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PRICING ALGORITHMS APPLICATIONS:
IMPLICATIONS FOR VERTICAL AND HORIZONTAL AGREEMENTS AND COMPATIBILITY WITH EU COMPETITION LAW

Adrián Vilà Montoya

N.I.A 217906

Bachelor's Degree Final Project tutor:

María de la Paz Soler Masota

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Adrián Vilà Montoya

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ABSTRACT

In 2017, the European Commission published a final report on the sector inquiry carried out in the E-commerce sector. The Staff Working Document accompanying the report reflected that 53% of the respondent retailers to the inquiry tracked online prices of competitors, out of which 67% used automatic software programmed to achieve more efficient price tracking. 78% of the retailers that used software price tracking adjusted their own prices to those of their competitors.

While algorithm-enabled price tracking is considered to be legal under EU competition law, some scholars have shown opposition to its effects on competition. Also, even though software intervention in price determination can be lawful, there are still situations which are deemed to be illegal.

Under EU competition law, a number of potential implications arising from pricing algorithms can be analysed from both a vertical and horizontal perspective, with particular focus on algorithmic tacit coordination.

Keywords: algorithms, collusion, pricing algorithms, tacit coordination, price tracking, horizontal agreements

Data! Data! Data! I can't make bricks without clay.

Sir Arthur Conan Doyle (1859-1930)

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En agradecimiento a mi tutora, *Paz Soler Masota*, por haber sido guía en este proyecto e inspirarme siempre a mejorar.

A mi *madre*, quien con su sacrificio y esfuerzo ha conseguido sacarme adelante. A mi *abuela*, cuyos valores siguen presentes.

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GLOSSARY OF TERMS

Algorithm: list of computational operations applied to a piece of information (input) which determines an output.

Algorithmic collusion: collusion facilitated or enforced through algorithms.

Artificial intelligence: type of algorithms enabled to perform tasks that require human intervention, such as speech recognition.

Big Data: large and complex data sets that present an elevated level of diversity and that are processed and analysed with high velocity.

Deep learning: artificial neural networks that replicate human neuron activity and present automatic feature engineering.

Machine learning: algorithms that iteratively learn from data and requires manual features manual features engineering.

Oligopoly: market with few undertakings who in conjunction dominate the competitive structure and a group of smaller sellers adapt to their activity.

Parallel behaviour: independent, responsive behaviour to market condition changes which does not constitute by itself evidence of existence of a concerted practice.

Price signalling: unilateral and public disclosure of information to third parties that may lead to coordination between competitors.

Resale price maintenance: anticompetitive practice consists in establishing a fixed or minimum price for the resale of a product by retailers.

Tacit coordination: any form of anti-competitive practice or understanding achieved without express communication between the parties.

1. INTRODUCTION

On 19 February 2020, the National Commission on Markets and Competition ("CNMC", after the Spanish initials) issued a press release which expressed concerns that the price coordination between seven real estate intermediaries had been facilitated by real estate brokerage software and the algorithms embedded in them.

The CNMC specified that it was suspected that the means by which this coordination had been implemented included the use of software and digital platforms. The press released presented the case as the first pricing algorithm case to happen in Spanish markets.

The qualification of the informatics proceedings used by the firms as "algorithms" was in fact disputed by some of them during the proceeding, arguing that the proceedings lacked technical complexity.

The decision issued on the matter by the Competition Chamber of the Council of the CNMC stated that the investigated behaviours did not constitute "a collusive scenario in which a dynamic pricing fixation has occurred by using sophisticated algorithms or using artificial intelligence" (page 162 of 185, last paragraph).[1] The CNMC, however, referred to the technical mechanisms as a necessary mean to the effective implementation of the collusive agreement reached by the firms.

It is not clear if said mechanisms could be in fact classified as algorithms (see, paragraph 3) but the decision gives reason to believe that this could be the first case of algorithmic collusion in Spanish markets.

The facts presented in the case would correspond to one of the simplest scenario of algorithmic collusion.

Tracking prices set by other undertakings engaging in commercial activity in the same market is lawful under EU law. Moreover, the *intelligent adaptation* to competitive prices of those competitors who are being tracked does not generally leave the tracker open to liability.

[1] Decision of the CNMC S/0003/20, 25 November 2021. Retrieved from https://www.cnmc.es/sites/default/files/3831141_0.pdf

Even though said practices can be lawful, there are still situations with algorithms implications which are deemed to be illegal. Assessment of other scenarios with more advanced algorithms, however, may entail a high degree of difficulty.

In any case, implications resulting from cases in which pricing algorithms and its application to price determination can be analysed from both a vertical and horizontal perspective. In occasions, application of pricing algorithms can result in tacit coordination, particularly in oligopolistic markets in which a vast amount data is available and repetitive interactions between firms happen.

