>

### 3.4. Conclusion

The analysis shows that algorithms possess the capabilities to facilitate a stronger form of tacit collusion. When summarizing the effects of algorithms on the characteristics of the market, the OECD has created the following table:

Relevant factors for collusion		Impact of algorithms on the likelihood of collusion
Structural characteristics	Number of firms	±
	Barriers to entry	±
	Market transparency	+
	Frequency of interaction	+
Demand variables	Demand growth	0
	Demand fluctuations	0
Supply variables	Innovation	-
	Cost asymmetry	-

*Note:* + positive impact; - negative impact; 0 neutral impact; ± ambiguous impact.

Table 1. OECD overview of effects of algorithms on the market.<sup>154</sup>

The analysis has shown that the implementation of algorithms enhances the conditions under which tacit collusion can occur. Firstly, it may take place between a greater number of firms. Secondly, the possibility to monitor competition effectively and acquire a mutual understanding on the common price is increased. Thirdly, algorithms allow the punishing of deviations by existing market players and diminish competitive restraints. Algorithms also facilitate in raising barriers to entry for new entrants in the market. Moreover,

<sup>152</sup> OECD, *Algorithms and collusion – background note by the secretariat* [2017], DAF/COMP(2017/4), par. 51; Li S. & Xie C., *Rise of the machines: Emerging antitrust issues relating to algorithm bias and automation* [2017], The Civil Practice & Procedure Committee’s Young Lawyers Advisory Panel: Perspectives in Antitrust, Volume 5, Number 3, p. 2

<sup>153</sup> Whish, R., and D. Bailey, *Competition Law* (8<sup>th</sup> edition, Oxford University Press 2015), p. 598

<sup>154</sup> OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD <[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018, p.22

the stability of the collusive scheme will be improved by the elimination of human biases and the necessity of trust, as well as a greater chance of like-minded agents operating on the market.<sup>155</sup>

The rationale behind the legality of tacit collusion seems to be substantively affected by algorithms. The idea that tacit collusion would almost never happen in a market of four players no longer holds true, since tacit collusion will be possible between more players on a market. Moreover, the interdependence between competitors on the market will grow due to the increased frequency of interaction and monitoring capabilities. The increased transparency and stability of collusive behaviour may also lead to an increase in tacit collusion in practice. Finally, the competitive restraints offered by small players and new entrants on the market will be diminished. These changes hold true especially in the scenario where the use of the Digital Eye algorithm is widespread, but also apply to a widespread use of a predictable agent algorithm.

In light of these developments, the legality of tacit collusion seems to have lost its foundation in economic rationale, as discussed in chapter 2.2. The upcoming chapter will discuss whether this development should change the existing views on the legality of tacit collusion.

---

<sup>155</sup> As seen in chapter 3.2. and 3.3.

## 4. The consequences of algorithms on the legality of tacit collusion

In the previous chapter the changing notions surrounding tacit collusion have been analysed and discussed. From here, this research will have a prospective focus. It will focus on the legal consequences of the shifted notions surrounding algorithmic collusion. The European Commission has already joined the discussion on the effects of algorithms on tacit collusion. In the roundtable with the OECD, the Commission sets out four routes which can be taken when dealing with algorithmic collusion.

The first route would be to wait and examine whether or not algorithmic pricing is indeed making tacit collusion more prevalent and efficient.<sup>156</sup> A second route is to wait for the market to respond with counter-measures to defeat algorithmic collusion. However, the Commission notes that such counter-measures may arrive too late or not at all.<sup>157</sup> The third route would be an expansion of the notion of communication by arguing that the repeated interaction between two firms allows them to decode each other. However, the Commission does not deem it obvious that this behaviour would fall under the definition of communication under existing case law. After all, undertakings hold the right to respond intelligently and there is no actual communication between them when tacitly colluding through algorithms.<sup>158</sup> The fourth and final route that could be taken is the prohibition of tacit collusion. However, the Commission notes that it must be ensured that this still leaves a possibility to create a sensible and enforceable antitrust rule which still allows intelligent competition.<sup>159</sup>

Therefore, this chapter will contain an analysis of the possible routes set out by the Commission and conclude with a recommendation on which route to take. The first two routes will not be explored in-depth, since this research aims to provide a durable, legal and certain solution for a scenario where the effects of algorithmic collusion set out by Ezrachi & Stucke come into existence.

In order to explore which legal route the Commission should take, the focus of chapter 4.1 will be on information exchange and when it constitutes a concerted practice. The aim of this analysis is to discover why the Commission has chosen to include certain types of information exchange as a concerted practice and to what extent this shows parallels with tacit collusion in the form of algorithmic collusion. In 4.2. the route to expand the definition of communication will be explored. 4.3. will discuss the route where tacit collusion is prohibited. In 4.4. the enforceability of a prohibition of tacit collusion, as well as its effects on

---

<sup>156</sup> OECD, *Algorithms and collusion – note from the European Union* [2017], DAF/COMP(2017)12, par. 30

<sup>157</sup> *Ibid.*, par. 31 - 32

<sup>158</sup> *Ibid.*, par. 33

<sup>159</sup> *Ibid.*, par. 34

the right to freely conduct oneself on the market will be discussed.<sup>160</sup> Finally, in 4.5., a conclusion will be provided.

#### 4.1. Exploring the rationale behind information exchange as a concerted practice

To explain the importance of discussing information exchange in the context of the changing notions surrounding tacit collusion, the Court's reasoning in *Zuchner v. Bayerische Vereinsbank* is central. In this case the Court stated that direct or indirect communication between parties is central in the decision on whether similar behaviour between undertakings can be considered legal parallel behaviour or a concerted practice.<sup>161</sup> Thus, communication between undertakings is definitive regarding the legality of coordinated behaviour. Even though tacit collusion and concerted practices both bring harmful effects to consumer welfare, the latter is seen as an illegal restriction on competition, whereas the first is deemed legal.<sup>162</sup>

With respect to the debate on whether information exchange leads to a concerted practice, both the Commission and the Court have set out several conditions of the information exchange. Therefore, in this subchapter the focus will lie on the rationale behind considering some forms of information exchange a concerted practice.

##### 4.1.1. The Commission's notions on information exchange as a concerted practice

The Commission Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements (hereafter: The Guidelines) discuss information exchange as a concerted practice from paragraph 58 of the Guidelines and onwards.<sup>163</sup>

The Commission considers certain exchanges of information to constitute a concerted practice.<sup>164</sup>

The Commission Guidelines specify that information exchanges are viewed as problematic when part of an agreement, concerted practice or a decision by an association of undertakings.<sup>165</sup> To define when a concerted practice exists, the Guidelines refer to relevant case law, the definition is as follows: "*a form of coordination between undertakings by which, without it having reached the stage where an agreement*

---

<sup>160</sup> Charter of fundamental rights for the European Union, article 16 (the Charter)

<sup>161</sup> OECD, *Algorithms and collusion – note from the European Union* [2017], DAF/COMP(2017)12, par. 21 & 22.

<sup>162</sup> Freed, M. et al, *The detection and punishment of tacit collusion* [1997], *Loyal Consumer Law Review*, p. 153 - 158

<sup>163</sup> European Commission, *Commission Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements*, 2011/C 11/01, 14 January 2011, par. 59

<sup>164</sup> *Ibid.*, par. 59

<sup>165</sup> *Ibid.*, par. 60

*properly so-called has been concluded, practical cooperation between them is knowingly substituted for the risks of competition*".<sup>166</sup> The criteria of cooperation and coordination are necessary to establish a concerted practice. However, there is no need to have worked out an actual plan, since the criteria are rather to be understood in the light of the Treaty. This entails that each company must determine independently the policy which it intends to adopt on the internal market, as well as the conditions under which it offers its goods to customers and consumers.<sup>167</sup>

According to the Guidelines, coordination as mentioned above exists when there is direct or indirect contact between competitors, with the object or effect to create conditions of competition which do not correspond with the normal competitive conditions of the market.<sup>168</sup> Hence, the exchange of information can constitute a concerted practice if it creates reduced strategic uncertainty.<sup>169</sup> The restriction of competition is especially relevant when it is liable to make undertakings aware of the marketing strategies of their competitors. The competitive outcome depends on factors such as market concentration, transparency, stability, symmetry and complexity, as well as the type of information which is exchanged.<sup>170</sup> The foregoing analysis shows that a diminished independence of an undertaking in decision making, as well as the reduction of strategic uncertainty, are central to the question if a concerted practice exists.<sup>171</sup>

One aspect of a market that is central to the reduction of strategic uncertainty is market transparency. The Commission mentions specifically that by *"artificially increasing transparency in the market, the exchange of strategic information can facilitate coordination of companies' competitive behaviour and result in restrictive effect on competition"*. The Commission considers such a behaviour to be collusive.<sup>172</sup> The Commission mentions specific concerns arising from this increased transparency by exchanging information. Firstly, it may lead undertakings to come to a common understanding on the terms of coordination, creating mutually consistent expectations regarding the usual uncertainties in the

---

<sup>166</sup> Ibid., par. 60; Case C-8/08, *T-Mobile Netherlands and Others v. Nederlandse Mededingingsautoriteit* EU:C:2009:343 [2009], Ecr I-04529, par. 26; Joined Cases C-89/85 and others, *Wood Pulp*, [1993] ECR 1307, par. 63.

