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ALGORITHMIC AGREEMENTS AND COMPETITION LAW

KEYWORDS *European Union* *Anticompetitive practices* *Cartel* *Agreement (notion)* *Principle of transparency* *Agency agreement* *Anticompetitive object / effect* *Hardcore restriction* *Algorithms*

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Digital technologies can have both positive and negative effects on competition. The consumer benefits fully from the effect of increased transparency and competition through the posting of rates online. Nevertheless, the consumer could be harmed by the facilitating effect of algorithms in the implementation of a classic cartel (explicit cartel) or of an alignment generated by an indirect form of communication between algorithms (tacit cartel). The emergence of self-learning algorithms that define the best strategy for price optimization could duplicate the human reasoning that leads to cartels. However, European competition law, which firmly prohibits agreements or practices that restrict competition under Article 101 TFEU, is still based on proof of intentional and explicit collusion via contacts between natural and legal persons, which excludes a priori the simple tariff alignment via algorithms. This article aims to take stock of the main real and potential competitive problems posed by possible algorithmic collusion and to evaluate possible avenues for the implementation of "innovative regulation" adapted to these collusive risks. The idea of regulating ex ante the compliance of algorithms or ex post by changing the legal regime or strengthening the digital tools of proof of "tacit collusion" will be

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inally, an innovative approach could be to develop the algorithms n order to allow near real-time monitoring of markets without s to the company's algorithm.

"It is a hypothesis that not all algorithms will have been to law school. So maybe there is a few out there who may get the idea that they should collude with another algorithm who haven't been to law school either […] So of course, we would like to have our own algorithms to be out there, looking into the market, figuring out if there has been collusion taking place." [1]

INTRODUCTION

1. Pricing algorithms [2] have historically been developed in the financial sector, transportation and more recently in online commerce. They are now spreading to many sectors of the economy and are capable of processing a wide range of real-time market data such as competitor prices, demand, availability of substitute products, or the price sensitivity of different consumer groups. [3] While some algorithms have the potential to monitor competitor prices in real time and adjust to them automatically, they can also predict and react to market conditions by automating the response to a given scenario. The software used constantly adjusts market prices based on demand and predictable competing offers, which goes beyond simple competitive intelligence. There are different types of algorithms that serve their own purpose but can have a role in forming a deal.

2. In 2017, the European Commission's e-commerce survey [4] had revealed that two-thirds of retailers were using algorithms to track their competitors' prices. Very recent studies show that latest generation algorithms using, among other things, "*Q-learning*" [5] can learn to get along without formal instruction and without communicating with each other. [6]*Deep Q-learning*" allows this technique to be used through a more complex network of artificial neurons [7] which densifies the complexity of decision making so that it can easily escape the economist or the lawyer.

3. Algorithms can generate efficiencies, [8] but they have an increasing role in the digitalization of business models. There is an ongoing debate on the phenomenon of algorithmic collusion, which could partly escape the description of the classic infringement provided by Article 101 of the Treaty on the Functioning of the European Union (TFEU). By promoting market transparency to the extreme, certain algorithmic systems could in fact create very frequent pricing interactions between competitors without it being possible to detect any explicit communication, contact or coordination between competitors. Although they act unilaterally, the algorithms could lead to a tariff alignment with the same effects as a "tacit agreement", a concept that is only very partially understood by traditional competition law. Indeed, while the law easily recognizes cases where an explicit agreement would be facilitated by software or algorithms, it comes up against problems of qualification and proof that have triggered a debate on whether or not it is necessary to take tacit algorithmic collusion into consideration.

4. The doctrinal state of the art on the need to regulate these pricing algorithms is dense but remains classic with respect to the need to regulate markets in general. The most liberal authors focus on efficiency gains and innovation and find no particular reason to regulate, [9] especially since the extreme transparency of the market would allow consumers to fight cartels. [10] Others believe that the regulator should not aim to minimize prices and should not focus on pricing issues, [11] because below an equilibrium price for producers, overall gains become negative. Conversely, the more interventionist see this as a risk that requires increased regulation, which could go as far as banning certain algorithms. [12] The classicists consider that current competition law is sufficient, that we must wait to better

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ne real competitive risks and "at the same time" remain vigilant for the rench and German competition authorities published a joint report in es in this direction. [13]

5. The detection of explicit collusion remains a priority, because since algorithms do not communicate with each other, it would be illusory to disregard the prior search for an agreement between humans [14] which confers a greater degree of moral and legal gravity. Finally, pragmatists differentiate between types of algorithms and see a greater danger in "*machine learning*" type AI algorithms, as the latter are capable of achieving a tacit agreement on the market in the absence of direct communication between them. [15] As Marie Malaurie-Vignal explains, "*the crime could be perfect. There is no easy intention to implement. It is the algorithm itself that learns to identify this equilibrium* (...) *The fear here would be* (...) *as an economist and as a lawyer, to consider that tacit collusion would be the future of any market in which we would have companies capable of implementing such algorithms*". [16] The submission to the governance of numbers as denounced by Alain Supiot [17] allows an allegiance to technology whose coding content is by definition unfathomable for a human being who cannot apprehend the parameters defined to arrive at the result obtained. The "black box" algorithms can even escape their creators by leading to results that they had not foreseen. In this sense, the classical criterion based on anti-competitive "purpose" and collusive intent between humans could be partly defeated. It requires a review of potential risks (I.) and of regulatory strategies (II.). Among other things, this report recommends studying innovative regulatory strategies. Algorithms could be "pharmakon", both poison and cure. It could be a matter of "defeating evil with evil" by creating "surveillance algorithms" or "warning algorithms" on the markets.