As traditional markets definitely transform into e-commerce, pricing algorithms play an important role in price determination or, even, fixing. Algorithms could facilitate tacit coordination, which presents several problems under EU competition law from both an enforcement and regulatory perspective.

2. ALGORITHMS AND COLLUSION

2.1. BRIEF SUMMARY ON PRICING ALGORITHMS

At the time of writing, there is still a lack of a universal definition of the concept of algorithm.

A pricing algorithm, however, can be defined as an orderly finite set of well-defined operations computationally applied to a price or a piece of information relevant for the formation of said price (input) which determines an output.

Algorithms can be represented in plain language, diagrams, voice instructions or computer codes.

The input can be divided into two categories: internal input and external input. Internal input makes reference to the algorithm user's own information and the external to the market information.

Pricing algorithms automatically and continuously implement price changes in order to maximize profits (optimization algorithms).

Algorithm complexity is presented as an evolutive sequence with regard to the risk of tacit collusion. As the complexity of the algorithm increases, difficulty in collusion identification and sanction also grows.

2.2. **CLASSES OF ALGORITHMS: APPLICATION TO PRICING ALGORITHMS**

Simple pricing algorithms follow the traditional system of an algorithm: a piece of information is configured by the user into said software and the application of the operations embedded in the programme results in the output.

The intervention is based upon the fact that the variables using to set the output (in this case, for example, a price) are known by the user previously to the application of the programme. Although it is a basic form of algorithms, it still remains more efficient than engagement without it.

As simple pricing algorithms lack high level complexity, evidence supports the apparent necessity to revise the application of the algorithm and its results (sanity checks).[2] [3]

Unlike simple algorithms, machine learning can be presented in different forms and may operate even without input being provided by the user.

The most typical categories of machine learning are supervised and unsupervised learning and reinforcement learning. The latter presents the most complex scenario: the algorithm uses the feedback that it gets from an interactive environment by trial and error system and, in the event that input was not provided, it will learn from said system.

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[2] Competition & Markets Authority, Pricing Algorithms. Economic working paper on the use of algorithms to facilitate collusion and personalised pricing, 8 October 2018. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/746353/Algorithms_econ_report.pdf

[3] Eisen, M. (2011, April 22). Amazon's $23,698,655.93 book about flies. Retrieved from https://www.michaeleisen.org/blog/?p=358

In 2018, CMA already warned the eventual problems arising from the use of machine learning regarding collusion and pricing. The price increase resulting from the operation may be the consequence of tacit coordination and that the user of the algorithm would not have any knowledge of said cause.

Deep learning consists of Artificial Neural Networks (ANNs) which have two or more layers of neurons, with the next layer using the output from the previous layer as input. ANNs can be used to estimate market demand.

2.3. **POTENTIAL INPUTS AND OUTPUT**

As established before, a pricing algorithm consists of a set of pre-defined operations. This group of operations is applied to a price or a piece of information relevant for the formation of said price.

The price (or prices) factored into the algorithm or the information which is deemed important for the formation of said price or that can predict it is defined as the input. After the application of the operations or rules to the input, the result is defined as the output.

For example, a simple algorithm can be programmed in order to price match the competitor with the lowest price and to subtract 5 cents to the result (undercutting). The result after the subtraction is the output.

For a pricing algorithm to be effective the input into said algorithm should be a set of information relevant for the formation of a price, such as: competing firms' prices; firms' past pricing/profit/revenue data; individual customer information, including their purchase or browsing history or other indicators; market information such as competitors' stock levels; external information such as weather patterns; or firms' costs, such as production, storage and fulfilment. [4]

[4] Competition & Markets Authority, Pricing Algorithms. Economic working paper on the use of algorithms to facilitate collusion and personalised pricing, 8 October 2018. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/746353/Algorithms_econ_report.pdf

For example, an algorithm can be programmed to use real-time data in order to price match the competitor with the highest stock price. However, this may result in price distortion, if the algorithm lacks relevant information regarding the formation of the stock price and its causes.

This highlights the importance of both the quality and quantity of data and its impact on the application of algorithms and effectiveness.

3. IMPLICATIONS FOR VERTICAL AND HORIZONTAL AGREEMENTS

3.1. IMPLICATIONS FOR VERTICAL AGREEMENTS

3.1.1. *Vertical agreements*

Vertical agreements are those agreements (or concerted practices) between companies operating at different levels of the production or distribution chain, such as manufacturers and wholesalers or retailers, to buy and sell goods or services.

The key element is that the agreement has to be met by undertakings that participate in different stages of the chain.