<sup>167</sup> European Commission, *Commission Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements*, 2011/C 11/01, 14 January 2011, par. 60

<sup>168</sup> Ibid., par. 61

<sup>169</sup> Ibid., par. 61

<sup>170</sup> Ibid., par. 58

<sup>171</sup> Ibid., par. 61

<sup>172</sup> Ibid., par.64 - 65

market.<sup>173</sup> Secondly, the internal stability of the collusive behaviour will increase, by efficient monitoring of competitors' behaviour and the possibility to retaliate against deviations.<sup>174</sup> Finally, the external stability may be improved by allowing undertakings to collectively raise barriers to entry for new entrants into the market.<sup>175</sup>

These concerns, as set out by the Commission regarding information exchange, show a clear parallel with the concerns arising from tacit collusion through algorithms as discussed in chapter 3.3. The central underlying concern in both situations is that the behaviour will affect the characteristics of the market. It is more likely that undertakings collude in a market in which there is sufficient transparency, concentration, non-complexity, stability and symmetry. Thus, both information exchange and algorithms may alter market conditions to facilitate coordination.<sup>176</sup>

Another important aspect of information exchange is the type of data which is exchanged and the frequency with which it is exchanged. The Commission defines data which concerns prices and quantities as most strategic, followed by supply and demand. Information that covers future behaviour is also always more strategic than past or even present data, even though the exchange of present data still raises concerns about collusion faster than the exchange of historic data.<sup>177</sup> Therefore, when such information is exchanged, this may sooner lead to a concerted practice. A more frequent exchange of information will lead to a better common understanding of the market practice, which will, especially in normally unstable markets, facilitate a collusive outcome. Specifically, the frequent exchange of strategic data is a cause for concern for the legality of the exchanging of information.<sup>178</sup>

In this aspect of information exchange, the author again finds a parallel between the concerns of the Commission about information exchange and the effects that algorithms have on market conditions. Through constant monitoring by algorithms they provide a frequent update on prices by competitors and yields undertakings with a near zero lag response in adjusting to these prices. Therefore, although information is not exchanged, the effects on possibilities to coordinate would be similar as exchanging

---

<sup>173</sup> Ibid., par. 65 - 66

<sup>174</sup> Ibid., par. 67

<sup>175</sup> Ibid., par. 68

<sup>176</sup> Ibid., par. 78

<sup>177</sup> Ibid., par. 86

<sup>178</sup> Ibid., par. 91



present data. When this data is used for the predictive analysis, it shows parallel with data-exchange on future behaviours.

#### 4.1.2. Case law on information exchange

The fact that the Commission and the Court do not always agree on when information exchange may lead to a concerted practice was demonstrated in the landmark case *Wood Pulp*. In this case, the Commission Decision stated that an infringement consisted of concertation of prices between competitors. This decision was made on the basis of quarterly numbers to customers inside the EU, price recommendations by the Pulp, Paper and Paperboard Export Association of the US and the exchange of individualized data concerning prices of other wood pulp producers.<sup>179</sup> Thus, the Commission based their decision that a concerted practice existed on the basis of direct and indirect exchange of information about prices. However, in this case the CJEU decided that undertakings are allowed to exchange genuine public information with their competitors, as long as there is no commercially sensitive data involved.<sup>180</sup> In order to provide a complete image, it is therefore of vital importance to discuss when -and why- the Court considers information exchange to lead to a concerted practice.

The Court has decided on the importance of direct or indirect communication in a concerted practice in *Zuchner v. Bayerische Vereinsbank*.<sup>181</sup> Since then, the Court has seen multiple cases in which it considered information exchange to constitute a concerted practice. One notable aspect of these judgements is that the Court is not restrictive in its interpretation of when information exchange leads to a concerted practice. In the *T-mobile* case, the Court considered that one moment of contact between competitors in which strategic information is exchanged can already constitute a concerted practice, even if there is no clear effect on the price in the market.<sup>182</sup> Moreover, according to the *Cement* cases, the mere receiving of information may already lead to a concerted practice.<sup>183</sup> In *Treuhand*, it was decided that passive modes

---

<sup>179</sup> Joined Cases C-89, 104, 114, 116, 117 and 125-129/85, *A Ablström oy v Commission*, EU:C:1988:447, [1988], Ecr I-03793 (*Wood Pulp*), par. 3

<sup>180</sup> *Ibid.*, par. 59-65.

<sup>181</sup> Case C-172/80 *Zuchner v Bayerische Vereinsbank AG* EU:C:1981:178 [1981], Ecr. I-2021 (*Zuchner v. Bayerische Vereinsbank*, par. 21 & 22.

<sup>182</sup> Case C-8/08, *T-Mobile Netherlands and Others v. Nederlandse Mededingingsautoriteit* EU:C:2009:343 [2009], Ecr I-04529 (*T-Mobile*), par. 23

<sup>183</sup> Case T-25/95 etc., *Cimenteries CBR SA v. Commission* EU:T:2000:77 [2000], Ecr II-2667 (*Cement cases*); Whish, R., and D. Bailey, *Competition Law* (8<sup>th</sup> edition, Oxford University Press 2015), p. 118

of participation may lead to concertation as well.<sup>184</sup> This shows that even minor exchanges of information may lead to a concerted practice according to the Court.

The reason why communication between undertakings can be considered a concerted practice is explained in case law through multiple cases. In 1998, the Court decided in the *John Deere* case, which explains the role of information exchange was central in concertation. In this case an information exchange system was put in place, by which parties could be updated on past and present data. The CJEU agreed with the Court of first instance that “*This information exchange system reduces or removes the degree of uncertainty as to the operation of the market and that the system is therefore liable to have an adverse effect on competition between manufacturers*”.<sup>185</sup> This reduced uncertainty is an aspect that is central to concertation. The Court repeated that the exchange of information was incompatible with competition law if it leads to reduced uncertainty in *T-Mobile*, as well as in the *Dole Food* case.<sup>186</sup>

The Court also explains in different cases which characteristics of information exchange cause competitive concerns. For instance, in *John Deere*, the frequency with which information was exchanged was of crucial importance. The Court states specifically that “*the information on sales was disseminated systematically and with short intervals...to exclusion of suppliers*”.<sup>187</sup> Through frequent exchange of information the undertakings have the capacity to deduct a common path of price changes.<sup>188</sup> The Court also explained what the role of information exchange was in creating the anti-competitive behaviour. About this, the Court stated “*that if there were no information exchange system all the registration data exchanged might not be obtainable at the same level of quality and with the same frequency by individual market research or through a market research company.*”<sup>189</sup> This statement could be linked to algorithmic collusion as well. The Court reasoned that information exchange is an important condition to constitute a concerted practice, since the same amount of information could not be obtained by monitoring competition. However, the increased transparency and monitoring capabilities that algorithms provide, may lead competitors to harvest a similar amount of information without the exchange of information. Thus, algorithmic collusion could substitute the necessity for information exchange.<sup>190</sup>

---

<sup>184</sup> Case C-194/14, *AC-Treuhand v Commission* EU:C:2015:717 [2015] (Treuhand), par. 31

<sup>185</sup> Case T – 35/92 *John Deere Ltd v Commission* EU:T:1994:259, [1994], Ecr II-00957 (*John Deere*), par. 90

<sup>186</sup> Case C-8/08, *T-Mobile Netherlands and Others v. Nederlandse Mededingingsautoriteit* EU:C:2009:343 [2009], Ecr I-04529, par. 35; Case C-286/13P, *Dole Food Company v. European Commission* EU:C:2015:184 [2015], par. 110

<sup>187</sup> Case T – 35/92 *John Deere Ltd v Commission* EU:T:1994:259, [1994], Ecr II-00957 (*John Deere*), par. 89

<sup>188</sup> *Ibid.*, par. 90

<sup>189</sup> *Ibid.*, par. 125 - 126

<sup>190</sup> Conclusion of the author

A second characteristic of the exchange of information that the Court identified in *John Deere* was the age of the data. In fact, The Court stated that historic data which was older than a year would be safe to exchange, whereas a concerted practice could be constituted through recent and present data, besides data on future behaviour.<sup>191</sup> This supports the idea that the constant monitoring by algorithms of present data would create an equally unwanted competitive effect, since this would result in a constant mutual harvesting of present data.