I. ALGORITHMIC CARTELS: THE LIMITS OF TRADITIONAL COMPETITION LAW

6. The use of pricing algorithms by some competitors is not illegal. Nevertheless, new risks of collusion (1.) could be enabled by algorithms and Ezrachi and Stucke have identified and retained certain scenarios [18] among which algorithms could lead to collusion between firms. These new risks are still difficult to grasp under traditional competition law (2.).

1. The new risks of agreements

7. In the simplest version, humans can agree to fix prices for competing products or services and use algorithms to facilitate this agreement. Added to this is a new risk based on the development of "blockchain" systems that allow for precise execution of an illegal agreement. The "hub*and spoke*" scenario is possible when a common intermediary entity facilitates price fixing between competitors who use this platform. The "*predictable*agent" scenario is more difficult to understand: each competitor can develop its software unilaterally so that it takes into account the machine and the behavior of competitors. The*digital*eye scenario is even more complex, as it involves the latest developments in AI, the extent of which may still be underestimated.

1.1 The "facilitating" algorithms of agreement

1.1.1 The messenger scenario

8. In the classic framework of these anticompetitive agreements, collusion is explicit and algorithms can support or facilitate a voluntary agreement between several firms. Software programming allows for the exchange of information and the setting of prices in a discreet manner consistent with the agreement between competitors, which must be characterized by a prior pact. This mainly concerns the implementation by software of price alignment as part of a consensual horizontal cartel strategy. In the context of a vertical cartel (e.g. producer-distributor), algorithms can be used to detect deviations from a fixed retail price or from a

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reed floor price. These algorithms can also allow producers to control against distributors who do not comply with the set prices. The Topkins the first antitrust case involving pricing algorithms in the United States. From September 2013 to January 2014, David Topkins, who specialized in selling posters, was accused of colluding with other poster sellers to manipulate prices on Amazon.com's marketplace dedicated to third-party sellers. The main purpose of the collusion was to set, raise, maintain and stabilize the prices of certain posters sold on the platform, thereby eliminating price competition between sellers. While this type of agreement was classic in terms of the intent element, the algorithm was clearly used to facilitate and execute the agreement. More recently, the electronics manufacturers case has demonstrated that price agreements can be imposed by producers on online distributors. In Europe, electronics producers (Asus, Denon & Marantz, Philips and Pioneer) were monitoring retailers who were overpricing. They monitored the online prices charged by retailers while exerting commercial pressure (threats) that sometimes went as far as retaliation (sanctions or supply closures). By preventing them from lowering their prices, the lack of price competition directly harmed competition. Many retailers used online price-tracking algorithms and automatically adjusted to match the lowest available price, often without being informed of these adjustments. These tools amplify the constraint imposed by manufacturers, which amount to forced selling prices. Algorithms thus tacitly act as cartel facilitators, as they tend to generalize via online trackers the blocking of prices that could not fall below a certain threshold.

1.1.2 Algorithmic collusion via the blockchain

9. The blockchain [**20**] could represent an even greater risk, [**21**] as it would allow for the execution of an agreement between the parties by allowing for precise control of the agreement through "smart contracts". It could be decided to set a price or determine a market share while enforcing the anti-competitive commitment by automatically punishing deviations from the agreement.

1.1.3 The "signal" algorithms

10. A firm may also intentionally but less directly (because unilaterally) propose to its competitors to form a cartel by making public elements that allow competitors to decipher the algorithm or to publicly announce a change in pricing policy. The "signal" algorithm is used to indicate to competitors its intention on the market so that the other party can decrypt this "invitation" and align itself. Thus, it would be possible for a company to test its market position by increasing its prices in order to see if the competitors interpret this signal by aligning themselves upwards. There would be a fine line between legitimate price parallelism and concerted practice. The situation could be discussed on a case-by-case basis depending on the other evidence. In online sales, by definition, since prices are published in real time, all prices are signals. The signal could, however, be interpreted as a change in pricing policy that would be abnormal under historical market conditions.

1.1.4 The hub and spoke scenario

11. According to the OECD, [**22**] hub-and-spoke arrangements "*are coordinated agreements through indirect exchanges between a supplier and a retailer in a vertical relationship and not through direct exchanges between competitors in a horizontal relationship*." Hub-and-spoke agreements are facilitated by software monitoring that allows for the rapid realignment of prices when they diverge from the supplier's recommended prices. Indeed, in the context of vertical relationships, the practice of price fixing by suppliers constitutes a competitive restriction that tends to foster indirect horizontal collusion between retailers. Retailers are supposed to compete independently of the supplier. The alignment of prices between retailers on the products they resell therefore contributes to reducing "intra-brand" competition (or "inter-brand" when the products are incorporated into the distributor's brand).

