ALGORITHMIC PRICING AND MARKET COORDINATION – TOWARD A NOTION OF 'COLLUSIVE RISK'

PRECIOS ALGORÍTMICOS Y COORDINACIÓN DE MERCADOS – HACIA UNA NOCIÓN DE 'RIESGO COLUSIVO'

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Over the past couple of years, many competition and antitrust scholars have feared the dawn of 'algorithmic collusion'. Some have thus suggested expanding the notions of 'collusion' and 'agreement' in order to capture such coordination.

Rather than using an expansive reading of 'collusion', the author of this article suggests an approach that works with the core and original intent of Article 101(1) TFEU: the fostering of independent conduct and prevention of market coordination. It finds this to be doctrinally undisputed and also consistent with long-standing competition policy debates, as well as an egalitarian notion of price that lays the foundation of the free market economy. On this basis, and considering given uncertainties, an operational notion of 'collusive risk' is put forward.

KEYWORDS: algorithmic pricing; collusive risk; Article 101(1) TFEU; artificial intelligence, coordination.

En los últimos años, varios investigadores especializados en temas de competencia han evidenciado cierto temor por el surgimiento de la llamada 'colusión algorítmica'. A este respecto, algunos de ellos han sugerido expandir los conceptos de 'colusión' y 'acuerdo' con el propósito de englobar los alcances de este tipo de coordinación.

A diferencia de la mayoría de trabajos, la autora de este artículo propone una aproximación que se adecúe a la intención central y originaria del artículo 101(1) del Tratado de Funcionamiento de la Unión Europea: la promoción de conductas independientes y la prevención de la coordinación de mercados. Este artículo concuerda con que lo anterior es indiscutible doctrinariamente y también que se condice con los permanentes debates sobre políticas de competencia, así como con la noción igualitaria del precio que yace en las fundaciones de la economía de libre mercado. Sobre la base de ello, y tomando en consideración determinadas incertidumbres presentadas, se propone una noción operacional de 'riesgo colusivo'.

PALABRAS CLAVE: precio algorítmico; riesgo colusivo; artículo 101(1) del Tratado de Funcionamiento de la Unión Europea; inteligencia artificial; coordinación.

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I.   INTRODUCTION

This paper looks at the impact that the large-scale implementation of algorithmic pricing could have on competition law, in particular competition law's primary rule: the absence of collusion and the securing of independent and rivalrous conduct.

The literature has already described the most likely scenarios of algorithmic collusion. While some authors treat these as single or unlikely cases that are shrouded in uncertainty and unlikely to occur, this paper tries to look at the changes that are occurring as a more fundamental and far-reaching phenomenon, thereby warranting further inquiry and legal attention. The paper then explores the current suggestions on how to capture algorithmic collusion with the competition law toolkit. It finds that the debate on the expansion of the notions of 'agreement' or 'concerted practices' is somewhat circular and has reached a dead end. Instead of working purely semantically and expansively, this paper then turns to the core principles of the prohibition of collusion and finds that while communication has served the central requirement in the analog world, the underlying purpose and function of this rule is not so much rooted in communication, but rather seeks to prevent coordination and market alignment as much as possible.

This paper argues that this reading is not only consistent with EU case law and competition law doctrine, but also with theoretical and policy debates concerning 'tacit collusion'. It is further in line with commonly accepted egalitarian conditions for market conduct found in contract law and contract theory. Finally, it finds that while an extension of the competition law toolkit is currently difficult and untimely, the development of an operational notion of 'collusive risk' would enable the development of a consistent regulatory framework. While this article deals primarily with EU competition and Article 101 (1) of the Treaty on the Functioning of the European Union (TFEU) –the EU's rule against collusion in the form of agreements between undertakings that restrict or distort competition–, its assumptions and findings apply to other jurisdictions.

II.   DEFINITIONS

A.   Algorithms

While the word 'algorithm' has fallen into common usage, it is seldom defined with great specificity or even consistently (ADLC/BKartA, 2019, p. 3; Organisation for Economic Co-operation and Development [OECD], 2017, p. 8). The term algorithm describes a systemized procedure or method to solve problems rather than an abstract and unimplemented mathematical formula. For the digital algorithms, relevant to this article provide the following definition: "any well-defined computational procedure that takes some value, or set of values, as input and produces some value, or set of values, as output". An algorithm is thus "a sequence of computational steps that transform the input into the output" (Cormen *et al*., 2009, p. 5). While this paper focuses primarily on pricing algorithms, it should be noted that algorithms that track, rank and match market data –as well as algorithms able to customize their output based on consumer or user data– are also a part of larger pricing infrastructures[1].

B.   Artificial Intelligence

Equally, the debate on how to define artificial intelligence or the "science and engineering of making intelligent machines" (OECD, 2017, p. 9) seems to range from AI being synonymous with 'software' to a kind of 'black-box' scenario where AI is an autonomous system that we cannot fully comprehend. The Organisation for Economic Co-operation and Development (OECD) paper on algorithms and collusion defines artificial intelligence as "the broad branch of computer science that studies and designs intelligent agents who should be able to carry out tasks of significant difficulty in a way that is perceived as intelligent" (2017, p. 10).

Regarding the pricing algorithms relevant to this paper, both definitions seem appropriate. Schwalbe, who calls algorithms "a fancy term for software", also highlights the varying degree of their complexity and autonomy, stating that

> some are just very simple heuristic rules of thumb […] [but] at the other end of the spectrum there are much more complex pricing algorithms based on deep neural networks that are also used in self-driving cars, natural language processing, image recognition and automatic translation (2018, p. 7).