A final judgement which will be discussed to explore the Court's rationale behind considering the exchange of information is the recent *Eturas* case.<sup>192</sup> In this case, an automated discount recommendation system was implemented by multiple competitors.<sup>193</sup> The E-turas system sent messages between competitors which resulted in an automatic 3% discount rate, this would be automatically applied to all undertakings, unless the undertakings opted out.<sup>194</sup> In this case the Court clarified its position on the presumption of innocence regarding concerted practices. In *T-Mobile* the Court took a harsh stance on the exchange of information, stating that a concerted practice by attending meetings may even exist if there is no direct effect on prices.<sup>195</sup> In *Eturas* however, the Court stated that the mere fact that a message has been sent out did not necessarily lead to a presumption that an undertaking had taken part in a concerted practice.

The Court stated here that if the national courts had doubts that the competitors had been aware of the message, the presumption of innocence precluded the national courts from deciding that the recipients of the message had been aware.<sup>196</sup> However, due to the principle of effectiveness, national courts are allowed to presume that recipients of the message were aware of the message if there are indicia to support this. Indicia, in the form of circumstantial evidence, would allow the court to apply a rebuttable presumption that the recipient was aware of the message, even in the absence of hard evidence.<sup>197</sup> The

---

<sup>191</sup> Case T – 35/92 *John Deere Ltd v Commission* EU:T:1994:259, [1994], Ecr II-00957 (*John Deere*), par. 81 - 89

<sup>192</sup> Case C-74/14, *Eturas and others v. 'the Competition Council' of Lithuania* EU:C:2016:42 [2016], (*Eturas*)

<sup>193</sup> *Ibid.*, par. 42 - 50

<sup>194</sup> *Ibid.*, par. 42 - 50

<sup>195</sup> Case C-8/08, *T-Mobile Netherlands and Others v. Nederlandse Mededingingsautoriteit* EU:C:2009:343 [2009], Ecr I-04529, par. 51 - 53

<sup>196</sup> Villani, L., *The E-Turas case: When concerted practices meet technology* [2016], (Eurojus

<<http://rivista.eurojus.it/the-e-turas-case-when-concerted-practices-meet-technology>> accessed on 2 May 2018)

<sup>197</sup> Case C-74/14, *Eturas and others v. 'the Competition Council' of Lithuania* EU:C:2016:42 [2016], (*Eturas*), par. 39 -

Court decided that the fact that the discount of 3% was applied automatically was important to the case. Due to this automatic application, the recipients that were aware of the message are considered to partake in a concerted practice unless they opt out of the discount.<sup>198</sup> This is due to the fact that undertakings would know that if they accepted the automatic adjustment, their competitors would do the same, resulting in cooperation.<sup>199</sup>

This decision in *Eturas* raises the following question about algorithmic collusion: When undertakings are aware that multiple competitors' algorithms are following their same strategy, and this can be made plausible through indicia, would the presumption set out in *Eturas* still apply? This will be discussed in chapter 4.4.

#### 4.1.3. Interim conclusions on the rationale behind concertation to information exchange and algorithmic collusion

The author aims to show by the analysis above that, although algorithms do not exchange information between one another, the practical effects of the use of algorithms on the characteristics of the market are highly similar. The rationale which was used to consider information exchange a concerted practice is linked to changes in the characteristics of the market. The Guidelines considers information exchange to be problematic when it is used to artificially raise transparency on the market, with the consequence that competitors create a mutual understanding and coordinate their behaviour accordingly. The main anti-competitive effects of this coordination are the creation of a mutual understanding on what conduct will happen in unexpected situations and the improved internal and external stability of the cartel.<sup>200</sup> When reading the judgements of the Court, it shows that the Court has placed the information exchange as a central component in competitors' capacity to achieve these anti-competitive effects.

According to *John Deere*, the role of information exchange was crucial since undertakings could harvest sufficient data to establish the mutual understanding without it.<sup>201</sup> However, when information exchange

---

<sup>198</sup> Ibid., par. 42 - 45

<sup>199</sup> Villani, L., *The E-Turas case: When concerted practices meet technology* [2016], (Eurojus <<http://rivista.eurojus.it/the-e-turas-case-when-concerted-practices-meet-technology>> accessed on 2 May 2018)

<sup>200</sup> European Commission, *Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements*, 2011/C 11/01, 14 January 2011 par. 61 - 65

<sup>201</sup> Case T – 35/92 *John Deere Ltd v Commission* EU:T:1994:259, [1994], Ecr II-00957 (*John Deere*), par. 125 - 126

had taken place, the Court has shown a strict approach in *T-Mobile, Eturas* and *Dole Food*.<sup>202</sup> Therefore, the following will be argued in this research: *When algorithms provide stable coordination between undertakings, either through an exchange of information or without an exchange of information by equally effective means, such coordinated behaviour should be considered as a concerted practice.*

Therefore, the discussion will revolve around the question what the legal consequences should be. The Commission may choose to either expand the definition of communication, or to prohibit tacit collusion altogether.

#### 4.2. Expanding the definition of communication

To start the discussion on expanding the definition of communication to capture algorithms, the effects of algorithmic collusion on the market characteristics will be recapitulated. Algorithms create an artificial transparency of a market by constant monitoring of competition. The increase in transparency, as well as the coordination of conduct, does in fact lead to diminished strategic uncertainty.<sup>203</sup> Especially in the case of the Digital Eye, where misconceptions on deviations are eliminated. This in turn leads to a more stable cartel internally, where deviations are punished swiftly and efficiently, algorithms separate natural movements of the market and deviations without interference of human biases.<sup>204</sup> The external stability of the collusion is increased as well. The data-driven barriers to entry, combined with the use of predictive analysis, allow the algorithms to raise artificial barriers to entry on the market.<sup>205</sup> The monitoring of algorithms provide a constant stream of present data on prices. In case of the digital eye, this may even extend beyond prices to organizational practices of competitors.<sup>206</sup> Moreover, it has been discussed that algorithms will likely be implemented in a large part of the market, since failure to adopt similar algorithms will likely lead to leaving the market.<sup>207</sup>

---

<sup>202</sup> Case C-8/08, *T-Mobile Netherlands and Others v. Nederlandse Mededingingsautoriteit* EU:C:2009:343 [2009], Ecr I-04529, par. 35; Case C-286/13P, *Dole Food Company v. European Commission* EU:C:2015:184 [2015], par. 110

<sup>203</sup> OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD <[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018, par. 61 - 62

<sup>204</sup> *Ibid.* par. 61 - 62

<sup>205</sup> *Ibid.* par. 68

<sup>206</sup> *Ibid.* par. 67

<sup>207</sup> *Ibid.* par. 69 - 71

Therefore, from the rationale behind the classification of some forms of information exchange as concerted practice, it would seem that algorithmic collusion meets all these criteria. Due to the applicable rationale, it would not be surprising if the prohibition of exchange of information could catch algorithmic collusion under its scope in the future. This is supported by the fact that the Guidelines contain a non-exhaustive list in the manner in which information exchange may lead to a concerted practice.<sup>208</sup> Moreover, the Commission has been shifting from a formalistic to an economic approach to competition law already for years.<sup>209</sup> Therefore, it would make sense for the Commission to expand the definition of communication to algorithmic collusion as well, if the effects of this behaviour have the same economic effects as the exchange of (strategic) information.

However, the Commission has already commented that algorithmic collusion would not fall within the current definition of information exchange. After all, there is no actual exchange of information. In order to solve this, the Commission has introduced the notion that the mutual decoding of algorithms may lead to concertation through communication.<sup>210</sup> However, it is the Court who decides if mutual decoding can be considered communication.