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ntervention by third-party "enablers" allows competitors to avoid any unication or contact that might prove classic collusion. Ezrachi and ee artificial intelligence and algorithms as potentially contributing to hub-and-spoke collusion. Using the same algorithm, software, intermediary, or common service provider (IT provider) may allow for rate coordination. Rate alignment at the algorithm (code) level is different from alignment at the data level. In the first case, the third party provides not only algorithms with a common purpose such as price calculation. In the second case, competitors can use the algorithm as a means of exchanging information based on a common data pool between them.

13. The difficulty for the regulator lies in the fact that this coordination may be consensual or tacit. When it is consensual, the agreement will be characterized when this information is known and the collusive behavior is expressly intended to avoid the competition rules. When it is tacit, the competitors are unaware that they are using the same software and the coordination is not intentional. According to the [**24**] limited case law in this area, one of the key issues is proving that competitors are aware of the anticompetitive acts or could have at least reasonably foreseen them. In 2016, in the Eturas case, the CJEU [**25**] clarified the conditions for a tacit agreement to qualify as an anticompetitive concerted practice. Eturas operated a joint online travel booking system. Lithuanian travel agencies using this software were able to offer travel on their websites according to a standardized booking method. The software's internal messaging system sent a "pop-up" notification when a travel agency offered a discount of more than 3% off the list price. Higher discounts were not contractually prevented, but additional technicalities were required if they were exceeded, which tended to discourage spontaneous discounts. Although there were no exchanges between competitors or explicit agreements on the obligation to respect an explicit price target, algorithmic programming when coupled with a centralized monitoring and communication system can lead to a collusive effect. A concerted practice was materialized by the simple fact that the travel agencies had "taken cognizance" and had not distanced themselves from this practice. This knowledge raised a presumption of anticompetitive behavior for which the company could not ignore the collusive effect on competition. The Court thus shifted the criterion from "intent" to "awareness" of an anticompetitive practice to characterize the cartel.

1.2 Artificial intelligence algorithms

1.2.1 The*predictable*agent scenario

14. Humans unilaterally define the behavior of the machine so that it reacts predictably to market conditions. The predictable agent scenario does not involve explicit agreement between competitors. Each firm develops its own algorithm unilaterally in order to predict the competitor's rates. By systematizing this model, all competitors will tend to interact with each other. The prediction function generated by the algorithm will allow to analyze and anticipate the competitors' tariff evolutions. This situation will lead to an equilibrium situation that will tend to align the tariffs downwards or upwards. According to Ezrachi and Stucke, this dynamic allows tariff coordination in two ways. [**26**] The first is that the algorithms reach a similar understanding that is not explicitly negotiated, as the algorithms learn to quickly detect and "punish" any price decreases or deviations by competitors. As a result, this market dynamic achieves a supra-competitive price. However, the second concerns the case where the algorithms will lead to parallel behavior that may not be driven by competition, but rather by upward price alignment. While this scenario may result in cartel effects, it does not fit the traditional criteria. Firms and their algorithms are not intended to create a cartel as such, but market transparency taken to the extreme generates cartel effects. More explicitly, a malicious mind could hide behind this impunity offered by technology to hide a real cartel that would be difficult to prove without other evidence.

1.2.2 The "digital eye" or "machine learning" scenario

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ario leaves out any intentional element but delegates the function of strategy to the software. In this "machine learning" framework, the st set both an optimal price to generate profits and a price that does not discourage customers from buying the products or services. As an example, new tools are being developed that detect changes in performance and adapt their strategy according to predefined goals. [27] In the same way that price collusion is an element of rational profit optimization through human agreement, artificial intelligence could enable "conscious parallelism" of behavior. It is possible that the machine will develop self-learning systems that allow it to find an optimal strategy of defining collusion as an optimal strategy and thus lead to rate increases without the legal intent of the cartelists.

2. The difficulty of understanding algorithmic agreements in traditional law

16. Tacit collusion traditionally implies contact between competitors (means), an intention to coordinate their behavior on the market (object) which results in higher prices (effects). Tacit algorithmic collusion is potentially capable of overturning this scheme, because it raises the question of liability, the criteria for qualifying the agreement and the proof.

2.1 The initial problem: The question of responsibility

17. The initial problem in regulating pricing algorithms is determining the scope of responsibility for pricing decisions. Are they made by algorithms or rather by human beings? From a philosophical, theological or religious point of view, God or nature would have created human beings while giving them the freedom and responsibility to act as individuals. Man has created AI, but the latter is not endowed with a total consciousness nor with a total autonomy of reflection. It mirrors the will of its creator but it also has the potential to escape the will of its creator. The apprehension of AI by the law in general requires a public debate that takes into account ethical, legal, economic and social elements. This responsibility could be imputed either to the algorithm itself, or to the humans who implement them, or to neither. [28] The first option seems difficult to implement, because algorithms do not have a legal personality. [29] The third option is not conceivable either, because it would amount to total impunity. The law recognizes only the second possibility, i.e. the responsibility of natural or legal persons.