One of the Vertical Block Exemption Regulation (*see*, paragraph 4), however, specifies that the undertakings engaging in vertical restrictions must operate at a different level of the production *for the purposes of the agreement or the concerted practice*.[5] [6]

In my opinion, this provision renders irrelevant whether the undertakings in question are *natural* companies operating at different levels of the production or distribution chain or not, in the event that regarding the agreement they are, and vice versa. For example, if a manufacturer were to supply to another manufacturer a specific amount of product, the

[5] Guidelines on Vertical Restraints (EC), OJEU C 130, 19.05.2010, para. 24. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52010XC0519%2804%29

[6] Article 1(1)(a) of the Commission Regulation 330/2010 of 20 April 2010 on the application of Article 101(3) of the Treaty on the Functioning of the European Union to categories of vertical agreements and concerted practices.

agreement would still be vertical since, for the purposes of that agreement, each undertaking would be operating at a different level of the market.

The most common type of vertical agreements is resale price maintenance (RPM) or restrictions. Nevertheless, other agreements may be construed as vertical restrictions, such as single branding, exclusive distribution, exclusive customer allocation, selective distribution, franchising, exclusive supply, upfront access payments, category management agreements and tying. The list is not exhaustive and so other agreements that do not strictly fall into the aforementioned specific vertical constrictions may also be considered anticompetitive.

Following article 101(1) TFEU, under EU competition law, vertical agreements are prohibited when they (i) affect trade between Member States, and (ii) prevent, restrict or distort competition. These agreements are null and void.

Article 101 establishes a system based on the analysis of positive and negative effects of the vertical restraints: when the effects arising from the agreement do have a positive impact on competition and those outweigh the anti-competitive effects, the agreement is exempted, according to article 101(3). Article 2 of Regulation 1/2003 provides that the legal burden of proof rests on the party claiming the benefit of Article 101(3) TFEU.

Following the European Commission Guidelines on Vertical Restraints, vertical agreements which generally fall outside article 101(1) are agreements of minor importance[7], SMEs, agency and subcontracting agreements.

In the European Union, the Council and the Commission adopted the block exemption system, which also applies to horizontal agreements. This system consists in specifying the conditions under which certain types or categories of agreements or concerted practices are presumed to

[7] Agreements are of minor importance: (a) if the aggregate market share held by the parties to the agreement does not exceed 10 % on any of the relevant markets affected by the agreement, where the agreement is made between undertakings which are actual or potential competitors on any of those markets (agreements between competitors); or if the market share held by each of the parties to the agreement does not exceed 15 % on any of the relevant markets affected by the agreement, where the agreement is made between undertakings which are not actual or potential competitors on any of those markets (agreements between non-competitors).

See: Communication from the Commission — Notice on agreements of minor importance which do not appreciably restrict competition under Article 101(1) of the Treaty on the Functioning of the European Union (De Minimis Notice).

be valid and enforceable. When an agreement falls within the scope of application of a block exemption regulation, it is presumed that the restriction satisfies the conditions of Article 101(3) TFEU without the need to determine whether the conditions for the application of Article 101(1) TFEU are met.

If said conditions are satisfied, the Vertical Block Exemption Regulations exempt agreements between manufacturers and distributors provided their agreements do not contain price-fixing or other hardcore restrictions and both do not have over a 30% market share.

In 2021, the European Commission published drafts of the revised Vertical Block Exemption Regulation and its guidelines, after following the review procedure. One of the objectives is to adapt the regulation to new models of e-commerce, which will expire on May 31, 2022.

3.1.1.1. Summary on resale price maintenance (RPM)

Resale price maintenance consists in a supplier and a retailer (undertakings operating at different levels of the supply chain) agreeing on the retailer's downstream price in the form of a fixed or minimum sales price (direct resale price maintenance) or discount prices at a specific level (indirect RPM).[8] Resale price maintenance also includes restrictions on the part of a manufacturer.

Direct resale price maintenance may also determine a maximum sales price, which is allowed under EU competition law. The reason why maximum resale prices are allowed is consumer benefit. A maximum resale price, however, will amount to a fixed or minimum price if it is not genuinely possible for the reseller to lower that sale price.

The prohibition applies also to indirect forms of RPM. Examples of indirect RPM cover, apart from fixed discount prices, margin fixing, use of *monitoring systems* to deter discounting and imposition of sales periods.

[8] In a horizontal relationship (i.e., between competitors), price-fixing agreements usually take the form of a cartel. For example, a price imposition on part of a supplier to a retailer qualifies as a vertical agreement, while the same agreement (not an imposition) at a horizontal level constitutes a cartel.