C.   Machine Learning

Schwalbe uses Mitchell's definition to describe machine learning as a field of computer science that produces AI systems which can learn functional relationships from data without the need to define (or program) these relations *a priori*:

> A computer program is said to learn from experience E regarding some class of tasks T and

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[1]   See also ADLC/BKartA (2019, p. 5).

performance measure P if its performance at the task in T, as measured by P, improves with experience E (Mitchell, 1997, p. 2).

Commonly three different types of machine learning (supervised learning, unsupervised learning and reinforcement learning) are distinguished from the so-called deep learning (OECD, 2017, p. 8 *et seq*.). Deep learning uses a complex set of artificial neural networks to replicate human neurons, making the learning process complex and capable of abstraction, rather than just linear (OECD, 2017, p. 11). In addition, Calvano, Calzolari, Denicolo and Patorello (2019) have been using Q-learning methods or reinforced learning algorithms, which use a policy or strategy rather than a model, to show the emergence of advanced autonomous pricing algorithms. In addition, their paper claims that experimental and behavioral use of such algorithms "display a stubborn propensity to collude" (Calvano *et al*., 2019, p. 4).

III.   SOME NOTES ON PRICING

Today, most consumers are accustomed to standard prices or price tags. In contrast, dynamic pricing refers to a manner of determining product prices in a fluid rather than static manner based on a timely analysis of market conditions (Hwang & Kim, 2010). In addition, customized prices –"a form of price discrimination that involves charging different prices to consumers according to their willingness to pay" (OECD, 2018, p. 2)– have also become a commonplace in the pricing of goods and services in the digital economy. Both methods of pricing are forms of algorithmic pricing.

Contrary to our experience, however, individual pricing has been the norm for most of human history and may very well have been the underlying mechanism that lay the foundation for classical economic theory –Adam Smith's 'invisible hand'. Up until about 1870, the prices of most goods

were–, haggled over and stores employed clerks to negotiate individual prices for almost every customer. It was only with the rise of the department store that these clerks were rationalized and replaced by the price tag[2]. The deregulation of airplane travel and airfare pricing in the 1970s made this the first sector to see the return of individual prices and the first use of dynamic pricing methods (Mehra, 2016a, p. 1336)[3].

By and large, the rise of dynamic and algorithmic pricing in the retail sector is celebrated for its contribution to efficiency and transparency. It does, however, also lead to a further abstraction of the price for consumers, meaning that consumers have even less say in or autonomy over the prices they ultimately pay. In addition, it carries risks of unseen collusion and unfair discrimination[4].

The analysis that follows will highlight the importance of independent and rivalrous conduct, not only as a normative parameter in competition law but also as an assumption of how markets function. For over 250 years, the market myth –the idea that the ingredients of rivalry and freedom stir up the so-called 'invisible hand' and lead to advantageous results– has fared pretty well as an institution that distributes wealth and stipulates the value of almost every economic interaction in society. In addition, much of the promises of the free market are expressed in price. Price nominally expresses consumer surplus but is also an expression of an egalitarian method of bargaining and commensuration (Markovits, 2014).

Thus, competition law's fixation on price is owed to the fact that no other parameter is as decisive a yardstick for competition or the absence thereof. With the exception of monopoly profits and fixed prices, it is also commonly accepted that there is no such thing as a nominally 'fair' or 'just'; 'unjust' or 'unfair' price[5]. Instead, prices are deemed fair by virtue of being the product of a fair competitive

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[2]   As the legend goes, standard prices were first introduced by Quakers who adhere to strict equal pricing rules. When the Quaker founder of Macy's —Rowland Hussay Macy— first introduced the price tag, other major department stores soon followed in order to be able to compete on price and save the costs of employing persons to bargain and barter prices individually. See Goldstein (2015).

[3]   Mehra writes:
    Initially, however, it denoted pricing based on proxies for competitive intelligence about demand, such as time of day, season, or weather. For example, airlines increase their price of tickets to Colorado ski destinations based on the availability of snow, and electrical utilities charge less per kilowatt-hour during night-time, when air conditioning is used less (2016, p. 15).

[4]   See Wagner and Eidenmüller (2018).

[5]   Andrews says
    Adam Smith's "natural price" has long been interpreted as the "normal price" or 'centre of gravitation price' based on the famous gravitation metaphor of the Wealth of Nations, natural in the sense that it is the price that would result if competition were truly free, unobstructed by monopoly or government regulation, and could also therefore be called normal price, appealing to a sense of natural as opposed to that which is produced artificially (2014, p. 42).

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process –the power of supply and demand–. Fundamental changes to the pricing system and risks of collusion do not only threaten to break the central rule of competition law but could also endanger core normative assumptions and mechanisms in free-market societies.

IV. ALGORITHMIC PRICING AND COLLUSION

Commonly, three scenarios in which algorithmic pricing can lead to collusion have been identified. They are discussed below and range from collusion merely being facilitated by algorithms, to the hypothetical scenario where algorithms autonomously develop strategies to collude without recognizable human intent or intervention.

A. Three Scenarios

1. Algorithms as Facilitators (Scenario 1)

The first scenario does not pose any novel competition law challenges. Here, algorithms are used unilaterally to implement, monitor or enforce previously agreed horizontal or vertical collusion or concerted practices. They thus "execute the will of humans in their quest to collude" (ADLC/BKartA, 2019, p. 60). In these scenarios, the necessary contact between competitors has usually been established prior to the use of the algorithm (Ezrachi & Stucke, 2017, pp. 1175, 1182). This kind of facilitation can include messages not to undercut certain prices or not to target each other's customers. Such facilitation can, however, also be used to stabilize collusion, whether it be by scanning and monitoring the market for deviation, or by devising strategies that make collusion harder to detect (ADLC/BKartA, 2019, pp. 27-28; Ofgem, Decision of 26.07.19, p. 92 *et seq*.). In all of these cases, the infringement of article 101 (1) TFEU lies in prior communication, but the facilitation by use of algorithms can support the authorities' case and help trace the infringement.