2.2 The central problem: The criteria for characterizing the cartel

18. Article 101 TFEU prohibits agreements "*which have as their object or effect the prevention, restriction or distortion of competition*". The object is defined by the purpose of the agreement and the effects concern restrictions of competition, such as jointly offering high prices or engaging in abnormal monopoly behavior. While the notion of intent may be debated, it is clear that an agreement is only characterized if the alignment is consciously consented to.

2.2.1 A voluntary and formal agreement to restrict competition

19. Within this traditional framework of Article 101 TFEU, it remains difficult to characterize "signaling algorithms" as "agreements" due to the fact that companies operating these algorithms do not necessarily aim to agree on behaviors and outcomes in a voluntary, conscious, and coordinated manner.

2.2.2 A consciously coordinated practice (concerted practices)

20. The concept of "concerted practice" as set out in Article 101 TFEU and developed by case law allows for the capture of behavior that is not sealed by a prior formal agreement or by a planned follow-up of a cartel. Competition law does not require a formal agreement to be demonstrated in order to prove an anticompetitive agreement. However, a concerted practice requires a "*direct or indirect contact*"

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petitors that has the intention or effect of changing the structure of the Even if the intention to restrict competition through a formal agreement to characterize the object of an illicit agreement, the intention of the parties is not an absolutely necessary element. A more discreet concurrence of wills can be accepted. Case law has long recognized that a cartel may be characterized by "*a form of coordination between undertakings which, without having been carried through to the conclusion of an agreement as such, knowingly substitutes practical cooperation between them for the risks of competition*". [**31**] The freedom of economic agents is limited when any "*direct or indirect contact*" would have "the*object or effect*" of "*influencing the market behavior of a current competitor*" or of "*revealing* (...) *the behavior that one has decided to, or plans to, adopt on the market*". [**32**] Assuming that algorithmic signals can interact with each other, the practice would have to constitute an intended "*direct or indirect contact*" between the parties for the purpose of influencing a competitor's market behavior, or disclosing a course of action so that a competitor can be informed and aligned with that behavior. [**33**] However, pricing algorithms can respond unilaterally to unilateral signals from other algorithms.

2.2.3 Collusion that goes beyond mere price parallelism

21. The mere finding of parallelism in prices or behaviour on the market is not sufficient to demonstrate an anticompetitive agreement. [**34**] Firms are allowed to react to the behaviour of their competitors, including when this consists of aligning themselves with competitors, in the context of a seasonal pricing policy (high demand in the sector for a given period of time, for example) or in the context of an oligopolistic market trend.

2.3 The implementation problem : The issue of proof

22. Algorithmic collusion faces a decisive problem of proof since it cannot be deduced from computer code alone. [**35**] This element must be accompanied by evidence of exchanges or contacts between individuals in order to demonstrate the concerted practice. The most plausible option would be to trace the thread of liability from the agent (the algorithm) to the principal (the human beings who created and implemented it for the purpose of restricting competition). However, this basis for regulation faces a serious problem since this link between machine and human being is by definition unclear or more or less hidden in lines of coding. In the absence of other information, does the code itself detect the illegal nature of the creator's collusive or abusive intent? In *machine learning*, algorithms make their pricing decisions in complete autonomy. In this case, who is responsible? Is an adaptation of the law itself necessary or would the classical framework allow the necessary jurisprudential and regulatory developments?

II. TOWARDS NEW REGULATORY TOOLS

23. The difficulty of understanding in a systemic way the effects of algorithms on competition outside any specific case is real. Nevertheless, algorithms that facilitate or conceal the execution of a prior agreement or that allow a tacit form of collusion collide with certain traditional foundations of competition law, which could require new regulatory tools (1.). If the collusive risk were to become more prevalent, more disruptive measures would have to be considered (2.), bringing innovation into the realm of competition law, which is by its very nature an evolving and pragmatic law.

1. The evolution of traditional competition law?

1.1 A control of the "coordination by design" with access to the algorithmic code

24. Where algorithms facilitate a pre-existing cartel or where they are potentially avoidable by the programmers or users of the algorithm, they could be recognized as practices constituting "coordination by design". [**36**] All of these cases are directly

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ompetition law, as they are related to the collusive intent of firms
.

1.2 Strengthening the evidence without access to the algorithmic code

1.2.1 Audits

25. Algorithms can be analyzed through audits by collecting or simulating data to be used as *input* to a given algorithmic system and then analyzing the *output*, performing a systematic analysis. This type of audit tests a hypothesis by examining the inputs and outputs for bias in the outcome of a decision, as opposed to a broader inspection to determine whether a system complies with specific regulations. A recent report from the UK competition authority [**37**] indicates that it is important to explore avenues for regulating automated systems without direct access to the underlying code of the algorithm. The report cites a study [**38**] in which it was shown that it was possible to identify price discrimination in search results on e-commerce websites (e-commerce, hotels, car rentals). This process consists in determining a search by a control tool in comparison to the real user's search without access to the source code of the algorithm. It was possible to identify sites that modified results based on the user's operating system or browser, the account created on the online retailer's site, and the history of products clicked or purchased. Some travel sites directed users to book hotels with more expensive rates. While the focus here was on identifying price discrimination, a similar technique could be developed to identify collusive price movements to see if competitors' rates react in a coordinated manner based on defined search or personalization criteria.