In light of the rationale behind considering information exchange to constitute a concerted practice in some instances, it seems plausible that the Court would accept algorithmic collusion as a form of communication. When looking at the theories of harm, it is possible that the excessive monitoring of competition by algorithms leads to a practical form of coordination, which replaces competition.<sup>211</sup> This in turn raises the question whether the terms under which competitors operate will still be considered as 'normal market conditions'. Since the transparency has been raised artificially by the monitoring behaviour and the consequent tacit collusion may lead to supra-competitive pricing and decreased strategic uncertainty.<sup>212</sup> The implementation of algorithms may mean that the exchange of information is no longer a necessity to obtain the amount and quality of data which is necessary to achieve these effects, as was discussed in *John Deere*.<sup>213</sup> Thus, the effects that have led to information exchange being classified

---

<sup>208</sup> Ibid. par. 62

<sup>209</sup> Schmidtchen D. et al, *The More Economic approach to European Competition Law* (1<sup>st</sup> edition, Hart Publishing 2017), p. 37 - 59

<sup>210</sup> OECD, *Algorithms and collusion – note from the European Union* [2017], DAF/COMP(2017)12, para. 33

<sup>211</sup> Case C-48/69, *Imperial Chemical Industries Ltd v Commission* EU:C:1972:70 [1972], Ecr I-619 (*Dyestuffs*), par. 63 - 66

<sup>212</sup> Joined Cases 40 to 48, 50, 54 to 56, 111, 113 and 114/73, *Suiker Unie v Commission* EU:C:1975:174 [1975] ECR I-1663, (*Suiker Unie*), para. 1942; Case C-286/13P, *Dole Food Company v. European Commission, Opinion of AG Kokott* EU:C:2014:2437], par. 110 - 113

<sup>213</sup> Case T – 35/92 *John Deere Ltd v Commission* EU:T:1994:259, [1994], Ecr II-00957 (*John Deere*), par. 90, 120 -125

as possibly leading to a concerted practice, may also apply to algorithmic collusion. Furthermore, the Court also stated that concerted practices may arise in any form or shape, and that the Court has always been careful in defining or limiting what may amount to a concerted practice.<sup>214</sup> Within EU competition law, the Court has often interpreted definitions broadly in order to modernize EU competition law. It did so, for example, when it interpreted EU law as to include information exchange possibly leading to a concerted practice.<sup>215</sup> It did so as well as with the expansion of information to exchanging information with merely receiving information in the *Cement* cases.<sup>216</sup> Competition law has been subjected to changing definitions and scope since the implementation of the article, since it was never drafted to be exhaustive, but as all EU law, should be interpreted in light of its goals and objectives.<sup>217</sup> It can be argued that algorithmic collusion qualifies as a passive mode of participating in coordinated behaviour, by receiving information from competitors, which leads to altered market conditions. Such an expansion of the definition of communication may be accepted by the court, in light of its broad interpretation of information exchange in the *Cement* and *Treuhand* cases.<sup>218</sup>

The CJEU has however shown already in *Wood Pulp*, that it will not accept any reasoning given by the European Commission. Moreover, the reduction of strategic uncertainty is an ambiguous concept. Every action undertaken by players competing on the market to gather information, which will support their pricing strategy, can be seen as to reduce strategic uncertainty to some extent. This reduction of strategic uncertainty may very well happen on unilateral basis and does not necessarily lead to any anti-competitive effects. The gathering of such information is a normal part of conducting a business.

Therefore, in the eyes of the author, some things are of vital importance for the Commission if they wish to argue an expansion of the definition of communication before the CJEU. Firstly, the evidence that the excessive monitoring has led to reduced uncertainty must be clear and unambiguous. This reduced

---

<sup>214</sup> Case C-288/94, *Argos distributors Ltd v. Office of Fair Trading v. Commissioners of customs & excise* EU:C:1996:398 [1996], Ecr I-5311 (Argos Ltd.), par. 22

<sup>215</sup> Joined cases 56 and 58/64, *établissement Consten SARL v. Grundig-Verkaufs GmbH* EU:C:1966:41, [1966], Ecr. I-299, par. 319

<sup>216</sup> Case T-25/95 etc., *Cimenteries CBR SA v. Commission* EU:T:2000:77 [2000], Ecr II-2667 (*Cement cases*); Whish, R., and D. Bailey, *Competition Law* (8<sup>th</sup> edition, Oxford University Press 2015), p. 118

<sup>217</sup> Case C-283/81, *CILFIT v. Ministry of Health & Lanificio di Gavardo Spa* EU:C:1982:335 [1982], Ecr I-3415 (Cilfit), para. 20.

<sup>218</sup> Case T-25/95 etc., *Cimenteries CBR SA v. Commission* EU:T:2000:77 [2000], Ecr II-2667 (*Cement cases*); Whish, R., and D. Bailey, *Competition Law* (8<sup>th</sup> edition, Oxford University Press 2015), p. 118; Case C-194/14, *AC-Treuhand v Commission* EU:C:2015:717 [2015] (*Treuhand*), par. 31

uncertainty must be reflected by market conditions which have been altered from the normal market conditions. These conditions include an artificial increase of transparency and a stable collusive scheme which has led to supra-competitive pricing.<sup>219</sup> Secondly, it must be clear that this reduction of strategic uncertainty has been caused by the implementation of algorithms on a large part of the market, which mutually decoded each other's conduct and have begun coordinating their behaviour, and that this similar behaviour would not be possible without the implementation of such algorithms.<sup>220</sup> If it can be proven that the anti-competitive effects have a direct causal link with the mutual decoding of algorithms by one another, it is not unthinkable that the Court may consider this a form of communication.<sup>221</sup>

There are however some questions that arise from this conclusion. Firstly, what level of algorithmic collusion would constitute a concerted practice? Is the expansion of the definition of communication really useful when enforcement challenges exist in the gathering of evidence and auditing the algorithms?<sup>222</sup> Secondly, if algorithms merely facilitate tacit collusion in a highly efficient form, is it not more logical to re-evaluate the legality of tacit collusion in itself? After all, algorithms provide in a highly efficient form of tacit collusion, and not in a way for competitors to communicate between one another. Therefore, the discussion will continue on the topic of a prohibition of tacit collusion.

#### 4.3. Reconsidering the legality of tacit collusion

In order to discuss a prohibition of tacit collusion, it is important to remind the reader why tacit collusion is to be considered legal. The first argument is that tacit collusion did not occur often and was often unsustainable. The second argument is that it could only occur in homogeneous markets and the third argument is that small players and new entrants would offer competitive restraints.<sup>223</sup> Contrarily, the anti-competitive nature of tacit collusion has never been denied. As a matter of fact, the anti-competitive effects of creating market conditions for tacit collusion lay at the foundation of the Merger Control legislation. When looking at paragraph 22(b) of the Merger Control Guidelines, the Commission clearly

---

<sup>219</sup> Joined Cases 40 to 48, 50, 54 to 56, 111, 113 and 114/73, *Suiker Unie v Commission* EU:C:1975:174 [1975] ECR I-1663, (*Suiker Unie*), para. 1942; Case C-286/13P, *Dole Food Company v. European Commission, opinion of AG Kokott* EU:C:2014:2437 [2014], par. 110 – 113; Case C-48/69, *Imperial Chemical Industries Ltd v Commission* EU:C:1972:70 [1972], Ecr I-619, par. 66

<sup>220</sup> Case T – 35/92 *John Deere Ltd v Commission* EU:T:1994:259, [1994], Ecr II-00957 (*John Deere*), par. 90, 120 -125

<sup>221</sup> Case C-74/14, *Eturas and others v. 'the Competition Council' of Lithuania* EU:C:2016:42 [2016], (*Eturas*), par.42 - 43

<sup>222</sup> OECD, *Algorithmic Collusion: Problems and Counter-Measures - Note by A. Ezrachi & M. E. Stucke* [2017], DAF/COMP/WD(2017)25, p. 110

<sup>223</sup> OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD

<[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018, p. 34



states that the oligopolistic market structure is a concern due to the increased possibility of coordinating the raising of prices, as well as to facilitate in easier, more stable and more effective coordination.<sup>224</sup>

This begs the question: why does competition law focus so heavily on the prevention of tacit coordination under Merger Control *ex ante*, but excludes tacit collusion from falling under a concerted practice *ex post*? The author believes that the answer to this question lies in the Court's judgement in *Zuchner v. Bayerische Vereinsbank*, where it emphasized that undertakings retain the right to adapt intelligently.<sup>225</sup> Merger Control can prevent the creation of the conditions which facilitate tacit collusion, for which it is easier to base the case on facts and figures such as market concentration and the current market structure.<sup>226</sup> An *ex post* approach to combatting tacit collusion would be considered more restrictive on the free conduct of undertakings once they are active in the market on a day to day basis, since the undertaking could be subjected to proceedings under 101 TFEU at any time during their operations. Thus, in *Zuchner v. Bayerische vereinsbank*, the Court laid the focus on direct or indirect communication to decide if parallel behaviour could turn into a concerted practice.<sup>227</sup>

It can be questioned whether the central role of communication should still apply with the introduction of algorithms. The algorithms do not rely on information exchange to achieve the anti-competitive effects and stability of the collusion.<sup>228</sup> Therefore, the rationale that was once behind the legality of tacit collusion no longer seems true. Because of this, the author will claim here that the introduction of algorithms should lead to a normative change on how tacit collusion should be viewed. In order to argue this normative change, the author will borrow from the considerations of the Court in litigation under the Merger Control regulation.