The Vertical Block Exemption Regulation lists resale price maintenance as a hardcore restriction, more specifically, resale price fixing and minimum resale price. By opposition, maximum sale price or recommended sale price are allowed, provided that no pressure or incentives have been exerted/offered by any of the parties.

3.1.2. *Use of price monitoring/matching algorithms*

Price monitoring algorithms can be used to detect deviations from a fixed or minimum resale price (RPM).

Algorithm-enabled price monitoring does not constitute an RPM offence as such, but forms part of the RPM infringement.[9] The role of the algorithm is to increase or maintain the effectiveness of the vertical agreement or, more typically, the RPM.

In this sense, detection of deviations from the vertical agreements are detected easier and more immediate. As a result, retailers may be incentivized not to deviate from the collusive agreement.

Despite not constituting an RPM offence (or a vertical agreement) as such and thus apparently not entailing any problem for competition authorities to detect this type of collusion, the logic is different.

Price monitoring software also allows easier detection of retailers that deviate from manufacturers' pricing *recommendation*.

EU competition law does allow pricing recommendation, as long as it does not work indirectly as resale price maintenance via the limitation of incentives or pressure/retaliation. Article 4(a) of the Vertical Block Exemption Regulation permits recommended prices provided that they do not amount to a fixed or minimum resale price as a result of pressure from, or incentives offered by, any of the parties.

[9] Algorithms and Collusion - Note from the European Union, DAF/COMP/WD(2017)12, para. 14. Retrieved from https://one.oecd.org/document/DAF/COMP/WD(2017)12/en/pdf

If a manufacturer retaliates against retailers that do not comply with pricing recommendations, the manufacturer would be engaging in RPM, even though initially its activity was legal. Manufacturers intervene, as opposed to recommend, based on their own initiative but also following complaints from other retailers about the price level of certain retailers in the market.[10]

Pricing algorithms may lead undertakings (or retailers) not engaging in vertical agreements to match the price of those incurring in said offence.

Pricing algorithms would probably lead to a tacit increase in prices from undertakings not incurring in RPM, which would render the framework in force insufficient (ECJ Case AT.40181 - *PHILIPS*).[11] The situation is the following one: retailer A engages in RPM and retailer B is monitoring retailer A's prices via algorithm. When retailer A fixes its prices, retailer B may match them, thus resulting in a price increase.

3.2. IMPLICATIONS FOR HORIZONTAL AGREEMENTS

3.2.1. *Monitoring and enforcing the explicit agreement*

The most basic scenario of algorithmic collusion is that which consists in using algorithms to implement and monitor the previously agreed price/s (or, more broadly, the agreement in question).

The algorithm is used to detect deviations from the pre-agreed price (or markets, bids) and, in the event of deviation, enforce the existing agreement and punish the undertaking (or undertakings) that decided to deviate from it.

As a result, the role of the algorithm is purely instrumental and its only objective is to enforce the previously reached anticompetitive agreement between the undertakings. In this sense,

[10] European Commission (2017), Commission Staff Working Document accompanying the Final Report on the E-commerce Sector Inquiry, SWD(2017) 154 final, 10.05.2017, para. 607. Retrieved from https://ec.europa.eu/competition/antitrust/sector_inquiry_swd_en.pdf

[11] Dobbin, M. (2020, December 9). Pricing algorithms and competition: what competitive concerns do pricing algorithms raise? Retrieved from https://www.lexxion.eu/en/coreblogpost/what-competitive-concerns-do-pricing-algorithms-raise/

algorithms activity is the same of that of proxies.[12] The monitoring and enforcement of said agreement via the application of an algorithm is more precise and immediate rather than off-line.

For example, firms A, B and C agree on a supply level and an above market price of products X and Y. The oligopoly utilizes a pricing algorithm in order to monitor the collusive agreement. When any of the firms deviate from the agreed price and/or the supply level, the algorithm will immediately detect said deviation. The time lapse between when the deviation occurs and is detected primarily depends on the set of values defined as input.

Use of pricing algorithms to monitor and/or enforce a previous agreement or concerted practice does not constitute itself an infringement, but a part of said infringement. [13]

As established before, monitoring *agreed* prices presupposes a previous agreement or concerted practice between undertakings. Since there is a previous agreement, said agreement is caught by Article 101(1) of the TFUE and, therefore, it does not constitute any problem for the current framework, as long as there is still strong evidence of the meeting of minds.

Regarding the imposition of fines, the Commission may take into account aggravating circumstances, such as any steps taken to coerce other undertakings to participate in the infringement and/or any retaliatory measures taken against other undertakings with a view to enforcing the practices constituting the infringement.[14] The interpretation of the guidelines gives reason to understand that the use of a pricing algorithm constitutes an aggravating circumstance.[15]

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[12] Colombo, N. (2018). Virtual competition: Human liability vis-a-vis artificial intelligence's anticompetitive behaviours. European Competition and Regulatory Law Review (CoRe), 2(1), 11-23. Retrieved from

[13] Ezrachi, A., & Stucke, M. E. (2016). Virtual competition: The promise and perils of the algorithm-driven economy.