1.2.2 Mystery shopping

26. Since online pricing has a transparent *output*, it is also possible to study how a virtual [**39**] mystery shopper could test several possible configurations. *Mystery shopping* allows to collect output data according to various input data (queries) by testing to compare results and identify some biases. Concerning online comparators, it has been identified for example that a travel agency or an online comparator can set up a policy consisting in conditioning its ranking or downgrading hotels. This strategy can "discipline" hotels and lead to much less aggressive pricing under certain conditions. [**40**] As in the *Eturas* case, algorithms could therefore lock in the competitive game between retailers in the context of a vertical relationship. It would thus be possible, if proof of this alignment serving the consumer could be provided, to retain an anti-competitive concerted practice.

1.2.3 *Reverse engineering*

27. Algorithmic reverse engineering uses an API to collect a set of data and perform direct testing or emulation of web applications to submit queries with specific data and capture the complete *output*. This allows companies to capture information about their competitors and differentiate themselves or copy their pricing or tariff setting system. Applied to the regulator, the same system would allow to identify and prove certain parallels in the construction of the algorithm itself and not in the final result (tariff).

2. The "disruption" of competition law

2.1 Ex ante regulation through "compliance by design"

28. Compliance by design" would consist in the creation of codes upstream to prevent the risks of collusion. It would allow "*the coding of the goals of competition law, with relatively simple instructions: not to fix prices collectively, not to exchange this or that category of information*". [**41**] The algorithm could also learn to incorporate the rules of competition law by learning not to perform tasks that would not be compliant. It would also be possible to blacklist algorithms that would pose

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isks. In its 2020 resolution, the European Parliament recommends *a comprehensive list of all high-risk AI systems in an annex to the* hat should be reviewed at least every six months, while relying on a committee of national AI experts but also experts in anthropology, sociology and mental health.

29. However, there are several problems with this approach. Firstly, the algorithm can partly escape the will of its creator and create behaviors that were not initially foreseen. Second, there is the risk of giving a "blank check" to an algorithm whose legality may vary according to the environment. Indeed, collusion requires a system where algorithms react to other algorithms. It would therefore be very difficult to say whether an algorithm would be compliant or not. Third, it is always possible for the coder to hide his real intentions through the code or to use a different code once the code is validated. [42]

2.2 The ex post regulation of "tacit algorithmic collusion

30. The OECD notes that algorithms can easily fall into the grey area between explicit and tacit collusion. [43] The question arises as to whether algorithmic collusion constitutes a concerted practice. When there is no communication or contact between natural persons that could formalize an illicit agreement, the parallel use of algorithms could be sufficient to characterize this infringement. Thus, scenarios related to "*machine learning*" and "predictable agent" would constitute cartels that could be retained as such by the competition authorities and the CJEU even if there is no communication and prior agreement between the natural persons. The classic competition law as it has developed through case law would be able to apprehend in part the most serious tacit collusions through case law developments.

31. First, while a public announcement or unilateral signal does not constitute a concerted practice, it is accepted that unilateral public announcements call for responses and "readjustments" by competitors that can be characterized as coordinated behavior. [44] This notion is compatible with pricing algorithms, in the sense that a signaling algorithm sends information to the market and to competitors that calls for a change in their behavior and for pricing adjustments. The frequency of interaction can induce a form of "indirect communication" and a phenomenon of tariff alignment "from above", which leads in game theory to a tacit non-aggression pact. This collusive hypothesis remains rational even with regard to the programming of an algorithm whose purpose is to unilaterally maximize the profit of an agent and to drag the market along with it.

32. Concretely, in a digital market, prices are public and can easily be monitored and copied by algorithms, avoiding the internal cost of determining the optimal price by humans. In some sectors such as retail, prices are almost identical and "*it is often easier to copy competitors' prices than to implement another pricing strategy*". [45] With very little differentiation in distribution products, "*if most distributors align with each other, the entire market can reach an equilibrium price*" [46] anticompetitive.

33. Secondly, although the finding of tariff alignment or parallelism does not constitute an offence in itself, it remains a valuable piece of evidence when corroborated by other elements, the whole constituting a "*cluster of serious, precise and concordant evidence*". [47]

34. The cartel could be characterized when it is shown that the equilibrium price thus obtained is abusive with regard to the effects of the cartel. As for the object of the cartel, if there is no proof of collusive will, the fact remains that a company cannot knowingly ignore that an equilibrium price that remains high on the market entails certain consequences for their liability. This shift from "will" to "awareness" has already been made in the *Eturas*case. [48] This development would not require a change in the legal basis, but the classic scope of tacit collusion is very limited. If it allows the purely "intentional" element to be set aside, it must be linked to elements

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s". This tends to come closer to the classic notion of liability, since any al person cannot ignore the consequences of his acts and is supposed damage generated by the latter.

