

GIUSEPPE COLANGELO* - FRANCESCO MEZZANOTTE**

THE EVOLVING (?) NOTION OF ‘AGREEMENT’
IN THE AGE OF ALGORITHMS.
INTERACTIONS
BETWEEN ANTITRUST AND CONTRACT LAW

ABSTRACT. By affecting business strategies and consumers’ behavior, the wide-scale use of algorithms, prediction machines and blockchain technology is currently challenging the suitability of several legal rules and notions which have been designed to deal with human intervention. In the specific sector of antitrust law, the question is arising on the adequacy of the traditional doctrines sanctioning anticompetitive cartels to tackle coordinated practices which, in the absence of an explicit “meeting of the minds” of their participants, may be facilitated by algorithmic processes adopted, and eventually shared, by market actors. The main concern in these cases, discussed both at regulatory and academic level, derives from the general observation that while the traditional concept of collusive agreement requires some form of mutual understanding among parties, nowadays decision-making of firms is increasingly transferred to digitalized tools. Moving on from these premises, the paper investigates the impact that the rules applicable to the conclusion of (smart) contracts may have, from an antitrust law perspective, in the detection and regulation of anticompetitive practices.

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* Jean Monnet Chair in *European Innovation Policy* and Associate Professor of *Law and Economics*, University of Basilicata

** Associate Professor, Private Law, Roma Tre Law Department.

1. *Introduction*

There's a red thread linking together the foundational elements of contracts, as comparatively detectable in modern systems of law, and the more specific notion of cartels or concerted practices, that is of interest for antitrust experts: both of these disciplines have as their basis some form of mutual understanding between parties aimed at coordinating the behavior of two or more subjects according to a certain "common meeting of the mind"¹.

In dealing with juridical rules depending on the existence and on the nature of the psychic states of the agents, a modern approach to the juridical phenomenon starts from the recognized impossibility of actually scrutinizing the inner forum of single individuals and (even more clearly) legal entities, and therefore of grounding certain technical notions – such as that of agreement – on purely subjective and intellectual elements².

In this regard, the abandonment of the nineteenth-century theories inspired by the dogma of the will goes hand in hand with the progressive emergence of an array of external indices on the basis of which legal systems have been prompt to consider the presence and the substantive content of a promise exchanged among the parties³. As a significant example, the standard rules on the formation of the contract offer a very effective representation of the close interdependence that exists between the legally binding manifestations of the will and the techniques available to legal subjects to mutually exchange information and communications⁴.

In this context, the most recent diffusion of digital technologies and

¹ On the different possible ways interrelation between contracts (as a primary manifestation of private autonomy) and regulatory tools (as those provided for by antitrust law), it appears still useful the analysis of C.R. SUNSTEIN, *Paradoxes of the Regulatory State*, in «University of Chicago Law Review», 57, n. 2, 1997, pp. 407-441.

² E. PEEL, *Treitel on the Law of Contract*, Thomson-Sweet & Maxwell, London, 2015¹⁴, para. 1-002.

³ For an overview of the history of concepts, P. SIRENA, *Introduction to Private Law*, il Mulino, Bologna, 2020³, p. 315; P. ZIEGLER, *Der subjektive Parteiwille. Ein Vergleich des deutschen und englischen Vertragsrechts*, Mohr Siebeck, Tübingen, 2018, pp. 25-30.

⁴ R.B. Schlesinger (ed.), *Formation of Contracts. A Study for the Common Core of Legal Systems*, Dobbs Ferry, New York-London, 1968.

automatized processes represents only the latest form of manifestation of an evolutionary path that has always called the interpreter to adapt the operational consequences of a pre-judicial notion, such as that of agreement, to the particular forms and tools available to the parties which mutually express their positions and, ultimately, their consent⁵. At the same time, the development of transactions based on the operation of algorithms, such as those that characterize smart contracts (especially when powered by blockchain technology), may appear so disconnected from human activity as to question the very premise of the discourse, namely that at the basis of a given legal effect there is an agreement between two or more subjects, inspired (at least indirectly) by their individual determination⁶.

In this framework, the intensive application of algorithmic technologies in entrepreneurial transactions is more recently raising peculiar issues from the point of view of antitrust law, where some form of conscious coordination between undertakings is considered necessary in order to trigger the enforcement mechanisms meant to sanction anticompetitive practices. It then becomes crucial for legal theorists and public bodies to examine the relationship between the meeting of the mind and the meeting of algorithms, in order to clarify whether the latter is (or should be treated as) a modern substitute for the former, or whether there is still room to ground on the free determination of market-actors the results of an entrepreneurial activity based on the automation granted by digital processes.