The fundament of this reasoning starts with the judgement in *Salz & Kali*, where the Court decided that when deciding if a merger will lead to anti-competitive effects, such as collective dominance, the competition authorities must consider the objective situation as to what extent undertakings on the

---

<sup>224</sup> European Commission, *Commission Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings* (2004/C 31/03), 05 February 2004, par. 22

<sup>225</sup> Case C-172/80 *Zuchner v Bayerische Vereinsbank* AG EU:C:1981:178 [1981], Ecr. I-2021, para. 14

<sup>226</sup> European Commission, *Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings* (2004/C 31/03), par. 11

<sup>227</sup> Case C-172/80 *Zuchner v Bayerische Vereinsbank* AG EU:C:1981:178 [1981], Ecr. I-2021, para 14

<sup>228</sup> Petit, N., *The Oligopoly Problem in EU Competition Law* [2012], *Research Handbook in European Competition Law 2012*, p. 2 - 10; Ezrachi, A, and Stucke, .E., *Artificial Intelligence & Collusion: When Computers Inhibit Competition* [2015], *University of Illinois Law Review*, Vol. 2017, p. 1792

market have economic links to one another.<sup>229</sup> This was expanded upon in *Gencor*, where the Court stated that the notion of economic links should include the relationship of interdependence that exists between the undertakings. When the market has the characteristics in terms of market concentration, transparency and product homogeneity which place the undertakings in a position where they can anticipate one another's behaviour. Then the competitors on the market are strongly encouraged to align with each other's conduct in the market in a way which maximizes profit or sets their prices. In such a context, each trader is aware that a highly competitive action on their side would call for an identical reaction of their competition, so that it would not derive benefits from its competitive action.<sup>230</sup>

These considerations were the basis of the three-step test of the General Court as set out in *Airtours*: Firstly, as previously mentioned, transparency and reciprocal observation plays a role. It is not enough for competitors to realize that aligning their conduct would be profitable, but there must be a precise and quick way of knowing how the competitions market conduct is changing.<sup>231</sup> Secondly, the tacit collusion must be sustainable, meaning that there is a long-term incentive for collusion and that all the involved parties either benefit or can be punished for derogation.<sup>232</sup> Thirdly, there must be an obstacle to third parties entering the market and undercutting the colluders.<sup>233</sup> The Court considered explicitly in *Maritime Belge Transports* that for such circumstances to lead to a restriction on competition, no agreement as under 101 (1) TFEU is required, but that other links could suffice.<sup>234</sup> The author considers algorithms that facilitate in creating these conditions as to be such other links.

From this the following conclusions can be drawn: First, algorithms' mutual decoding and monitoring leads to a quick way of knowing how the competitors' market conduct changes, the algorithms create sustainable tacit collusion. Moreover, as confirmed by the OECD, in a market with high transparency and quick methods for price changing, collusion is nearly always more profitable than competition, thus a long-term incentive for tacit collusion is created.<sup>235</sup> Thirdly, the algorithms support the possibility to artificially raise barriers to entry and to disincentivize discounters. Consequentially, the author believes that the

---

<sup>229</sup> Joined cases C-68/94 and C-30/95, *France v. Commission* EU:C:1998:148 [1998], Ecr I-1375 (*Salz & Kali*), p. 157 - 159

<sup>230</sup> Case T-102/96, *Gencor v. Commission* EU:T:1999:65, [1999] Ecr. II-00753 (*Gencor*), p. 276

<sup>231</sup> Case T-342/99, *Airtours plc. v. Commission* EU:T:2004:192 [2004], Ecr. II-01785 (*Airtours*), p. 61

<sup>232</sup> *Ibid.*, p. 61 - 62

<sup>233</sup> *Ibid.*, p. 62

<sup>234</sup> Case C-395/96 *Compagnie Maritime Belge Transports v Commission* EU:C:2000:132 [2000], Ecr II-01201 (*Compagnie Maritime Belge*), p. 45

<sup>235</sup> OECD, *Algorithmic Collusion: Problems and Counter-Measures - Note by A. Ezrachi & M. E. Stucke* [2017], DAF/COMP/WD(2017)25, par. 14 and 15

difference between coordination where there is direct or indirect contact as prohibited under 101 (1) TFEU, and tacit collusion as dealt with under the Merger Control Regulation, will become diffuse with the widespread introduction of algorithms.

Second, with the introduction of algorithms, undertakings will likely have the capacity to collect data which can create a mutual certainty in tacit collusion to the level discussed in *John Deere* without the exchange of information.<sup>236</sup> Instead, the necessity of information exchange will be substituted by other economic links which facilitate the creation of interdependent pricing policies, specifically algorithms. Markets where algorithmic collusion as described by Ezrachi & Stucke is in effect, will likely fulfil the *Airtours* criteria as set out above. Thus, the author believes that it would be feasible to include an *ex post* counter measure against tacit collusion. It was once chosen to deal with tacit collusion through an *ex ante* approach, by tackling oligopolistic market structures. However, with the introduction of algorithms, tacit collusion will no longer be limited solely to the oligopolistic market structure. This means that the *ex ante* approach could be insufficient to deal with tacit collusion.<sup>237</sup>

In conclusion, the author argues that in light of the efficiency, applicability and stability of tacit collusion, there is reason to prohibit tacit collusion. To treat harmful tacit collusion in which algorithms are applied, differently from harmful tacit collusion where algorithms are not applied through expansion of the definition of communication, will only complicate matters. After all, tacit collusion is still collusion, and has also been considered to be harmful to consumer welfare in its classical sense.<sup>238</sup> Such a separation will merely lead to a difficult process for the Commission to enforce against algorithmic collusion, since this would lead to the difficult discussion when the monitoring by algorithms should be construed as information exchange, and when it should not. Besides this, the Commission would also need to explain the separation between one form of tacit collusion and the other, when the use of algorithms merely facilitates a more effective form of tacit collusion.<sup>239</sup>

---

<sup>236</sup> Case T – 35/92 *John Deere Ltd v Commission* EU:T:1994:259, [1994], Ecr II-00957 (*John Deere*), par. 90, 120 - 125

<sup>237</sup> Ezrachi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016), p. 16

<sup>238</sup> Freed, M. et al, *The detection and punishment of tacit collusion* [1997], *Loyal Consumer Law Review*, p. 153 - 158

<sup>239</sup> Ezrachi A. & Stucke M.E., *How pricing bots could form cartels and make things more expensive* [2016], *Harvard Business Review*

#### 4.4 Prohibiting tacit collusion: Enforceability, evidence and the consequences for competition

The conclusion that it is warranted to prohibit tacit collusion is a controversial one. As stated before, the discussion must also include arguments on the enforceability of such a decision. Moreover, it must remain possible for competitors to properly conduct an intelligent pricing strategy.