2.3 "Near-real-time" regulation by "pharmakon" algorithms?

35. According to the philosopher Bertrand Stiegler, all technology is both poison and remedy. [**49**] He borrows the notion of "pharmakon" from Jacques Derrida and Plato. In Greek, "pharmakon" means both remedy and poison. Artificial intelligence contains, as such, the elements of evil and remedy. This "pharmakon" would use the "Achilles heel" of tariff algorithms, which is characterized by the fact that the effects of the algorithms are visible and that any tariff movement can be detected and interpreted by another algorithm that would be programmed for this purpose. This vision offers an avenue for reflection, as it opens the way to the regulation of algorithms by the power of the algorithms themselves. This notion would open a new field [**50**] which could be inserted between the traditional ex ante and ex post regulations by allowing a very rapid gradual ex post reaction by means of alerts once collusive elements have been detected and by offering a very powerful preventive effect, as companies venture into these practices knowing that they are "under the radar" of surveillance algorithms

2.3.1 Surveillance algorithms by "scraping

36. One can imagine tools for detecting online anti-competitive pricing practices using*web-scraping*, which allows one to find, extract and analyze a whole set of online data or to identify "*natural patterns*" that are not visible to the naked eye. [**51**] Some authors have proposed extracting data and using correlation systems between*output* data to assume which*input* data have been programmed. For example, data related to an e-mail or a web search can generate a personalized rate online. [**52**]

2.3.2 Public procurement

37. There are already initiatives such as helping algorithms detect collusion in public procurement. The Commission recently published a Communication [**53**] which encourages competition authorities to "*cooperate in the analysis of public procurement data in order to facilitate the detection of indications of collusion in procurement procedures*" and encourages Member States "*to put in place at national level simple and easy-to-apply methods for collecting and analyzing the large volumes of data available in electronic public procurement databases (possibly using algorithms, artificial intelligence algorithms or machine learning)*.

2.3.3 Drawing inspiration from the regulation of high frequency algorithmic trading

38. Financial markets were one of the first sectors to deploy algorithms through algorithmic trading. The EU Market Abuse Regulation [**54**] criminalizes price manipulation through concerted price fixing. This necessitated the need to regulate by proposing algorithmic "*flagging*". The European directive MiFID II sets the rules that financial institutions must comply with. [**55**] It has been supplemented by a MiFIR regulation specifying the requirements for fee structures. [**56**] Operators are required to keep an accurate and chronological record of all orders placed (order cancellations, executed orders, quotes on trading platforms) in order to ensure the traceability of orders placed at high frequency. The financial authorities and regulators have already put in place algorithmic surveillance systems that allow them to detect movements on the markets and to react quickly to price anomalies.

CONCLUSION

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risk of collusion emerging *via* algorithms may be offset by the extreme rency of the market, the increasing complexity and sophistication of ystems should not be underestimated. Unlike humans who can integrate legal boundaries, algorithms can easily fall into a gray area of competition law that focuses on intent and the voluntary or conscious process leading to the agreement or concerted practice. This can lead to anticompetitive price alignment on the effects but still legal on the object. Part of this phenomenon is likely to escape traditional competition regulation and the most gifted companies in this field will be able to exploit the loopholes in the regulation. It remains legally difficult to apprehend both the anticompetitive object and effect: "[I]*t may be difficult to prosecute such practices* (...) *it is possible that no coordination is necessary to achieve the same supra-competitive results that would result from anticompetitive collusion*". [57]

40. Generally speaking, algorithms do not exchange information, they do not meet, they do not necessarily aim to get along. However, they are capable of facilitating a prior agreement between humans, of being used by several competitors in a similar way, of monitoring retailers in real time, of adjusting upwards, of predicting the behavior of another competing algorithm or of doing self-learning to maximize profitability according to a rational calculation similar to the rational calculation that a human being would do to maximize his profit.

41. Competition law is still based on the incrimination of the most serious cases which concern agreements and intentional practices. However, there are already nuances in the jurisprudence that allow for the incrimination of tacit concerted practices in cases where economic agents could not ignore that their behavior produces the effects of a cartel. This shift from "intention" to "awareness" could allow for a broadening of the criteria. Reinforced by new detection and proof tools, the challenge for the regulator is to move as fast if not faster than companies by developing its digital expertise. This could go as far as the creation of monitoring systems based on algorithms according to a graduated system of alerts to inform companies of a possible or detected risk. Once a suspicious price alignment system has been identified, it would be more difficult for the company to escape by invoking the simple legality of price parallelism. Thus fully aware of the situation, a notion of corporate responsibility for algorithms could gradually take shape: "[A]*now that the idea that algorithms can get along may seem like science fiction, companies must realize that they could be held responsible for everything that the algorithms they develop or use do. They should think about the practical implications of this and the technical ways to prevent collusion between algorithms from happening*. [58]

42. Finally, it is recommended that competition authorities, data scientists, lawyers, economists, researchers, engineering schools and university experts work together to test the collusive potential of certain algorithms on the markets and to propose new regulations adapted to both the French and European levels.