[14] Guidelines on the method of setting fines imposed pursuant to Article 23(2)(a) of Regulation No 1/2003, OJ C 210, 1.9.2006. Retrieved from https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52006XC0901%2801%29

[15] Bentley, Philip, Buhart Jacques & Muto Mai, "The EU Commission fines electronic good manufacturers for resale price maintenance, (Asus/Denon & Marantz/Philips/Pioneer)," 24 July 2018, e-Competitions July 2018, Art. No. 89749. Retrieved from https://www.concurrences.com/en/bulletin/news-issues/july-2018-en/the-eu-commission-fines-electronic-goods-manufacturers-for-resale-price

Evidence of pricing algorithms executing a previous agreement or concerted practice is provided by several cases.[16] It is possible to extract some conclusions regarding the objectives and functioning of said software:

(i) Pricing algorithms can be designed and implemented to coordinate changes to the prices set by the undertakings engaging in collusion.

(ii) Pricing software can also be used to detect deviations from the agreement. For example, an algorithm can be used to monitor prices, making sure that neither of the firms parties to the agreement undercut the other.[17]

(iii) Algorithms can exclude selected competitors from the settings, therefore, the application of said software does not entail that all firms competing within the same market are subject to undercutting prices.

(iv) Some pricing algorithms only operate on specific platforms. It is possible for an algorithm to be only functional on Amazon Marketplace. The reasons underlying this type of application limitation are related, for example, to information exchange availability.

3.2.2. *Parallel algorithms*

The parallel algorithms model is based on competitors using the same algorithm in order to determine the market price. The result of competitors using the same algorithm is the following: competitors operate in a similar way and also react similarly to market changes (i.e., price modifications).

[16] Transcript of FTC Hearings Session No. 7: Competition and Consumer Protection in the 21st Century - Day 2 , U.S. F ED. TRADE COMM'N 19-84 (Nov. 14, 2018), p. 19, lines 24 and 25. Retrieved from https://www.ftc.gov/system/files/documents/public_events/1418693/ftc_hearings_session_7_transcript_day_2_11-14-18_0.pdf

[17] Decision of the Competition and Markets Authority Case 5022325, 12 August 2016. Retrieved from https://assets.publishing.service.gov.uk/media/57ee7c2740f0b606dc000018/case-50223-final-non-confidential-infringement-decision.pdf

The model consists of a vertical agreement between the algorithm developer and the undertakings that are applying it to its commercial activity.

The competitors only agreed to use the algorithm, but did not necessarily agree to fix the prices.[18] Therefore, this is the first scenario that could result in the formation of a tacit coordinated pricing result, thus, falling outside of the scope of article 101 TFEU.

A tacit coordinated pricing as a result, however, is not caused alone by the use of the same third-party-provided algorithm, but it also needs intention. The firms need to decide to keep their strategy and resist the election of a deviating alternative (i.e., modify their algorithm or undercut the collusive price and earn higher (short-term) profits).

The current framework *could* be sufficient to subject the scheme to enforcement. However, it is enough only as long as the spokes (undertakings using the same algorithm) are correcting their prices through the application of said algorithm knowing that the others are doing the same activity. The competitors must have been aware of the third party's anticompetitive acts or at least could have reasonably foreseen them.

If the situation is that the spokes unknowingly are adapting their strategy and prices to that of the other competitors, who are also adopting said strategy because they are using the same algorithm, then it would qualify as parallel behaviour. The application of article 101 TFEU is no longer a possibility in this case, at least as it is understood now.

3.2.3. *Algorithmic tacit coordination: basic conditions*

Algorithmic tacit coordination presents a model in which undertakings implement algorithms in an independent way. The firms implemented the algorithms unilaterally and did not set an anticompetitive agreement as an objective.

Algorithmic tacit coordination presents two possible scenarios:

[18] Ezrachi, A., & Stucke, M. E. (2016). *Op. cit.*, 11.

a) The algorithms reach a common understanding that is not expressly negotiated (tacit coordination) but instead it is the result of the software learning to quickly detect and punish rivals' price cutting.

b) The cause of reaching a parallel conduct is not retaliation for price cutting, but an individually rational decision.[19]

The first case has already shed light on one of the conditions for tacit coordination to happen. One of these requirements is a sufficient degree of transparency: more data available on rivals' prices results in a higher degree of transparency, which results in a market with a high probability of tacit collusion. Use of pricing algorithms increases market transparency, which is the reason for algorithms to increase the risk of tacit coordination.