The discussion about the enforcement issues in a legal order where tacit collusion is prohibited has been highlighted in the Turner - Posner debate in light of the Sherman act.<sup>240</sup> According to Donald Turner, tacit collusion should not be considered to be restrictive for competition.<sup>241</sup> Turner states that the existence of an agreement is excluded if the responses of competitors on a market are to be considered natural and independent.<sup>242</sup> Turner worked from the principle that if tacit collusion were to be illegal, it was necessary that the decisions by the undertakings formed an unlawful agreement. Therefore, Turner argued that such an agreement would only exist if three conditions were fulfilled. First, the decisions taken by a player go against its own self-interest. This would mean the conduct of the company is part of a larger scheme. Secondly, the decision of one undertaking would influence the decisions of other undertakings, showing interdependence. Finally, the conduct occurs in order to protect or augment market power, instead of being aimed at the rational exploitation of the profit potential of the oligopoly position.<sup>243</sup> Thus, according to Turner, illegal collusion could only exist if interdependence was constituted to be an agreement, and such an agreement was deemed unlawful. At the end of Turner's proposition, it was concluded that there is no effective remedy against oligopolistic interdependence. Turner argued that the normal flow of the market of oligopolies tend to lead to tacit collusion. Therefore, any attempt to regulate such behaviour would end in a process of price regulation. This would go against the principle that the market should, as far as possible, move freely and without interference by the state.<sup>244</sup>

Posner took a position which opposed Turner's proposition. According to Posner, the oligopolistic market structure in itself does not lead to tacit collusion necessarily. Conversely, tacitly collusive behaviour leading to supra-competitive prices is conducted on a voluntary basis. According to Posner, both consist of elements related to cartels and the punishment for tacitly colluding should be the same as colluding

---

<sup>240</sup> Maya J.E.C., *The limitations on the punishability of tacit collusion in EU competition law* [2017], Rev. Derecho Competencia. Bogotá (Colombia), vol. 13 N° 13, p. 212 - 217

<sup>241</sup> Ibid. p. 212

<sup>242</sup> Ibid. p. 213

<sup>243</sup> Ibid. p. 214

<sup>244</sup> Ibid. p. 215

through agreements.<sup>245</sup> The first argument coined by Posner was that a meeting of the minds between competitors, where one firm restricts output or raises prices is making an offer. The competitor which then follows the same conduct, accepts that offer. Thus, tacit collusion should be punished as it is a concert of firms for the purpose of charging monopoly prices and extracting monopoly profits.<sup>246</sup> In EU law, the prohibition on the concerted practice already exists. However, where information exchange in EU law is central to finding an illegal concerted practice, Posner argued that there are other objective criteria on which the authorities could prove tacit collusion as well.<sup>247</sup> Posner argues that concertation of a market can be proven when there is a) a proven pattern of systematic price discrimination, b) prolonged excess of capacity over demand, c) a reduction of changes in the market price as it is infrequent under circumstances of firms competing on a normal basis, d) if there are unusual profits and price leadership e) market shares are fixed for a prolonged period of time or f) where there is a refusal to offer discounts in spite of excess capacity.<sup>248</sup>

When applied to EU law, the author deems Posner's arguments more convincing. Within EU law the concerted practice is already included, therefore, the proposition by Turner that an agreement must be at the basis of coordination does not apply. Moreover, economic theory as discussed in 2.2., shows that the oligopolistic market structure would naturally lead to an equilibrium. Tacit collusion is merely a method which companies use to break this equilibrium to pursue higher profits.<sup>249</sup> Therefore, the author agrees with Posner that tacit collusion is in fact a voluntary behaviour. Thus, the proposition by Posner to include objective criteria to prove tacit collusion will be explored further.

The criteria set out by Posner serve the purpose of establishing collusive behaviour without relying on information exchange. Within EU law the principle that competition should be on the basis of merits, by taking decisions with a sound economic rationale that respond to normal market conditions has been set out in case law.<sup>250</sup> Thus, it would be possible for the Commission to formulate certain conditions such as has been done by Posner. Conditions such as unusual profits and price leadership may be strong indicators

---

<sup>245</sup> Ibid. p. 215

<sup>246</sup> Ibid. p. 215 - 216

<sup>247</sup> Ibid., p. 216

<sup>248</sup> Ibid., p. 216

<sup>249</sup> Kreps, D., *A Course in Microeconomic Theory* (1<sup>st</sup> edition, Princeton University Press 1990), p. 326; Pindyck, R & Rubinfeld, D., *Microeconomics*, (8<sup>th</sup> edition, Pearson 2001), p. 438

<sup>250</sup> Case C-8/08, *T-Mobile Netherlands and Others v. Nederlandse Mededingingsautoriteit* EU:C:2009:343 [2009], Ecr I-04529 (*T-Mobile*), para. 32- 33

for tacit collusion through algorithms. The idea that algorithms would align their prices corresponds with the concept of price leadership, moreover, the possibility to raise prices to a supra-competitive level indicates that there would be unusual profits.<sup>251</sup> The possibility for algorithms to raise artificial barriers of entry for new competitors may also be seen as an indication. When barriers to entry are otherwise low, but there is no new entrant upon the market for a prolonged period of time, that would correspond with fixed market shares.<sup>252</sup> The final example by the author would be the disincentivizing of discounters through algorithmic collusion. This has been treated extensively by Ezrachi & Stucke and corresponds with the final criterion set out by Posner.<sup>253</sup> The examples provided by the author are not intended to provide an exhaustive list, but instead aim to highlight the possibility to formulate criteria which can be used to assess the anti-competitive effects of tacit collusion.

In conclusion, the author believes that a prohibition of tacit collusion would be enforceable when the guidelines set out clear conditions on the (il)legality of certain behaviour. However, this does not mean that the enforcement against parallelism should become the norm, since it has to remain possible for undertakings to formulate an intelligent pricing strategy.<sup>254</sup> The Commission's main indicator should be that the conditions on the market no longer qualify as normal market conditions. Such an approach would be in line with the judgement in *Dyestuffs*.<sup>255</sup>

There must also be attention for the evidentiary burden for proving the criteria have been met. On the one hand, price-fixing is considered to be a restriction of competition by object. Thus, in line with case law, the anti-competitive effects would be presumed. Therefore, the Commission would not need to consider the effects of price-fixing through tacit collusion.<sup>256</sup> On the other hand, this would mean that competitors on a market are severely restricted in their freedom of conduct on the market. Such an approach would lead to competitors becoming liable for price-fixing which restricts competition by object through their unilateral conduct. The author has raised the question earlier, when discussing the *Eturas* case. If indicia

---

<sup>251</sup> Ezrachi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (1<sup>st</sup> edition, Harvard University Press 2016). p. 61

<sup>252</sup> *Ibid.*, p. 72

<sup>253</sup> *Ibid.*, p. 61

<sup>254</sup> Maya J.E.C., *The limitations on the punishability of tacit collusion in EU competition law* [2017], Rev. Derecho Competencia. Bogotá (Colombia), vol. 13 N° 13, p. 225

<sup>255</sup> *Ibid.* p. 224 – 225; Case C-48/69, *Imperial Chemical Industries Ltd v Commission* EU:C:1972:70 [1972], Ecr I-619 (*Dyestuffs*), par. 63 - 66

<sup>256</sup> Case C-8/08, *T-Mobile Netherlands and Others v. Nederlandse Mededingingsautoriteit* EU:C:2009:343 [2009], Ecr I-04529, p. 29 - 30

show that a competitor was aware that there was coordination, should this lead to the rebuttable presumption that the competitor has engaged in a concerted practice, even when there is no information exchanged?<sup>257</sup>

In the view of the author, this would go against the right to conduct oneself freely on the market and to respond intelligently. *Wood pulp* has shown that the Court strongly appreciates the right to respond intelligently.<sup>258</sup> Thus, in light of the right to conduct oneself freely on the market, as well as the presumption of innocence, the author believes that a higher burden of proof would be required than that which was applied to ‘by object infringements’ in *Eturas* and *T-Mobile*. Therefore, the author concludes the analysis on the enforceability of a prohibition on tacit collusion by citing Wish & Bailey, when they state that competition authorities “*must avoid reaching a conclusion that a concerted practice exists if there is an alternative explanation of any parallel behavior*”.<sup>259</sup> The latter would mean that enforcement is not easy, but considering the right of undertakings to conduct themselves freely on the market, an enforcement procedure against tacit collusion should be subjected to such a high standard. However, it will be up to the legislator and the Court to decide where the balance between the presumption of innocence and the principle of effectiveness should lie.

#### 4.5. Conclusion

In conclusion, prohibiting tacit collusion will lead to a difficult debate. When the notions surrounding legal tacit collusion change, this means that the notions surrounding existing case law, restrictions by object or effect and the evidentiary burden must be addressed as well. The prohibition would require revisiting the existing interpretation of 101 (1) TFEU, and it would require the Commission to adjust the applicable Guidelines.<sup>260</sup> Through the Guidelines, the Commission can address this shift in their enforcement policy prospectively. To treat price-fixing through tacit collusion differently than price-fixing through an agreement, would also mean that a new line of case law must be developed. It will then be for the Courts to interpret the changes in the notions surrounding tacit collusion and to give the definitive verdict on how the prohibition on tacit collusion should be applied.