The unilateral use of pricing algorithms by undertakings also bears a further risk: the facilitation of collusion and market alignment by means of the parallel use of a very similar or the same algorithm by several competitors. In this context, the UK Competition & Markets Authority (CMA) has pointed out that

> [...] if the competitors are aware or able to infer that they are using the same or similar pricing algorithms, firms would be better able to predict their competitors' responses to price changes, and this might help firms to better interpret the logic or intention behind competitors' price-setting behavior (2018, p. 25).

2. Algorithms and New Pricing Infrastructures (Scenario 2)

The second scenario describes new pricing infrastructures that use algorithms to determine the price charged by numerous users (Ezrachi & Stucke, 2017, pp. 1775-1782) by better and more effectively reading the market, creating transparencies and facilitating the implementation of far-reaching strategic pricing choices. Such an infrastructure most commonly appears in the shape of the so-called 'hub and spoke model'.

This can be illustrated using the example of Uber:

Central to the mechanisms is its use of market scanning intelligence or price reading algorithms allocated in the 'hub' (in this case Uber), which has several vertical agreements with the so-called 'spokes' (the drivers). There are also horizontal agreements amongst the spokes to adhere to the hub's terms and pricing policy. In many cases, hub and spoke systems are used to communicate market information, but not to coordinate pricing. In Uber's case, however, prices are unilaterally set by the hub, they then must be adhered to by the spokes, and sent to the consumers as 'take it or leave it' prices. Uber's pricing mechanism itself has been subject to extensive scrutiny.

While some claim that Uber uses this algorithm to set prices rather than to determine the market price, others go as far as to consider Uber a monopolist in its own market (Mehra, 2016a, p. 1324), rather than a competitor in a far larger market for all ride services ranging from traditional taxi services to all app-driven systems. Much of the legal analysis of this question has turned on the market definition but also on the question of whether Uber and its drivers form a single economic entity within the meaning of article 101 (1) TFEU. Thus, far this has largely fallen in favor of Uber.

In other cases, the 'hub'–and primary holder of the algorithm– is often a separate company and not identical to each of the individual spokes. Here, the hub is used to exchange market information amongst the 'spokes'. The 2016 E-TURAS Judgment, for example, deals with the coordination of prices set by travel agencies that were part of the Lithuanian E-TURAS system.

E-TURAS was a platform used to disseminate travel and flight information and to provide each participating travel agency with an electronic account and access to an internal mailing system. Trouble arose when the administration of the E-TURAS system sent all spokes or travel agencies a message suggesting a reduction of discounts, thereby insti-

gating a common minimum price strategy. Whilst some travel agents had clearly responded and acted on these messages, others had either distanced themselves from these suggestions or not responded or even opened the messages. The Lithuanian Supreme Administrative Court (SACL) sought guidance on the necessary conditions for a concerted (collusive) practice from the Court of Justice of the European Union (*E-TURAS,* 2016). In previous judgments, set in the analog world, the Court held that an exchange of price-sensitive information can suffice to prove concerted practices and that such practices can be "established solely on the basis of uniform or parallel conduct if collusion between undertakings constitutes the only plausible explanation for such conduct" (*Solvay v Comm'n*, 1995, para. 85; *Wood Pulp II*, 1993, para. 71). Despite the novelty of the E-TURAS Case, the Court of Justice of the European Union (CJEU) affirmed that concerted practices can be inferred "from a number of coincidences and indicia which, taken together, may, in the absence of another plausible explanation, constitute evidence of an infringement of the competition rules" (*E-TURAS,* 2016, para. 36; *Total Marketing Services v Commission*, 2015). Substantively, the E-TURAS Judgment saw sufficient evidence for the participation in a concerted practice by travel agents a) applying technical modifications necessary to implement that measure and b) having some awareness of the message.

The E-TURAS Judgment has shown that, to date, the standard competition law toolkit can suffice to deal with digital and algorithm-driven cases. It has also shown that digital infrastructures can be seen as structures that facilitate collusion and do not have to be treated as a mere manifestation of the logic of the market (as stated by Uber[6]) but are very much part of the conditions for and indicia of collusion.

3. Genuine Algorithmic (Black Box) Collusion (Scenario 3)

The third scenario of collusion is a big subject of debate in the literature since it encompasses collusion not only as being facilitated by autonomous algorithms but also as being fully performed and executed by them. The assumption or fear is that "through self-learning and experiments, machines independently determine the means to optimize profit" (Ezrachi & Stucke, 2017, p. 1783). This scenario assumes possible collusion that was not pre-programmed and which cannot be linked to human will or intent or be observed by humans. Hence, it is the result of an artificially intelligent learning process that takes place inside a black box. Ezrachi and Stucke have suggested two such scenarios. The first is the so-called **'predictable agent'** whereby "humans unilaterally design machines (or algorithms) to deliver predictable outcomes and react in a given way to changing market conditions" (Ezrachi & Stucke, 2017, p. 1783). Such algorithms are designed to read the market, monitor price increases (executed by other algorithms) and execute price-setting commands. A heightened risk of collusion is, however, dependent on an industry-wide adoption of similar algorithms, where these algorithms transform the market and increase its transparency.