Basic conditions are required for tacit collusion to happen and be sustainable. Still, it is considered tacit coordination not to be sustainable in any type of market or, even, non-existent.

First, a sufficient degree of transparency: tacit coordination will be achievable and, in turn, sustainable, when arisen in concentrated markets in which identical or similar products are being sold.

Algorithms can monitor behaviours (i.e., prices) from other competitors more efficiently prices and detect any deviations from the common understanding.

Also, as there is more data available in the e-commerce sector, this type of market is more susceptible to tacit collusion. Algorithms are able to monitor a vast amount of data, which potentially increases the risk. Big Data also is a risk factor in combination with pricing algorithms.

Big Data consists of three elements, namely, the large amount of available data, the possibility of accessibility of said data in real-time and the diversity of information collected, processed

[19] *Ibid*.

and analysed.[20] As noted previously, the information, in this case, has to be related to the market in which the undertakings using pricing algorithms compete (i.e., consumer information, competing agents' behaviour).

Big Data plays an important role in connection with pricing algorithms when referred to collusion, express or tacit, because it allows the user to display its effects more efficiently. The input of the algorithm becomes more sophisticated, both in terms of quality and quantity, and the algorithm does also.

In combination with transparency, sustainability is required for tacit collusion to happen. Tacit coordination will be sustainable only if a firm's incentive to cheat on the coordination is negated by rivals' ability to nullify the benefits of cheating.

Second, the existence of a credible deterrent mechanism. Algorithms play an important role regarding the element of a deterrent mechanism: detection of deviations is increasingly higher via algorithms, which results in that the retaliation also happens faster.

The greater the improbability that the first-mover will benefit from its discounting, the greater the likelihood of tacit collusion.[21] Since algorithms detect deviations in a speedier way, the deviation will likely result in none or little benefit when compared to an *obedient* behaviour.

If the deviation will likely result in non or little benefit and, in the event of benefit, it will be eliminated, the undertaking is not in an incentivized position to distance itself from the pricing coordination.

Finally, the firm decides that engaging in tacit collusion is a better course of action than competitive pricing, especially if competitive pricing leads to drastically larger sales volumes.[22]

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[20] Laney (2001), 3D Data Management: Controlling Data Volume, Velocity and Variety. Retrieved from https://www.gartner.com/en/blog

[21] Ariel Ezrachi and Maurice E. Stucke, SUSTAINABLE AND UNCHALLENGED ALGORITHMIC TACIT COLLUSION, 17 NW. J. TECH. & INTELL. PROP. 217 (2020), p. 227. Retrieved from https://scholarlycommons.law.northwestern.edu/cgi/viewcontent.cgi?article=1331&context=njtip

[22] OECD, Algorithms and Collusion - Note from the European Union, *op. cit.*, para. 30. Retrieved from https://one.oecd.org/document/DAF/COMP/WD(2017)12/en/pdf

Third, the absence of effective competition barriers or constraints. The reactions of outsiders, such as current and future competitors not participating in the coordination, as well as customers, should not be able to jeopardise the results expected from the coordination.[23]

In markets with any entry barriers any increase in profits will increase the incentives to deviate from the collusive equilibrium and will attract new entrants.[24] Therefore, the entrance of new firms will increase the potential risk of the existence of future competitors not participating in the coordination and probabilistically with the ability to jeopardise the results expected from said understanding.

With respect to future competitors not participating in the coordination, entry barriers as one of the possible basic elements of concentrated markets can apply. If the entry barriers are of a high level, there will be fewer future competitors, which will minimize the potential risks to the understanding. Moreover, tacit coordination has an increasing potential to rise in concentrated markets (first basic condition), which makes it difficult for future competitors to enter the market.

Customers, if understood as the weaker part of a contract, usually do not have the sufficient power to exercise their rights. Only would they have the ability to jeopardise the results expected from the coordination if they were to join forces (i.e., associations or organizations). Even in that case, it is still doubtful that they would be able to achieve the result.

However, other types of costumers, such as other firms, could possess countervailing buyer power. A customer has countervailing buyer power if it could immediately switch to other suppliers, credibly threaten to vertically integrate into the upstream market or to sponsor upstream expansion or entry for instance by persuading a potential entrant to enter by committing to placing large orders with this company.[25]

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[23] Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings, OJ C 31, 5.2.2004, para. 41. Retrieved from https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52006XC0901%2801%29

[24] Algorithms and Collusion - Background Note by the Secretariat, DAF/COMP(2017)4, para. 41. Retrieved from https://one.oecd.org/document/DAF/COMP/WD(2017)12/en/pdf

[25] Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings, *op. cit.*, para. 65.