The article proceeds as follows. Section (2) sets the scene of the analysis by describing how digital technologies are currently challenging legal remedies commonly applied by antitrust authorities against anticompetitive cartels; Section (3) looks at the issue through the more traditional lens of contract theories, which allow to widen the

⁵ R. WEBER, 'Smart Contracts: Do we need New Legal Rules?', in A. De Franceschi and R. Schulze (eds), *Digital Revolution - New Challenges for Law*, C.H. Beck-Nomos, München-Baden-Baden, 2019, pp. 299, 307; D. DEFOSSEZ, *Acceptance sent through email; is the postal rule applicable?* in «Law, State and Telecommunications Review», n. 23, 2019, p. 11.

⁶ See R. JANAL, 'Fishing for an Agreement: Data Access and the Notion of Contract', in S. Lohsse, Schulze and D. Staudenmayer (eds), *Trading Data in the Digital Economy: Legal Concepts and Tools*, Hart-Nomos, Baden-Baden, 2017, p. 271; but with a different approach, A.U. JANSSEN, 'Demystifying smart contracts', in C.J.H. Jansen, B.A. Schuijling and I.V. Aronstein (eds), *Onderneming en Digitalisering*, Wolters Kluwer, Deventer, 2019, p. 15.

investigation with a parallelism taken from the constitutive elements of agreement, commonly understood as an essential condition for a valid transaction. Section (4) concludes the analysis with a preliminary assessment of the main policy options that are currently animating, both at regulatory and academic level, the debate on a need to reform some of the foundational doctrines of antitrust law.

2. *New challenges to antitrust law*

Because antitrust rules have been designed to deal with human facilitation of coordination, they require some form of mutual understanding among firms looking at the means of communication used by players in order to coordinate, while mere interdependent conduct or collusion without communication (conscious parallelism) is lawful.

In particular, the caselaw has clarified that, irrespective of the form, the existence of an agreement requires ‘a concurrence of wills’ on the implementation of a policy, “the pursuit of an objective, or the adoption of a given line of conduct on the market”, the form in which it is manifested being unimportant so long as it constitutes the faithful expression of the parties’ intention⁷, or a “meeting of minds”, “a unity of purpose or a common design and understanding,” as well as “a conscious commitment to a common scheme”⁸.

Further, in the EU it has been introduced the concept of concerted practices, defined as any direct or indirect contacts intended to influence the conduct of other firms, with the aim of filling potential gaps by precluding coordination between firms which, «without having reached the stage where an agreement, properly called, has been concluded, knowingly substitutes practical co-operation between them for the risks of

⁷ Case T-41/96, *Bayer AG v. Commission* [2000] ECR II-3383, paras. 69 and 173. See also Case T-208/01, *Volkswagen AG v. Commission* [2003] ECR II-5141.

⁸ *Interstate Circuit Inc. v. U.S.*, 306 US 208, 810 (1939); *American Tobacco Co. v. U.S.*, 328 U.S. 781, 809-810 (1946); *Monsanto Co. v. Spray- Rite Service Corp.*, 465 U.S. 752, 768 (1984).

competition»⁹. Moreover, in order to tackle forms of coordination which are intermediate between agreements and conscious parallelism, courts have intervened in case of plus factors and facilitating practices (such as price announcements and information exchanges).

Nonetheless, given that under certain conditions oligopolists can coordinate their business behaviors without entering into an arrangement, antitrust authorities have traditionally struggled with tacit collusion. Therefore, the very notion of agreement has been questioned because deemed to be too formalistic, hard to make operational, and unconnected with the modern theory of oligopoly. Notably, it has been suggested to reform the agreement requirement by interpreting it as applicable to all interdependent behavior that is successful in producing oligopoly prices¹⁰.

In this framework, the wide-scale use of algorithms and the emergence of blockchain technology are currently posing even growing challenges to antitrust practitioners and experts.

2.1 *Collusion by algorithms*

Pricing algorithms, i.e. algorithms that use price as an input and/or use a computational procedure to determine price as an output¹¹, may make explicit collusive agreements more stable, by making it easier to monitor prices, thereby limiting the incentives to deviate or helping to detect deviations, and they may promote new forms of tacit collusion by triggering automatized coordination independently of any human intervention and even autonomously learning to play collusive strategies (so-called algorithmic collusion).