The second and most controversial one is the **'digital eye'** scenario. It describes an algorithm that is used unilaterally to achieve a set target by means of machine learning and the adoption of the optimal strategy. In theory, the digital eye would be programmed to exclude a strategy of outright collusion, and tacit collusion would seem unlikely given the market conditions but could find ways to either circumvent these or increase market transparency to a degree where conscious parallelism becomes feasible and sustainable (Ezrachi & Stucke, 2017, p. 1795 *et seq.*).

Whilst the likelihood of such conduct occurring is currently and highly unlikely (Ittoo & Petit, 2017; ADLC/BKartA, 2019; Schwalbe, 2018, p. 2[7]), some authors assume that "with the industry-wide use of computer algorithms, we may (even) witness conscious parallelism in markets with many more players, where collusion previously would have been unstable" (Ezrachi & Stucke, 2016, p. 77).

B. First Conclusions

When looked at separately and on a case-by-case basis, it appears that the three scenarios in which algorithms facilitate collusion can either be captured with the standard competition law toolkit or are still shrouded in too much uncertainty to war-

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6   As Uber's CEO has stated: "[W]e are not setting the price, the market is setting the price… [W]e have algorithms to determine what that market is". By this account, the market is both an independent force of nature that determines prices, but also paradoxically a result constructed at least in part by a proprietary algorithm. See also Stoller (2014).

7   See Schwalbe:

       There is, however, a debate whether the concern that self-learning, price-setting algorithms are indeed able to behave in a coordinated way and charge inflated prices like a monopolist is justified or whether this discussion belongs to the realms of legal sci-fi (2018, p. 2).

rant changes to competition law. This analysis does not, however, consider, how the large-scale introduction of pricing algorithms and new pricing infrastructure may affect the workings of markets on a whole and the application of competition law to it. While, in the past, the so-called 'oligopoly problem' (which will be analyzed later on) has been treated as a largely theoretical problem rather than a pressing concern and enforcement deficiency, this may be wildly different in future markets. Markets in which almost all parameters are being newly invented and established by algorithmic design may set the stage for far more transparency and more diverse forms of large-scale coordination. Thus, new pricing dynamics and increased transparency in markets may call for a much closer evaluation of this problem on all levels of competition policy[8].

V. CONSIDERING FUTURE ALGORITHMIC COORDINATION

A. Algorithm-Driven Markets and Larger Scale Coordination

While the chances for genuine algorithmic collusion remain uncertain (Calvano *et al.*, 2019; Deng, 2018; Klein, 2019) and some have argued that these depend on technological developments but also on shifts in market conditions that are currently not foreseeable (Ittoo & Petit, 2017), there are further factors and reasons why such a development should be observed closely. Alongside a set of factors that already require regulatory attention, two lines of argument favor a closer look at capturing potentially collusive or coordinating conduct.

First, the law often makes precautions for risks and even sheer uncertainties of where the protected goods or principles are sufficiently important. What is at stake here is not a mere infringement of competition laws, but a loss of faith in the price mechanism –its fairness and lack of corruption– and thereby in the pillar of the free-market economy and its distributing and commensurating function in society at large.

Second, it is highly likely that digital markets will see far more coordination and forms of alignment in the future, and that the collusion we know from the analog world will merely be one of the mul-

tiple forms of coordination in the future. One factor leading to more overall coordination is the far-reaching and large-scale future use of pricing algorithms. Two-thirds of all online retailers already use such pricing mechanism and the online retail sector continues to grow exponentially (Gal, 2019). Here, the potential use of the same or parallel algorithms by competitors makes more coordination and greater market alignment immediately viable. In addition, the speed of the developments –as well as their effects on market transparency– are pertinent factors to take into consideration. While an increase in transparency can mean that consumers have information and thus more agency, many oligopolistic theories of harm strongly correlate with an increase in transparency (Ezrachi & Stucke, 2017, p. 1797; 2020, p. 230).

B. Prevention of Coordination and the Protection of Competitive and Independent Rivalry as the Normative Foundation of Article 101 (1) TFEU

1. Article 101 (1) TFEU

All competition laws and antitrust traditions and lines of scholarship agree on the prohibition of collusion and that cartels constitute "the cancer of economies" (Monti, 2000) or the "supreme evil of antitrust" (*Verizon v Trinko*, 2004). Article 101 (1) TFEU prohibits all agreements, decisions and concerted practices –understood broadly as "joint conduct with an element of collusion" according to Jones and Sufrin (2019, p. 165)– that restrict competition and affect trade between member states. To date, collusion has always arisen from the actions of individuals (Jones & Sufrin, 2019) and their expression of the joint intention to substitute the risks of competition for practical cooperation (Göhsl, 2018).

Hence, the notion of the agreement "centers around the concurrence of wills" (*Bayer AG v Comm'n*, 2000, para. 2 and 173). It is interpreted broadly and without any requirement of a particular formal manifestation (Wish & Bailey, 2018, pp. 101-102), so long as there is evidence of the faithful expression of will and the intention to act cooperatively (*Bayer AG v Comm'n*, 2000, para. 69; *Bundesverband der Arzneimittel-Importeure eV v Bayer AG*, 2004). Proof of this agreement must constitute

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8   See Calvano, Calzolari, Denicolo & Patorello:
     In most countries, tacit collusion is not now regarded as illegal. The rationale is twofold. First, tacit collusion is held to be a chimera: illusory and practically impossible to achieve. And second, the position that is that even if tacit collusion nevertheless occurred, it would be hard to detect (2019, p. 4).

the existence of the subjective element that characterizes the very concept of the agreement, that is to say, a concurrence of wills between economic operators on the implementation of a policy, the pursuit of an objective, or the adoption of a given line of conduct on the market, irrespective of the manner in which the parties' intention is expressed (*Bayer AG v Comm'n*, 2000, paras. 2, 173).