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FOOTNOTES

[1] Margrethe Vestager, European Commissioner for Competition, Belgian Competition Authority conference, May 4, 2018, translation: "It's *reasonable to think that not all algorithms went to law school. So maybe a few might get the idea to collude with another algorithm that also didn't go to law school; So of course we will want to have our own algorithms in the market to look for whether a cartel has been set up.*", www.competitionpolicyinternational.com/eu-regulator-may-create-algorithms-to-find-anticompetitive-pricing

[2] Definition of the CNIL: "*An algorithm is the description of a sequence of steps allowing to obtain a result from elements provided in input. (...) For an algorithm to be implemented by a computer, it must be expressed in a computer language, in the form of software (often also called 'application'). A software program usually combines many algorithms: for data entry, result calculation, display, communication with other software, etc.*" (https://www.cnil.fr/fr/definition/algorithme .)

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[6] E. Calvano, G. Calzolari, V. Denicolò and S. Pastorello, Algorithmic collusion with imperfect monitoring, *International Journal of Industrial Organization*, vol. 79, December 2021, https://www.sciencedirect.com/science/article/abs/pii/S0167718721000059?via%3Dihub : "*We show that if they are allowed enough time to complete the learning, Q-learning algorithms can learn to collude in an environment with imperfect monitoring adapted from Green and Porter (1984), without having been instructed to do so, and without communicating with one another. Collusion is sustained by punishments that take the form of 'price wars' triggered by the observation of low prices. The punishments have a finite duration, being harsher initially and then gradually fading away. Such punishments are triggered both by deviations and by adverse demand shocks.*"See also T. Klein, Autonomous algorithmic collusion: Q-learning under sequential pricing, *RAND Journal of Economics*, vol. 52, no 3, 2021 pp. 538-558, https://onlinelibrary.wiley.com/doi/epdf/10.1111/1756-2171.12383 : "*This article shows that competing pricing algorithms powered by reinforcement learning can learn collusive strategies. This occurs even though the algorithms do not communicate with each other and are only instructed to maximize their own profits (i.e., do not receive any instructions to collude).*"

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See in particular. Q-Learning , DataSicence, https://datascience.eu/fr/apprentissage-automatique/q-learning .

[8] On the demand side, the gains for the consumer are generated by tariff transparency and on the supply side, these gains concern production and transaction costs.

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[11] See, e.g., T. Brennan, Should Innovation Rationalize Supra-Competitive Prices? A Skeptical Speculation, University of Maryland, Baltimore County, paper prepared for the Swedish Competition Authority seminar, November 2017.

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[18] A. Ezrachi and M. E. Stucke, Artificial Intelligence & Collusion: When Computers Inhibit Competition, *University of Illinois Law Review*, vol. 2017, no. 5, 2017, pp. 1775-1809, https://ssrn.com/abstract=2591874 . See also A. Ezrachi and M. E. Stucke, Emerging Antitrust Threats and Enforcement Actions in the Online World, *Competition L. Int'l*, vol. 13, no. 2, 2017, pp. 125-136.

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"[] blockchain *is a register, a large database that has the particularity of being shared simultaneously with all its users, all of whom are also holders of this register, and who also all have the ability to enter data into it, according to specific rules set by a very secure by a very well secured computer protocol thanks to cryptography.*" National Assembly, Information report of the joint information mission on the uses of blockchains (blockchains) and other register certification technologies, December 12, 2018, p. 119.

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[23] A. Ezrachi and M. E. Stucke, Artificial Intelligence & Collusion: When Computers Inhibit Competition, supra.

[24] CJEU, July 21, 2016, *VM Remonts v/ Konkurences padome*, case C-542/14; CJEU, January 21, 2016, *"Eturas" UAB and others v/ Lietuvos Respublikos konkurencijos taryba*, case C-74/14.

[25] CJEU, 21 January 2016, "Eturas" UAB and others v Lietuvos Respublikos konkurencijos taryba, aff. C-74/14: "Article 101(1) TFEU must be interpreted as meaning that, where the administrator of an information system, intended to enable travel agencies to sell travel on their internet site, using a uniform booking method, sends those economic operators, by means of a personal electronic message, a message warning them that the discounts relating to products sold through that system will henceforth be capped and that, following the dissemination that the system in question is undergoing the technical changes necessary to implement this measure, the said economic operators may, from the moment they of the message sent by the system administrator, they may be presumed to have participated in a participated in a concerted practice within the meaning of that provision, if they refrained from distancing themselves publicly from that distanced themselves publicly from the practice, did not denounce it to the administrative entities or did not or have not provided other evidence to rebut this presumption, such as evidence of of a systematic application of a discount in excess of the cap at issue."