---

<sup>257</sup> Case C-74/14, *Eturas and others v. ‘the Competition Council’ of Lithuania* EU:C:2016:42 [2016], (*Eturas*), para. 39 - 43

<sup>258</sup> Joined Cases C-89, 104, 114, 116, 117 and 125-129/85, *A Abström oy v Commission*, EU:C:1988:447, [1988], Ecr I-03793 (*Wood Pulp*), par. 71

<sup>259</sup> Whish, R., and D. Bailey, *Competition Law* (8<sup>th</sup> edition, Oxford University Press 2015), p. 569

<sup>260</sup> European Commission, *Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements*, 2011/C 11/01, 14 January 2011

It is then the question, if expanding the definition of communication may be a less arduous route to deal with this problem. However, this route contains problems as well. Although there are leads in case law and the Commission Guidelines that such an expansion may be acceptable, it would not be true to reality.<sup>261</sup> Algorithmic collusion is in fact a form of highly efficient tacit collusion, not one where information is exchanged. The Commission would be challenged to bring a case before the Court in which it shows a clear causal link between the adoptions of algorithms and the collusion, as well as explain to the Court why the algorithms are considered to be communicating. In the eyes of the author, it will be hard to argue why one form of harmful collusion is different from the other.

Therefore, in light of the advancements in algorithms, it may be necessary to prohibit tacit collusion to successfully combat the anti-competitive effects. However, considering the scope of the discussion which would follow, it remains to be seen what route the Commission will choose: Will algorithmic collusion be at the basis of a debate on the legality of tacit collusion, or will the Commission avoid this discussion by pursuing an expanded definition of communication?

---

<sup>261</sup> Joined Cases 40 to 48, 50, 54 to 56, 111, 113 and 114/73, *Suiker Unie v Commission* EU:C:1975:174 [1975] ECR I-1663, (*Suiker Unie*), para. 1942; Case C-286/13P, *Dole Food Company v. European Commission, opinion of AG Kokott* EU:C:2014:2437 [2014], par. 110 – 113; Case C-48/69, *Imperial Chemical Industries Ltd v Commission* EU:C:1972:70 [1972], Ecr I-619, par. 66; Case T – 35/92 *John Deere Ltd v Commission* EU:T:1994:259, [1994], Ecr II-00957 (*John Deere*), par. 90, 120 -125; Case C-74/14, *Eturas and others v. 'the Competition Council' of Lithuania* EU:C:2016:42 [2016], (*Eturas*), par.42 - 43



## 5. Conclusion

This research began with the following question: *“Does the implementation of price-setting algorithms by competitors lead to concerns about the legality of tacit collusion and to what extent should the treatment of tacit collusion under 101 TFEU be affected?”*

In order to answer this question, the research began with distinguishing the concepts of parallel behaviour, tacit collusion and concerted practices. Through this, the criteria and conditions for tacit collusion to effectively substitute competition, as well as the rationale why it has been considered legal behaviour have been explored. From this it has been shown that tacit collusion is legal due to its relatively rare occurrence and practical instability. In order for tacit collusion to function, transparency of the market, stability of the collusive behaviour and a lack of competitive restraints are important. Until now, the only market structure which could support tacit collusion was the oligopoly. Even within oligopolies tacit collusion is hard to sustain, since there is no communication between competitors.

With the implementation of the predictable agent and Digital Eye algorithm, tacit collusion will become a more sustainable form of collusion. Algorithms possess the capability to constantly monitor competition. This means competitors in a market can use algorithms to process large quantities of information and zero-lag price adjustments. Through this, algorithms artificially enhance the conditions needed for tacit collusion. The widespread implementation of algorithms may lead to near perfect transparency of a market, highly parallel behaviour and a strong mutual understanding of what competitors need to do to maximize profit through tacit collusion. This highly parallel behaviour will also lead to a swift and efficient retaliation against any discounters on the market, as well as the possibility to raise artificial barriers of entry.

The effects described above would change the notions surrounding the legality of tacit collusion. The idea that tacit collusion is hard to sustain has now been replaced with the idea that tacit collusion would nearly always be an efficient substitute for competition on merits, with only the exception of highly dynamic and heterogeneous markets. This coordination will be possible when algorithms are implemented widespread on a market and achieve the objectives of high transparency and zero lag adjustment to one another. The problem of tacit collusion will also become more prevalent and possibly move from oligopolies to markets with more players. Thus, the discussion surrounding tacit collusion has gained renewed relevance, the economic rationale which applies to the legality of tacit collusion, does not hold true when tacit collusion is facilitated by algorithms.

Therefore, the Commission will now have to take a decision on how to respond to these developments. It is possible to wait for the effects of algorithmic collusion to quantify, or to wait for countermeasures to form. However, considering the scenarios set out by Ezrachi & Stucke, it is likely that a more serious response will be necessary. The Commission has set out two routes by which it could respond. Firstly, the definition of communication could be expanded to capture algorithmic collusion. Secondly, the Commission may choose to prohibit tacit collusion completely.

When the Commission Guidelines are explored, there is a strong parallel between the rationale behind prohibiting certain forms of information exchange and the outcomes from algorithmic collusion. Information exchange can be seen as a concerted practice when it artificially creates market characteristics which are necessary for collusion, such as transparency and stability of the cartel. Information exchange leads to concertation when it alters the market conditions to facilitate coordinated conduct. One of the reasons that communication is considered to be central to establish a concerted practice, was the belief that coordination with such anti-competitive effects would be unlikely to be established without at least some exchange of information. Algorithms will change that notion through the possibility to monitor excessively, leading to the same economic effects as the exchange of information. This leads the author to believe that there is now a clear rationale to consider algorithmic collusion to be a concerted practice.

First, the route of tackling algorithmic collusion by expanding the definition of communication to involve ‘the mutual decoding’ of algorithms by each other was discussed. Although an interpretative reading of case law and the Guidelines support the possibility of including algorithmic collusion as a form of information exchange, the author questions its effectiveness. The Commission would need to build a strong case to support its position that the anti-competitive effects have a causal link to the use of algorithms. The Commission would also have to explain why it defines algorithmic collusion as to be different from tacit collusion, when in reality it is simply a highly efficient form of tacit collusion.

Thus, the author concludes that the problem lies, in fact, with the renewed effectiveness and stability of tacit collusion. The current way by which the Commission combats tacit collusion is through Merger Control. Through Merger Control the Commission focuses on preventing concentration on a market to prevent coordination and anti-competitive behaviour. In *Airtours* the Court has identified three conditions as to when an oligopoly leads to anti-competitive concerns. Firstly, there should be transparency and reciprocal observation, which allows the creation of an understanding on a mutual pricing strategy. Secondly, the tacit collusion must be sustainable. It must be possible to punish deviations and maintain the

incentive to collude and finally, it must be possible to raise barriers to entry. The anti-competitive effects of these market conditions were limited to the oligopoly, due to the lack of an underlying agreement. Creating the mutual understanding to tacitly collude was only viable on concentrated markets with few competitors, because a clear overview of the market and trust were a necessity. However, the analysis of the effects of algorithms on tacit collusion shows that algorithms can replace concentration as the enabling factor in order to fulfil these conditions. Therefore, tacit collusion is not only more sustainable, but also possible between more players. This means that the *ex ante* enforcement mechanism will likely no longer be sufficient to combat tacit collusion when algorithms are implemented. As a consequence, the author argues that an *ex post* enforcement mechanism against tacit collusion must be introduced.

The conclusion of this research is that a prohibition of tacit collusion would be the most effective manner in which tacit collusion can be tackled *ex post*. However, such a prohibition would require a discussion about the evidentiary burden to which the Commission should be subjected. To treat price-fixing through tacit collusion as a restriction by object, would have highly restrictive consequences for market players to freely conduct themselves on the market. In order to safeguard this right, the Commission should only enforce against tacit collusion when the market characteristics are severely altered, and this can only have happened as a result of tacit collusion. Thus, in order to create legal certainty for market players, the Commission must include clear and unambiguous criteria for illegal tacit collusion in their Guidelines.

The decision to prohibit tacit collusion would be a highly controversial one, which would spark heavy debate and create difficult legal questions. Therefore, it is not unthinkable that the Commission will pursue to expansion of the definition of communication to avoid dealing with these issues. However, the decision to reconsider the legality of tacit collusion would do must justice to reality. EU law is ever evolving and, in light of the rapid technological advancements in the fields of algorithms and artificial intelligence, such an evolution may prove necessary in the near future.