Expanding on this, 'decisions by association of undertakings' encompass collusive arrangements that are coordinated through the conduct of association of undertakings.

As a third variation, 'concerted practices' capture forms of coordination between undertakings which, "short of the conclusion of an agreement properly so-called, knowingly substitute cooperation between the undertakings for the risk of competition" (*Dyestuffs*, 1972, para. 64). This means that the agreement does not need to have reached the stage of formal conclusion and can be replaced with an implied by other reactive means of coordination. In fact, even in the absence of an agreement altogether or the working out of a common plan, there can be enough evidence of contact and reciprocal influence to assume coordination by means of concerted practices. Thus, any direct or indirect contact can be sufficient, if its object or effect is to influence the conduct of competitors or to disclose its own conduct (*Suiker Unie and Others v Comm'n*, 1975, para. 26; *T-Mobile Netherlands BV and Others v Raad*, 2009, para. 26). However, in terms of evidence, both contact and subsequent anticompetitive behaviors require proof (Gal, 2019; Gata, 2019; van Cleynenbruegel, 2014; Whelan, 2013), as concerted practices do not encompass coordination that is achieved 'over the market' or any other form of 'conscious parallelism'. For instance, in the famous *Wood Pulp* case, the Court of Justice found no collusion by undertakings that had announced price increases in advance, because this information had rapidly spread across the market via the trade press and become common knowledge to all buyers and sellers (*Wood Pulp II*, 1988).

All three terms (agreement, concerted practices, decisions by association of undertakings) are fluid and overlap. There are no legal consequences in

finding evidence for one or the other. The distinction between concerted practices and conscious parallelism thus forms the outer limits of what is still considered 'collusion' within the meaning of Article 101 (1) TFEU.

2.   Expansive Reading of the Requirements of Article 101 (1) TFEU

While algorithms induced or aided collusion in scenarios 1 and 2 and then have found solutions using the current competition law toolkit, this does not hold for potential future forms of genuine algorithmic or 'black box' collusion (scenario 3). Here, the lack of communication or pre-programmed intent means that the requirements of Article 101 (1) TFEU are not met. Many authors have thus said that the shift from standard to dynamic pricing warrants a closer look at potentially expanding the scope of the meaning of 'agreements' or 'concerted practices'. In this context, the OECD concludes that algorithms may "expand the grey area between unlawful explicit collusion and lawful tacit collusion" and thereby "may enable firms to replace explicit collusion with tacit co-ordination" (2017, p. 25).

Thus far, the lines of argumentation that accept this challenge work expansively with the current rules of competition law, thereby trying to bring them to their natural conclusion and encompassing their full adaptation to the digital world[9]. One such line of argumentation dates back to the early Chicago School of Antitrust's formulation of 'tacit collusion' and Richard Posner's conclusion from 1968 that "there is no distortion of accepted meanings (of an 'agreement') in collusions where sellers, for example, 'communicate' (non-verbally) by restricting their output and this is 'accepted' by their rivals in restricting their output as well" (1968, p. 763)[10]. This argument is conclusive when considering its normative goal: treating all forms of conduct with the same effect on efficiency equally. The use of an analogy, however, shows that it is purely rhetorical and not a full interpretative argument. It does not address any of the notions such as the concurrence of wills, expressed intent or communication, which are usually associated with the term 'agreement'. And while Posner's—and more recently Kaplow's (2013)—analysis and analogy may hold for instances of "signal-

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9   See Akman (2019).

10   In his seminal paper, Posner wrote:
     The dictionary is no longer a fashionable aid to statutory interpretation, and for good reason: context is vitally important. Nonetheless, an attempt to torture statutory language very far from accepted meanings does place the burden of explanation on the proponent of the interpretation. There is no distortion of accepted meaning, however, in viewing what I have termed accepted collusion as a form of concerted rather than unilateral activity. [...] A seller communicated his offer by restricting output and the offer is "accepted" by the actions of his rivals in restricting their output as well. (1968, p. 763).

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ing" (OECD, 2017, p. 30)[11], it is likely that other instances of alignment or cooperative behavior, in particular when induced by algorithms, cannot be captured by such an analogy. Rather than providing a sound solution, this points to one of the fallacies when thinking about problems relating to artificial intelligence. In an almost Turing test-like manner, we look at scenarios in the digital world by trying to compare them as closely as possible to such scenarios in the analog world. But just as the fact that an object such as an airplane can fly does not imply a bird would confuse it for another bird (Bratton, 2015), we may soon be entering a pricing world where coordination does not have the same feature as traditional collusion, so analogies fall short. While Posner can claim that he does not need the analogy to determine an anti-competitive price but can use price theory instead he does need a formulation of a legal standard for illegality.

Another such expansive reading of competition rules to fit the digital economy is an analysis based on the MasterCard Decision of the European Commission (*MasterCard*, 2007). The Commission concluded that all merchants participating in the MasterCard payment system constitute an 'association of undertakings' and their pricing policy as 'decisions' that manifestly align their market behavior, thereby constituting collusion. Pieter van Cleynenbruegel suggests applying this expansive interpretation to the use of parallel or uniform algorithms by platform, albeit viewing the platform itself as an 'association of undertakings'. Hence, the pricing strategy or conduct inferred by these algorithms could constitute a decision of such an association when "used to align business behavior (and) its effects replace the need for physical contact" (van Cleynenbruegel, 2020, p. 439). While this reasoning could potentially turn all platforms into formal cartels, it remains unclear which (non-communicative) algorithmic conduct would constitute a decision. This is a question van Cleynenbruegel does not (and, to be fair, cannot) answer and turns instead to a method of 'co-regulation' to develop such parameters in the future.