[26] A. Ezrachi and M. E. Stucke, Artificial Intelligence & Collusion: When Computers Inhibit Competition, *supra*.

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[29] The European Parliament adopted a resolution (P9_TA(2020)0276) at the end of 2020 with recommendations on a civil liability regime for artificial intelligence, which states that AI systems "*almost always have as their starting point a person who develops, deploys or disrupts a system*" and "there*is no need to confer legal personality on AI systems.*"

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According to the glossary of the European Commission: "*Coordination between undertakings which, without having gone so far as to conclude a formal agreement, have knowingly adopted a practical cooperation rather than expose themselves to the risks of a competitive market. A concerted practice may consist of direct or indirect contacts between undertakings the intention or effect of which is either to influence market behaviour or to make known to their competitors the behaviour they intend to adopt*in the future" (https://www.concurrences.com/IMG/pdf/glossary_competition_archived_fr-4 . pdf ? 51122/8e2d7dfa651bb28cd3a8ac47538776ee3f232cc4).

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[33] R. Steppe, Algorithmic pricing and tacit collusion under competition law, *International Economic Law Review* 2019/3 (vol. XXXIII), pp. 347-361.

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[39] Mystery shopping is a technique of "masked" control of the quality and service of a company in the form of an audit by sample.

[40] M. Hunold, R. Keisler, and U. Laitenberger, Hotel Rankings of Online Travel Agents, Channel Pricing and Consumer Protection, *Discussion Paper* No. 300, Dusseldorf Institute for Competition Economics, September 2018, https://www.dice.hhu.de/fileadmin/redaktion/Fakultaeten/Wirtschafts

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wissenschaftliche_Fakultaet/DICE/Discussion_Paper/300_Hunold_Kesler_Laitenberger.pdf : "*In a longer term perspective, an OTA may also employ a policy of conditioning its ranking directly on price differentials of hotels across channels and in particular rank hotels with a lower price elsewhere worse. A more drastic down-ranking might not even be in the short-term interest of the OTA as described above. However, such a policy can discipline hotels and thus lead to much less aggressive prices elsewhere. If it is very effective, it can even lead to equal prices across channels like a (successfully enforced) price parity clause. This drastic down-ranking can ultimately raise the OTA's profits even more than the short-run profit maximization.*

[41] J.-C. Roda, La compliance by design en antitrust: entre innovation et illusion, in *Les outils de la compliance*, M.-A. Frison-Roche (ed.), Journal of Regulation & Compliance and Dalloz, 2021, pp. 257-266.

[42] M. Malaurie-Vignal, Algorithmes et concurrence, *Contrats, conc., consom.* no 6, June 2021: "Example: the pricing algorithm will 'officially' take into account the prices of several companies and their average, but in reality, the prices charged by this or that company will be the only ones that will be decisive for the algorithm."

[43] OECD, Algorithms and Cartels, 2017, supra, p. 29, § 60: "algorithms allow firms to substitute tacit coordination for explicit agreement".

[44] Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal cooperation agreements, supra, § 63.

[45] For an example of thinking about quantitative *supply chain* optimization and this mechanism, see G. Grasset, Alignment des prix, Lokad (Quantitative Supply Chain), https://www.lokad.com/fr/d%C3%A9finition-alignement-des-prix .

[46] Ibid.

[47] Aut. conc. decision no. 05-D-65 of November 30, 2005 concerning practices in the mobile telephony sector, § 234.

[48] See *above*.

[49] https://www.espace-ethique.org/ressources/article/ bernard-stiegler-a-man-of-thought-and-action.

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Regulation (EU) No. 596/2014 of the European Parliament and of the Council of 16 April 2014 on market abuse, *OJEU* No. L 173, 12 June 2014, p. 1, Art. 12, § 2(a):"[L]*he securing by one person or by several persons acting in concert of a dominant position in the supply of or demand for a financial instrument, related spot commodity contracts or auctioned products based on emission allowances, with the effect, actual or potential, of directly or indirectly fixing prices or the creation or potential creation of other unfair trading conditions. unfair trading conditions*" (https://eur-lex.europa.eu/legal-content/FR/TXT/PDF/?uri=CELEX:32014R0596&from=FR).

[55] Markets in Financial Instruments Directive. Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments, OJEU No. L 173 of June 12, 2014, p. 349, pt 67: "In*order to ensure effective supervision and to enable competent authorities to take appropriate and timely action against irregular or dishonest algorithmic strategies, it is necessary to mark all orders generated by algorithmic trading. Through marking, competent authorities should be able to identify and distinguish between orders generated by different algorithms and effectively reconstruct and evaluate the strategies used by traders using algorithms. This should mitigate the risk that orders are not unambiguously attributed to an algorithmic strategy and trader. Marking allows competent authorities to react effectively and efficiently to algorithmic trading strategies that constitute abusive behavior or pose a risk to the proper functioning of the market*" (https://eur-lex.europa.eu/legal-content/FR/TXT/PDF/?uri=CELEX:32014L0065&from=EL).

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[58] V. Freshfields, *supra*.

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AUTHOR

Romain Papy
Dassault (Paris)

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