The main concern posed to regulatory bodies is that algorithms (in particular,

⁹ Cases C-48, 49, 51-57/69, *ICI v. Commission (Dyestuff)* [1972] ECR 619.

¹⁰ L. KAPLOW, *On the Meaning of Horizontal Agreements in Competition Law*, in «California Law Review», 99, 2011, p. 683.

¹¹ UK Competition and Markets Authority, *Pricing Algorithms* (2018) 9 <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/746353/Algorithms_econ_report.pdf>.

self-learning algorithms) may amplify the oligopoly problem expanding the grey area between unlawful explicit collusion and lawful tacit collusion by coordinating independently of human intervention and even autonomously learning to collude without communicating with one another¹².

Two approaches have emerged within the law and economics literature. According to a first strand, algorithmic collusion represents a realistic scenario and may eventually disrupt antitrust law¹³. In contrast, other scholars highlight the lack of evidence downplaying algorithmic collusion as merely speculative and further arguing that the expanding use of algorithms raises familiar issues to antitrust enforcers that are well within the existing canon¹⁴.

Policy makers and competition authorities have endorsed a wait-and-see approach so far. According to the UK Competition and Markets Authority (CMA),

¹² OECD, *Algorithms and Collusion: Competition Policy in the Digital Age* (2017) 25 and 34-36 <www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm>.

¹³ See, e.g., S. ASSAD, R. CLARK, D. ERSHOV, and L. XU, *Algorithmic Pricing and Competition: Empirical Evidence from the German Retail Gasoline Market* (2020) CESifo Working Paper No. 8521 <www.cesifo.org/en/publikationen/2020/working-paper/algorithmic-pricing-and-competition-empirical-evidence-german>; Z.Y. BROWN and A. MACKAY, *Competition in Pricing Algorithms* (2020) Harvard Business School Working Paper No. 67, <<https://hbswk.hbs.edu/item/competition-in-pricing-algorithms>>; E. CALVANO, G. CALZOLARI, V. DENICOLÒ, and S. PASTORELLO, *Artificial Intelligence, Algorithmic Pricing and Collusion* (2020), 110 *American Economic Review* 3267; E. CALVANO, G. CALZOLARI, V. DENICOLÒ, and S. PASTORELLO, *Algorithmic Pricing: What Implications for Competition Policy?* (2019) 55 *Review of Industrial Organization* 1; A. EZRACHI and M. STUCKE, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (Cambridge-London: Harvard University Press, 2016); J.E. HARRINGTON, *Developing Competition Law for Collusion by Autonomous Price-Setting Agents* (2018) 14 *Journal of Competition Law and Economics* 331; S.K. MEHRA, *Antitrust and the Robo-Seller: Competition in the Time of Algorithms*, (2016) 100 *Minnesota Law Review* 1323.

¹⁴ See, e.g., L. BERNHARDT and R. DEWENTER, 'Collusion by code or algorithmic collusion? When pricing algorithms take over' (2020) 16 *European Competition Journal* 312; A. GAUTIER, A. ITTOO, and P. VAN CLEYNENBREUGEL, 'AI algorithms, price discrimination and collusion: a technological, economic and legal perspective' (2020) 50 *European Journal of Law and Economics* 405; A. ITTOO and N. PETIT, 'Algorithmic Pricing Agents and Tacit Collusion: A Technological Perspective', in H. Jacquemin and A. De Streel (eds), *L'intelligence artificielle et le droit* (Bruxelles: Larcier, 2017), 241; J. JOHNSON and D. SOKOL, 'Understanding AI Collusion and Compliance', forthcoming in D. Sokol and B. van Rooij (eds), *Cambridge Handbook of Compliance* (Cambridge: Cambridge University Press, 2021); M.K. OHLHAUSEN, 'Should We Fear The Things That Go Beep in the Night? Some Initial Thoughts on the Intersection of Antitrust Law and Algorithmic Pricing' (2017) 11 <www.ftc.gov/public-statements/2017/05/should-we-fear-things-go-beep-night-some-initial-thoughts-intersection>; U. SCHWALBE, 'Algorithms, Machine Learning, and Collusion' (2019) 14 *Journal of Competition Law & Economics* 568.

algorithmic pricing is more likely to exacerbate ‘traditional’ risk factors facilitating collusion in markets which are already susceptible to human coordination¹⁵. In a similar vein, the French and German antitrust authorities, as well as the UK Digital Competition Expert Panel, have concluded that, in the situations considered so far, the current legal framework is sufficient to tackle possible competitive concerns¹⁶.