3.   Basing Further Analysis on the Original Intent of Article 101 (1) TFEU

Not in negation, but in awareness of the constraint of the above-mentioned arguments, this article, however, takes another (albeit, for the time be-

ing, non-conclusive) approach. Instead of expanding the scope of the rule, it looks at its underlying function and intent. While 'communication' has served as pertinent guidance for finding undue coordination in the analog world, I argue that the underlying intent and function of Article 101 (1) TEFU is not to prevent communication as such, but rather to prevent forms of coordination and cooperation that stifle competition and inhibit independent conduct and rivalry.

Since the terms 'agreement', 'concerted practices' and 'decisions by associations of undertakings' overlap, it follows that the collusion or coordination they intend to catch is the same in nature[12] and that they serve the identical legislative intent. To find the underlying intent and function of Article 101 (1) TFEU, it thus seems prudent to consider the full scope of the collusive conduct it captures. This means looking at both its core and most archetypal forms of conduct, as well as at its boundaries or outer limits, that mark which conduct is still captured by the provision. While the term 'agreement' in conjunction with the cases listed under Article 101 (1) (a)-(e) shapes the core of Article 101 (1) TFEU, its outer limits are found at the point of distinction between illegal 'concerted practices' and 'conscious parallelism'.

Turning to the 'core' of Article 101 (1) TFEU, the famous Dyestuffs Judgment looks at price-fixing as the prototypical form of an anti-competitive agreement. It uncovers the essential function of Article 101 (1) TFEU as a rule seeking to prevent coordination and removal of uncertainty and rivalry that is synonymous with competition:

> The function of price competition is to keep prices down to the lowest possible level [...]. Although every producer is free to change his prices, taking into account in so doing the present and foreseeable conduct of his competitors, nevertheless it is contrary to the rules on competition contained in the Treaty for a producer to co-operate with his competitors, in any way whatsoever, in order to determine a coordinated course of action relating to a price increase and to ensure its success by prior elimination of all uncertainty as to each other's conduct regarding the essential elements of that action, such as the amount, subject-matter, date and place of such changes (*Dyestuffs*, 1972, paras. 9-10).

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[11]   See OECD:
"[A]lgorithms might reduce or even entirely eliminate the cost of signalling, by enabling companies to automatically set very fast iterative actions that cannot be exploited by consumers, but which can still be read by rivals possessing good analytical algorithms. [...] For instance, firms may program snapshot price changes during the middle of the night, which won't have an impact on sales but may be identified as a signal by rival's algorithms." (2017, p. 30).

[12]   See Wish & Bailey (2018, p. 101 *et seq.*).

The importance of independent, rivalrous and non-coordinated conduct as a general rule in competition law, is, however, illuminated most clearly in cases that define the boundaries of Article 101 (1) TFEU by distinguishing between cooperative or collusive concerted practices and mere parallel behavior or conscious parallelism. The early Polypropylene Commission Decision (1986) held that

> the importance of the concept of concerted practices does not result so much from the distinction between it and an agreement as from the distinction between forms of collusion falling under Article 101 (1) and mere parallel behavior with no element of concentration (*Polypropylene*, 1986, para. 87).

More recently, the Dole Food Judgment (2015) –which involved the exchange or pre-price and estimated pricing information concerning green bananas and their ripening fee by transatlantic food dealers and traders– found that coordination and cooperation are necessary components for finding concerted practices and that these are to be interpreted in light of the notion that undertaking must act independently –"each economic operator must determine independently the policy which he intends to adopt on the common market" (*Dole-Food*, 2015, para. 119; *T-Mobile Netherlands and Others*, 2009, para. 32)– even when adapting to market conditions or to the anticipated conduct of competitors. It further states that this notion is inherent to the treaty provisions on competition (*DoleFood*, 2015, para. 119). Concerning notions inherent to the provisions of the treaty, the T-Mobile judgment previously found that:

> While it is correct to say that this requirement of independence does not deprive economic operators of the right to adapt themselves intelligently to the existing or anticipated conduct of their competitors, it does, none the less, strictly preclude any direct or indirect contact between operatory by which an undertaking my influence the conduct on the market of it actual or potential competitor or disclose to them its intentions or decisions concerning its own conduct on the market where the object or effect of such contact is to create conditions of competition which do not correspond to the normal conditions of the market in question, regard being to the nature of the products or services offered, the and number of the undertakings involved and the

volume of the market (*T-Mobile Netherlands and Others*, 2009, para. 33).

Whilst coordination is not sufficient to find a violation of Article 101 (1) TFEU and both the finding of collusive cooperation and the absence of independent conduct (or the "intelligent adaptation to existing or anticipated conduct of competitor") requires an element of intent and (at least indirect) communication, the avoidance of coordination rather than communication shapes the purpose of Article 101 (1) TFEU. Thus, avoiding coordination and fostering independent conduct and rivalry –rather than looking for conduct analogous to communication– should serve as a guiding star when considering an expansion of the competition law or regulatory law toolkit to capture yet to be determined forms of algorithmic collusion.