This practically leaves the ability to put the coordination results at risk to the current competitors not participating in the coordination.

4. ALGORITHMIC TACIT COORDINATION UNDER EU COMPETITION LAW: LIABILITY AND REMEDIES

The prohibition set out by Article 101 TFEU applies to agreements, decisions by associations and concerted practices. The definition of agreement is clear, yet ECJ case-law has broadened it and is only interested in the concept of meeting of the minds (also, concurrence of wills).

Therefore, the principle of freedom of form (or formalities) applies to the concept of agreement under EU competition law.

The concept of concerted practices entails that the undertakings engaging in coordination have not reached the stage of concluding a formal agreement. Still, concerted practice regime does not apply to tacit coordination (i.e., interdependent pricing).[26] [27]

This affirmation is sometimes controversial. In some sense, it could be argued that the scope of application of concerted practices includes tacit collusion: parallel behaviour itself is not to be identified with a concerted practice, but it is evidence of it, if it leads to conditions which do not correspond to the normal conditions of the market.

Therefore, in an oligopoly, the behaviour of the few undertakings engaging in interdependent price-setting seems to fall outside of the scope of Article 101 TFEU. The probability of this type of coordination to happen when algorithms are applied increases potentially.

4.1. ALGORITHMIC TACIT COORDINATION UNDER EU COMPETITION LAW: IS THERE SOMEONE WHO IS LIABLE?

[26] Francisco Beneke, Mark-Oliver Mackenrodt, Remedies for algorithmic tacit collusion, *Journal of Antitrust Enforcement*, Volume 9, Issue 1, March 2021, pp. 152–176. Retrieved from https://doi.org/10.1093/jaenfo/jnaa040

[27] Alison Jones and Brenda Sufrin, EU Competition Law (OUP 2016), 153.

EU competition law does not deprive economic operators of the right to adapt themselves intelligently to the existing and anticipated conduct of their competitors. The *correction* of prices after the monitoring is also not constituting of a breach of antitrust law. The ECJ has also taken this approach, but with limitations.

The monitoring of prices of competing undertakings does not constitute an anticompetitive practice and neither does the monitoring via the use of algorithms. Parallel conducts are *generally* not subject to be considered an infraction.

The key element that determines that algorithm-enabled price monitoring does not constitute an infringement of antitrust law is the previous communication between undertakings. Moreover, the simple use of pricing algorithms was not a breach itself of the competition rules, rather than a reinforcement of the effects of pricing restrictions imposed by manufacturers.

Conscious parallelism (or parallel behaviour that appears in oligopolies) is not subject alone to sanction. Said behaviour or activity is not to be regarded as evidence of a concerted practice, with one exception.

Parallel behaviour can qualify as evidence of existence of a concerted practice when that is the only plausible (or possible) explanation for such practice. In consequence, conscious parallelism or tacit coordination can be construed as proof of an existent concerted practice, therefore, not falling outside of the application of article 101 TFEU.

This doctrine cannot be positively evaluated because it presents several problems, most importantly, the uncertainty and vagueness of the concept “only plausible explanation”.

In a number of cases, the Commission concluded that there was no other plausible explanation for the concerted practices other than parallel behaviour. However, on appeal, the Court of Justice held that it was not the only possible alternative.

For example, in *Wood Pulp*, the quarterly announcement of prices that had created an artificial transparency on the market was a relevant factor in order to conclude that there was a concerted

practice.[28] However, according to the ECJ, the announcements could be explained by the high degree of market transparency.

4.2. DETERRING ALGORITHMIC TACIT COORDINATION: *EX ANTE* MERGER CONTROL

As noted previously, one of the basic conditions for tacit collusion to happen is a sufficient degree of transparency. In this context, this results in highly concentrated markets in which identical or similar products are being sold.

One of the main reasons why oligopolies are more susceptible to tacit collusion is that the supra-competitive benefits resulting from tacit collusion (or explicit, for that matter) have to be divided. The more firms, the less benefit for each one.

Also, pricing algorithms can have an effect on the concentration of the market and price levels, resulting in harm to consumers.

Several scholars have proposed to apply an *ex ante* merger control in order to decrease the potential risk of tacit collusion in concentrated markets with algorithmic presence. Accordingly, the European Council Merger Regulation declares incompatible with the common market mergers with a Community dimension which may impede effective competition.[29] [30]

In this sense, the Regulation establishes that the Commission, in its appraisal of concentrations to establish whether or not they are compatible with the common market, shall take into account, amongst others, the structure of all the markets concerned, barriers to entry, supply and demand trends.