The European Commission, instead, appeared ready to endorse a proactive approach. Indeed, it published an open public consultation on the need for a new competition tool that allows intervention when a structural lack of competition prevents the market from functioning properly, such as oligopolistic market structures with an increased risk for tacit collusion, including markets featuring increased transparency due to algorithm-based technological solutions¹⁷. However, in the proposal presented in December 2020, the planned new competition tool has been folded into the Digital Markets Act and apparently watered down into market investigations that will allow the Commission to update the obligations for gatekeepers and design remedies to tackle systematic infringements of the Digital Markets Act rules¹⁸.

Therefore, at this stage a complete reshape of the current antitrust has been considered exaggerated. After all, antitrust authorities have been already able to tackle the algorithmic-facilitated coordination in some scenarios. Indeed, antitrust authorities have detected cartels implemented thanks to the use of dynamic pricing algorithms, i.e. software designed to monitor market changes and automatically react adjusting conspirators’ prices in order to avoid eventual undercuts¹⁹. Admittedly, in this scenario,

¹⁵ UK Competition and Markets Authority, ‘Pricing Algorithms’, 48.

¹⁶ Autorité de la Concurrence and Bundeskartellamt, ‘Algorithms and Competition’, (2019) <www.bundeskartellamt.de/SharedDocs/Meldung/EN/Pressemitteilungen/2019/06_11_2019_Algorithms_and_Competition.html>; UK Digital Competition Expert Panel, ‘Unlocking digital competition’, (2019) <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/785547/unlocking_digital_competition_furman_review_web.pdf>.

¹⁷ European Commission, ‘New Competition Tool’, Inception impact assessment (2020) <ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12416-New-competition-tool>.

¹⁸ European Commission, ‘Proposal for a Regulation on contestable and fair markets in the digital sector (Digital Markets Act)’, COM(2020) 842 final.

¹⁹ See European Commission, 24 July 2018, Case AT.40465 (*Asus*), AT.40469 (*Denon & Marantz*), AT.40181 (*Philips*), AT.40182 (*Pioneer*); UK Competition and Markets Authority, 12 August 2016, Case 50223, *Online sales*

the algorithms play a secondary role serving as a mere tool to facilitate and enforce an explicit coordination already established between humans, hence it is not problematic to evaluate these conducts within the standard definition of agreement and concerted practice.

However, as previously mentioned, pricing algorithms may also lead to tacit coordination and may extend tacit collusion beyond the boundary of oligopoly. In particular, the collusive outcome may be reached via third party algorithms, companies could unilaterally use algorithms to facilitate conscious parallelism, and finally self-learning algorithms may even autonomously collude.

Under the first hypothesis, competitors adopt the same algorithmic pricing model and third-party providers of algorithm services act as a hub in a so-called hub-and-spoke scenario, allowing a coordination without the need of direct communication or contact between the companies. And the CMA has considered this hypothesis of conspiracy as the most immediate risk²⁰. Nonetheless, it poses competition issues that could be addressed under existing antitrust rules. Indeed, according to the caselaw, because it is the rim that connects the spokes, proof of a hub-and-spoke cartel requires evidence of a horizontal agreement among the spokes (the so-called rim requirement), being discussed the level of knowledge required to the spokes, i.e. awareness or just foreseeability²¹.

Nonetheless, two additional hypotheses appear more troublesome from the perspective of the antitrust enforcement. Notably, companies may unilaterally design pricing algorithms to react to rivals' pricing or may rely on algorithms which, learning by themselves, may arrive at tacit coordination, without the need for any human intervention and without communicating with one another. In the former case, because algorithms have been designed to respond intelligently to the conduct of competitors, the mere interaction of algorithms increases the likelihood of reaching a conscious

of posters and frames; U.S. Department of Justice, 6 April 2015, *U.S. v. David Topkin*.

²⁰ UK Competition and Markets Authority, 'Pricing Algorithms', 31.

²¹ See, e.g., Case C-74/14, *Eturas UAB and others v. Lietuvos Respublikos konkurencijos taryba* [2016] 4 CMLR 19; *United States v. Apple, Inc. (The eBook Case)*, 791 F.3d 290 (2nd Cir. 2015).

parallelism, without requiring companies to engage in any communication²². Hence, the question for antitrust enforcers is whether this algorithmic interaction may constitute a form of coordination (algorithmic communication), facilitated for instance by signalling practices. In the latter case, because there is no human intervention and no communication between algorithms, it may be even questioned the possibility to attribute their conduct to a firm.