C.   Evidence from the Law and Economics Literature on 'Tacit Collusion'

The reading that independent conduct or rivalry underlies current competition law provisions is also consistent with the renowned Posner-Turner debate or 'oligopoly problem' that gave rise to the notion of 'tacit collusion' in the 1960s. While this is often seen as a debate on the semantic limitation of the terms 'agreement' and 'collusion', a closer look reveals that the underlying argumentation on both sides turns on what should reasonably be expected from economic agents acting intelligently and independently.

The 'oligopoly problem' concerns instances where there is a high degree of interdependence and mutual self-awareness in oligopolistic markets. By definition, these are characterized by price transparency, product homogeneity, high barriers to entry and few market players. Tacit collusion or price-fixing 'via the market' can hence occur without the need for express communication.

Posner's solution to the oligopoly problem is the legal adoption of the 'subtle' and 'simple' approach developed by George Stigler, "and to treat such collusion as a special case of a more general economic theory of collusive pricing" (Stigler, 1968, p. 39). With the help of an economic analysis –price theory and so-called facilitating practices[13]– Posner looked for an all-purpose rule to prevent monopoly and collusive pricing (Posner, 2011, p. 60). In his analysis cartels and other forms of collusive

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[13]   See Page:
Posner suggests that, where practices like these do facilitate price coordination, court should in some cases hold firms liable for tacit collusion. And Donald Turner, who otherwise believed tacit collusion to be beyond the reach of Sec 1 agreed with Posner in this point (2012, fn. 61, pp. 173 & 180).

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conduct may vary in formality, but the effect of collusion, whether formal or tacit, is the same. As is, Posner suggests, the rationality or risk taken by these firms, including the expected punishment costs. Only the threat of punishment can adequately influence that calculus in the case of tacit collusion and by deterring it. Under these assumptions, all forms of collusion –from the formal cartel to tacit collusion– would be punishable under Section 1 of the *Sherman Act* (conspiracy or agreement). Enforcement would be focused on price theory-evidence of collusion and the so-called 'facilitating practices' that usually accompany collusive conduct due to the volatile and unstable nature of any collusion. Posner's approach is a response to the so-called 'interdependence theory'. This theory is focused on the structural and strategic interdependence of firms in a close oligopoly, rather than on the naturally resulting collusive or monopolistic pricing and was put forward as a legal doctrine by Donald Turner. According to this theory, oligopolists are interdependent in their pricing: they base their pricing decisions in part on anticipated reactions to them the result is a tendency to avoid vigorous price competition (Turner, 1962). This interdependence, however, means that oligopoly pricing is rational conduct under given circumstances and that demand oligopolists price, otherwise would not only be unfair as a matter of law but would also make full compliance nearly impossible.

Whilst Posner does not disagree with this, he sees no reason not to change the companies' rationale by making the threat of illegality part of the rational calculus. Turner instead turns to what he deems to be the core of the problem: the structure of the market. Turner sees oligopolistic pricing as a structural flaw and one leading to monopolization or an attempted monopolization of the industry and deems merger control regulation or an illegality/divestiture under Section 2 appropriate[14]. There are many reasons why the Chicago School has never been in favor of structural remedies, least of which divestiture, and the purity and almost evangelical simplicity of its own theory (based wholly in price theory and mathematical mod-

els) is only one of them. Posner further feels that Turner's assumption of linear rational behavior is an overstatement, as it ignores both time lags and strategic moves –which are typically attributed to game theory– but also already appear in Stigler's oligopoly theory of pricing. Hereby, companies do not move in isolation but very much in awareness of each other's past or future strategic moves; if collusive pricing is intolerable, then the punishment of a collusive move must be part of the risk of an illegal or at least anti-competitive strategy.

It is perhaps worth noting that Posner has recently retracted from this original position. Though not in principle, but in light of doubts concerning the efficacy of any form of price regulation: "[...] I now think that I didn't sufficiently appreciate the force of Turner's doubts about the feasibility of an antitrust remedy for tacit collusion" (Posner, 2014).

It is not entirely clear what the current literature hopes to gain from this seminal debate[15], since neither Posner nor Turner actually linguistically or legally expand the term 'agreement'. I have shown that it does however –possibly more than any other debate in antitrust scholarship– highlight the fundamental and principal assumptions and conditions that justify the respective interpretation of the functions of antitrust law.

D. Consistency with Liberal Contract Law Theory and Other Fields of Market and Price Regulation

Lastly, the notion of independent, rivalrous conduct is also consistent with liberal contract theory in so far as it establishes egalitarian conditions for contracts ('the freedom of contract') and bargaining in the free market economy. Contract law is important regarding competition law issues since contracts form the basis and provide the legal construction of most market conduct. An infringement of the conditions of both contract and competition laws (unconscionability or monopoly price) results in the contract being void and thereby illegal market conduct. In the context of contract law, Dan-

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[14] See Turner: "If effective and workable relief requires a radical structural reformation to the industry, this indicated that it was the structural situation, not the behaviour of the industry members, which was fundamentally responsible for the unsatisfactory result" (1962, p. 671).