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[28] Judgment of the ECJ of 27 September 1988 (A. Ahlström Osakeyhtiö and others v Commission of the European Communities) (ECLI:EU:C:1988:447). Retrieved from https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:61985CJ0089

[29] Article 2(1)(a) of the Council Regulation (EC) No 139/2004 of 20 January 2004 on the control of concentrations between undertakings.

[30] Commission notice on remedies acceptable under Council Regulation (EC) No 139/2004 and under Commission Regulation (EC) No 802/2004, OJ C 267, 22.10.2008, para. 4. Retrieved from https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52008XC1022%2801%29

In particular, the use of pricing algorithms should be factored in.

Tacit collusion, because of algorithms, spreads beyond duopolies to markets with as many as five to six significant players.[31] As a result of the expanding impact of pricing algorithms, the competition authorities of several countries have been advised to lower the threshold of intervention and investigate the risk of tacit collusion in merger cases of even 5 to 4 firms.

Pricing algorithms have an exponential impact on transparency, which would determine that the Commission shall also take its effects into account when assessing the compatibility of the merger with the common market. An example of the effects of transparency is the velocity of price changes and adaptation to the activity of other undertakings engaging in the same market.

Concentrations can be compatible with the common market subject to the compliance of a series of conditions and obligations.[32] In this sense, there is evidence that algorithms can be designed to tacitly collude.

Therefore, the Commission should address said issue when setting out the conditions and obligations for a merger to be authorized.

One advantage of the *ex-ante* merger control deterrence system, when compared to structural and behavioural remedies, is the possibility of preventing harm from happening.

5. CONCLUSIONS

The system followed in this project has been the analysis of the different points of connection between algorithms and collusion from the point of view of EU competition law. The objective is to assess whether the current regulatory framework is sufficient to correctly subject to enforcement algorithmic anticompetitive practices, with particular emphasis on tacit coordination.

[31] Ezrachi, A., & Stucke, M. E. (2016). *Op. cit*., 11.

[32] Articles 6(2) and 8(2) of the Council Regulation (EC) No 139/2004 of 20 January 2004 on the control of concentrations between undertakings.

Several factors increase the risk of collusion, either express or tacit: a sufficient degree of market transparency, high level of concentration in the market (i.e., few players operating in the market and that jointly dominate the competitive structure), a credible deterrent mechanism, which is a result of an elevated frequency of interaction between firms, and a low buyer power. Also, a low power from firms not engaging in coordination should be considered.

In the digital era, the combination of advanced algorithms with a vast amount of available data exponentially increases the risk of tacit coordination, specifically in the e-commerce sector. An algorithm could be designed to act as a proxy between firms engaging in collusion but also facilitate parallel conducts or, even, collude on their own.

Algorithms and data availability increase traditional risk factors, but there is still not sufficient evidence to determine whether it constitutes an additional item. The problem with this conclusion, however, is that it is abnormally difficult the detection of algorithmic collusion. Pricing software increases, for example, the stability of collusion by drastically reducing or directly eliminating the benefits of the deviation from the anticompetitive agreement. In this sense, Big Data allows algorithms to be applied more efficiently, since the input becomes more sophisticated, both in terms of quality and quantity.

From the perspective of competition regulatory authorities, even though detection increases in difficulty, the enforcement activity is not a challenge if algorithms applications are limited to an incidental role.

As long as there is a meeting of the minds, competition enforcement authorities should not have any additional problem other than those related to evidence.

The more challenging scenario consisting in conscious parallelism does, however, rise concerns. Although initially it was not deemed as an illegal activity under EU competition law, ECJ case law vaguely limited this approach. As noted previously, this case law should not be positively assessed. Therefore, in a market with few dominant undertakings, the behaviour of the few firms engaging in interdependent price-setting seems to not be caught by Article 101 TFEU.

Until regulatory changes are introduced, the difficulties in detection, along with enforcement issues, demands other measures to be taken. In my opinion, the application of an *ex-ante* merger control in order to reduce the level of concentration of markets with algorithmic activity should be one of the options to be considered.

One of the factors which increases the risk of tacit collusion are highly concentrated markets in which identical or similar products are being sold. Therefore, reduction of the concentration level would lead to reduction of risks or, at least, destabilization.

Apart from reducing the concentration level of competitive structures, competition authorities should lower the threshold of intervention and investigate the risk of tacit collusion in merger cases of 5 to 4 firms.

Apart from the enforcement approach, the regulatory perspective should also be addressed. Several proposals have been made on this part, including the modification of the concept of "agreement", the lawfulness of conscious parallelism and regulation of pricing algorithms (i.e., prohibition of algorithms designed to collude). Such regulatory proposals, however, would most likely result in competition restrictions (specifically, the first two options) and outweigh its eventual benefits.

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