## 6. Bibliography

### Books

1. Eyrachi, A. and Stucke, M.E., *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* ( 1<sup>st</sup> edition, Harvard University Press 2016), (*Virtual Competition*)
2. Kreps, D., *A Course in Microeconomic Theory* (1<sup>st</sup> edition, Princeton University Press 1990)
3. Whish, R., and D. Bailey, *Competition Law* (8<sup>th</sup> edition, Oxford University Press 2015), (*Competition law*)
4. Pindyck, R & Rubinfeld, D., *Microeconomics*, (8<sup>th</sup> edition, Pearson 2001)
5. Schmidtchen D. et al, *The More Economic approach to European Competition Law* (1<sup>st</sup> edition, Hart Publishing 2017)

### Articles

1. Agerholm, H, “Angela Merkel says internet search engines are ‘distorting perception’ and algorithms should be revealed” [2017], The independent
2. Chamberlin E,H, “Duopoly: value where sellers are few” [1929], 44<sup>th</sup> ed. Quarterly Journal of Economics
3. Eyrachi, Ariel and Stucke, Maurice E., *Artificial Intelligence & Collusion: When Computers Inhibit Competition* [2015]. University of Illinois Law Review, Vol. 2017, 2017;
4. Eyrachi A. & Stucke M.E., *How pricing bots could form cartels and make things more expensive* [2016], Harvard Business Review
5. Freed, M. et al, *The detection and punishment of tacit collusion* [1997], Loyal Consumer Law Review
6. Harrington J.E.J., “A theory of tacit collusion” [2011], Economics Working Paper Archive, The Johns Hopkins University, Department of Economics
7. Koch C., *How the Computer beat the Go master* [2016], Scientific American
8. Kühn, K., *Fighting Collusion by Regulating Communication between Firms* [2001], Economic Policy, Vol.16, No.31
9. Li S. & Xie C., *Rise of the machines: Emerging antitrust issues relating to algorithm bias and automation* [2017], The Civil Practice & Procedure Committee’s Young Lawyers Advisory Panel: Perspectives in Antitrust, Volume 5, Number 3,

10. Lohr S., *the age of big data* [2012], New York Times (online)  
<<https://www.nytimes.com/2012/02/12/sunday-review/big-datas-impact-in-the-world.html>>,  
accessed 2 February 2018
11. Maya J.E.C., *The limitations on the punishability of tacit collusion in EU competition law* [2017],  
Rev. Derecho Competencia. Bogotá (Colombia), vol. 13 N° 13, 195-240
12. Morgan R., *Uber settles federal probe over 'God View' spy software* [2017], New York Post,
13. Moschovakis Y.N., *What is an Algorithm?* [2001], Mathematics Unlimited, Springer
14. Moujahid A., *A practical Introduction to deep learning with Caffe and Python* [2016], (online:  
<<http://adilmoujahid.com/posts/2016/06/introduction-deep-learning-python-caffe/>> Accessed  
on 13 March 2018
15. Norton Rose Fullbright, *OECD workshop addresses algorithms and collusion issues* [2017], NRF,  
<<http://www.nortonrosefulbright.com/knowledge/publications/149481/oecd-workshop-addresses-algorithms-and-collusion-issues>>, accessed 6 May 2018
16. Oxera, *When algorithms set prices: winners and losers* [2017], Oxera discussion paper of 19 June  
2017
17. Petit, N., *The Oligopoly Problem in EU Competition Law* [2012], Research Handbook in European  
Competition Law 2012
18. Potters J., S. Suetens, '*Oligopoly experiments in the current millennium*' [2013], Journal of  
Economic Surveys 27(3)
19. Spice, B., *Carnegie Mellon artificial intelligence beats top poker pros* [2017], Carnegie Mellon  
University: < <https://www.cmu.edu/news/stories/archives/2017/january/AI-beats-poker-pros.html>>, accessed at 3 February 2018
20. Schumpeter, *Flexible figures, A growing number of Companies are using Dynamic pricing* [2016],  
The Economist <[www.economist.com/news/business/21689541-growing-number-companies-are-using-dynamic-pricing-flexible-figures](http://www.economist.com/news/business/21689541-growing-number-companies-are-using-dynamic-pricing-flexible-figures)>, accessed on 6 May 2018
21. Villani, L., *The E-Turas case: When concerted practices meet technology* [2016], (Eurojus  
<<http://rivista.eurojus.it/the-e-turas-case-when-concerted-practices-meet-technology>>  
accessed on 2 May 2018

## Reports

1. Ivaldi et al, *The economics of tacit collusion* [2003], Report for DG Comp, IDEI 2013

2. OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* [2017], OECD <[www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm](http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm)>, accessed 12 April 2018, (abbr. "Competition policy in the Digital age")
3. OECD, *Algorithms and collusion – note from the European Union* [2017], DAF/COMP(2017)12
4. OECD, *Algorithms and collusion – background note by the secretariat* [2017], DAF/COMP(2017/4)
5. OECD, *Algorithmic Collusion: Problems and Counter-Measures - Note by A. Ezrachi & M. E. Stucke* [2017], DAF/COMP/WD(2017)25
6. OECD, *Roundtable on information exchange between competitors under competition law* [2010], DAF/COMP/WD(2010)118

## Case law

1. Case C-8/08, *T-Mobile Netherlands and Others v. Nederlandse Mededingingsautoriteit* EU:C:2009:343 [2009], Ecr I-04529 (T-Mobile)
2. Case C-48/69, *Imperial Chemical Industries Ltd v Commission* EU:C:1972:70 [1972], Ecr I-619 (Dyestuffs).
3. Joined cases C-68/94 and C-30/95, *France v. Commission* EU:C:1998:148 [1998], Ecr I-1375 (Salz & Kali).
4. Case C-74/14, *Eturas and others v. 'the Competition Council' of Lithuania* EU:C:2016:42 [2016], (Eturas)
5. Case C-172/80 *Zuchner v Bayerische Vereinsbank AG* EU:C:1981:178 [1981], Ecr. I-2021 (Zuchner v. Bayerische Vereinsbank)
6. Case C-194/14, *AC-Treuhand v Commission* EU:C:2015:717 [2015] (Treuhand)
7. Case C-283/81, *CILFIT v, Ministry of Health & Lanificio di gavardo Spa* EU:C:1982:335 [1982], Ecr I-3415 (CILFIT)
8. Case C-288/94, *Argos distributors Ltd v. Office of Fair Trading v. Commissioners of customs & excise* EU:C:1996:398 [1996], Ecr I-5311 (Argos Ltd.)
9. Case C-286/13P, *Dole Food Company v. European Commission* EU:C:2015:184 [2015], (Dole Food)
10. Case C-286/13P, *Dole Food Company v. European Commission, Opinion of AG Kokott* EU:C:2014:2437],
11. Case C-395/96 *Compagnie Maritime Belge Transports v Commission* EU:C:2000:132 [2000], Ecr II-01201 (Compagnie Maritime Belge)

12. Joined Cases 40 to 48, 50, 54 to 56, 111, 113 and 114/73, *Suiker Unie v Commission* EU:C:1975:174 [1975] ECR I-1663, (*Suiker Unie*)
13. Joined cases 56 and 58/64, *établissement Consten SARL v. Grundig-Verkaufs GmbH* EU:C:1966:41, [1966], Ecr. I- 299 (*Consten v. Grundig*)
14. Joined Cases C-89, 104, 114, 116, 117 and 125-129/85, *A Ablström oy v Commission*, EU:C:1988:447, [1988], Ecr I-03793 (*Wood Pulp*)
15. Case T-25/95 etc., *Cimenteries CBR SA v. Commission* EU:T:2000:77 [2000], Ecr II-2667 (*Cement cases*)
16. Case T – 35/92 *John Deere Ltd v Commission* EU:T:1994:259, [1994], Ecr II-00957 (*John Deere*)
17. Case T-41/96, *Bayer AG v. Commission* EU:T:2000:242, [2000], Ecr II-03383(*Bayer v. Commission*)
18. Case T-102/96, *Gencor v. Commission* EU:T:1999:65, [1999] Ecr. II-00753 (*Gencor*)
19. Case T-342/99, *Airtours plc. v. Commission* EU:T:2004:192 [2004], Ecr. II-01785 (*Airtours*)

#### Law and soft law

1. European Commission, *Commission Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements*, 2011/C 11/01, 14 January 2011.
2. European Commission, *Commission Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings* (2004/C 31/03), 05 February 2004
3. European Union, *Charter of Fundamental Rights of the European Union*, 2012/C 326/02, 26 October 2012
4. *Consolidated version of the Treaty for the functioning of the European Union* (2012/C 326/01), 26 October 2012