[15] See Ezrachi and Stucke:
To illustrate this possibility, imagine an oligopolistic market in which transparency is limited and therefore conscious parallelism cannot be sustained. Under these relatively competitive market conditions, the firms will compete as expected. Now, think of the basic conditions for tacit collusion/ conscious parallelism. Suppose that to shift price transparency from humans to computers, each firm must increase price transparency. Now both the firm's customers and rivals can promptly observe all the competitively significant terms. Indeed, competitors may, like high-speed traders, have the incentive to invest in technology that allows them to see the competitively significant terms a few seconds before customers. Also, suppose that the products are relatively homogenous. By shifting pricing decisions to computer algorithms, competitors increase transparency, reduce strategic uncertainty, and thereby stabilize the market. In such a market, tacit collusion may be sustained, leading to supra-competitive prices (2017, p. 1790).

iel Markovits' seminal work, 'Market Solidarity', describes the function of price (the outcome or product of contracts) as a process of commensuration, a term he borrows from economic sociology whereby commensuration is the expression or measurement of different entities according to a common metric. According to Markovits, "market prices establish an inter-subjective, commensurating value frame in which all market-participants, whatever their private beliefs and preferences, enroll" (2014, pp. 7-10). Markets are thus "aggregative rather than discursive mechanisms, which operate not through judgement so much as will" (Markovits, 2014, pp. 7-10). The primary condition for commensuration is the formal (egalitarian) equality of all participants. This requires all market participants to be **'price-takers'** and not **'price-makers'**. Demanding (only) that all market participants be 'price takers' translates into nothing other than the normative demand that all agents act independently and thus in the complete absence of monopoly power and collusion.

E. Conclusions

Not knowing the exact unfolding of future scenarios or their scale, it is difficult to expand the competition law toolkit or to find new definitions or distinctions. However, looking at the underlying assumptions and the primary purpose of Article 101 (1) TFEU can help to map the parameters for future tools and distinctions. Given the importance of non-coordinated, independent conduct to the functioning of the pricing and free-market systems as a whole, it seems plausible to introduce interim regulation to better understand the development of algorithmic pricing and to develop rules and mechanisms in order to prevent coordination and anti-competitive market alignments in the future.

VI. REMEDIES

This article has highlighted both the importance of safeguarding the pricing system from collusion and coordination (market corruption), as well as given reason to assume that the further development of pricing algorithms and concurrent market changes jeopardize this. Since some scenarios of algorithmic coordination would not meet the requirements of Article 101 (1) TFEU as a matter of

semantics, this article has looked at the original intent of Article 101 (1) TFEU to establish a basis for future regulatory intervention. The finding that the intent of Article 101 (1) TFEU is the protection of independent rivalrous conduct and the avoidance of coordination and market alignment is, however, still too broad to inform a future extension of the competition law toolkit. Such an endeavor is further made impossible by the uncertainty of what such scenarios may look like in the future. This does not, however, mean that such risk is unworthy of regulatory attention. Given the importance of non-coordination, the literature has already produced a range of regulatory ideas –from market observation to strict 'command and control'– rules, such as the introduction of an *ex ante* or *ex post* prohibition of algorithms capable of colluding 'by design'. There have also been calls for soft-law interventions, regulatory sandboxes or introducing a method of co-regulation –the involvement of governmental or regulatory as well as private actors in the development, setting and enforcement of regulatory standards[16] (Marsen, 2011; Finck, 2018; van Cleynenbreugel, 2020)–. Since (interim) regulation and competition law can be seen as mutually reinforcing tools and regulatory attention seems sensible and unavoidable, I would last like to frame the regulatory aim as one dedicated to avoiding further coordination or 'collusive risk'.

VII. TOWARDS A NOTION OF 'COLLUSIVE RISK'

In light of numerous and far-reaching uncertainties and to prevent and study the future emergence of new forms of algorithmic collusion and unwanted types of coordination and market alignment, it seems prudent to develop a notion of **'collusive risk'**. Developing such a notion serves several functions: it recognizes the threats inherent to the ongoing and dynamic changes and further abstractions of our pricing systems, it cements the aim of future regulation and it gives regulatory intervention a succinct legal basis and clarity regarding its intent.

Since we have yet to see real-world examples of genuine or black box collusion, deeming this a 'risk' seems fitting and valuable. Indeed, much of the legislation concerning uncertain technological advances in critical fields (pharmaceuticals, nucle-

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[16] *See* van Cleynenbreugel:
Under this framework, platforms would be responsible for setting up compliance schemes to ensure compatibility with Article 101. In doing so, they would be guided by clear red flags (unacceptable types of behaviour) and green flags (acceptable algorithmic tasks) set out beforehand by the European Commission. The grey zone in between would be the subject of detailed protocols developed by the platforms, demonstrating awareness of and remedies in case of infringements of competition law. At least three key building blocks of such a co-regulation framework would need to be distinguished, two of which require Commission intervention and a third one that asks platforms to complement those initiatives (2020).
For the most basic definition of co-regulation, see European Commission (n.d.).

ar energy, harmful materials) –as well as legislation in the field of artificial intelligence– deals with the same problem: that of uncertainty. While the notion of 'risk' is often seen as synonymous or close to that of a threat of a danger, 'risk' essentially captures scenarios that are uncertain, unpredictable, or even unknowable (Mendelsohn, 2019). Where the goods to be protected or conduct to be avoided is of inherent value or importance, the mere risk of their harm can already legitimize regulatory intervention. The existence of collusive risk would thus merit the design of regulatory rules or principles that guarantee a high level of rivalry and prevent harmful forms of cooperation and market coordination in the future. Though much of the future of algorithmic pricing is uncertain and unknowable, both non-corrupted prices and independent or rivalrous conduct shape the very cornerstones of competitive markets. Algorithmic collusion has the potential to undercut these and transform future markets –leading to higher prices and consumer harm (Ezrachi & Stucke, 2020)–.

It will be up to future theorists and regulators to balance collusive risk against the promised efficiencies of dynamic pricing. In this context, it is, however, worthwhile to remember, that it is not only low prices and efficiencies that have made markets and prices the primary institutions and mechanisms for ordering our societies for over two centuries. Markets also guarantee freedoms and even cradle the conditions for humanity and solidarity. 🏛

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