Against this backdrop, it comes as no surprise that the growing use of algorithms in business decision-making has reinvigorated the debate about the need to revisit the antitrust notion of agreement.

2.2 *Collusion by blockchain*

Rather than debating on algorithmic collusion, a recent strand of literature urges to investigate the potential anticompetitive use of blockchain technology²³. Indeed, the antitrust enforcement is designed to tackle issues where market power is centralized, consequently it appears at odds with decentralization²⁴.

As the argument goes, while algorithmic collusion remains old wine in new bottles, i.e. a new way of implementing well-known practices, blockchain-based collusion, especially when it involves the use of smart contracts, changes the nature of collusion creating an almost infinite number of possibilities for antitrust infringement²⁵.

²² M. VESTAGER, 'Algorithms and Competition' (2017) Remarks at the Bundeskartellamt 18th Conference on Competition <https://ec.europa.eu/competition/speeches/index_theme_17.html>.

²³ See J. ABADI and M. BRUNNERMEIER, 'Blockchain Economics' (2018) NBER Working Paper No. 25407 <www.nber.org/papers/w25407>; C. CATALINI and C. TUCKER, 'Antitrust and Costless Verification: An Optimistic and a Pessimistic View of Blockchain Technology' (2019) 82 *Antitrust Law Journal* 861; L.W. CONG and Z. HE, 'Blockchain Disruption and Smart Contracts' (2018) NBER Working Paper No. 24399 <www.nber.org/papers/w24399>; A. DENG, 'Smart Contracts and Blockchains: Steroid for Collusion?' (2018) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3187010>; T. SCHREPEL, 'Collusion by Blockchain and Smart Contracts' (2019) 33 *Harvard Journal of Law & Technology* 117.

²⁴ CATALINI and TUCKER, 'Antitrust and Costless Verification: An Optimistic and a Pessimistic View of Blockchain Technology'.

²⁵ SCHREPEL, 'Collusion by Blockchain and Smart Contracts'.

Further, by allowing the implementation of agreements whose constraint stems from cryptographic rules, blockchain and smart contracts transform collusion into a cooperative game strengthening trust and stability among colluders. Therefore, blockchain solutions may create fundamental issues for antitrust facilitating both the sharing of sensitive information and the implementation of anticompetitive agreements.

This perspective has caught the attention of the U.S. antitrust enforcers. As recently acknowledged by Makan Delrahim, former Chief of the Antitrust Division at the U.S. Department of Justice, even though blockchain technology offers tremendous potential value, there is potential for misuse of well-crafted blockchain solutions²⁶.

In contrast, some scholars call for a cautionary approach pointing out that, although the blockchain may create additional possibilities to reach and protect collusive outcomes, the underlying theories are not new and this is not the case that the technology itself is illegal but rather the use that the parties make of it²⁷.

In order to assess the potential anticompetitive risks brought by the blockchain technology, it is useful to distinguish the case in which a collusive outcome is reached or facilitated due to the participation to a blockchain consortium from the case in which users of the blockchain codify their collusive agreement in a smart contract.

The former scenario reflects the traditional concerns about horizontal co-operation agreements which may lead to the sharing of sensitive information, hence it should be tackled by antitrust authorities pursuant to the general principles for the assessment of the exchange of information²⁸. In this regard, it has been noted that private/permissioned blockchains require more attention than public/permission-less

²⁶ M. DELRAHIM, 'Never Break the Chain: Pursuing Antifragility in Antitrust Enforcement' (2020) Remarks at the Thirteenth Annual Conference on Innovation Economics <www.justice.gov/opa/speech/assistant-attorney-general-makan-delrahim-delivers-remarks-thirteenth-annual-conference>.

²⁷ R. NAZZINI, 'The Blockchain (R)evolution and the Role of Antitrust' (2019) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3256728>. See also OECD, 'Blockchain Technology and Competition Policy' (2018) <[https://one.oecd.org/document/DAF/COMP/WD\(2018\)47/en/pdf](https://one.oecd.org/document/DAF/COMP/WD(2018)47/en/pdf)>.

²⁸ See European Commission, 'Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements Text with EEA relevance', (2011) OJ C 11/1; Federal Trade Commission and U.S. Department of Justice, 'Antitrust Guidelines for Collaboration among Competitors' (2000) <www.ftc.gov/sites/default/files/documents/public_events/joint-venture-hearings-antitrust-guidelines-collaboration-among-competitors/ftcdojguidelines-2.pdf>.

blockchains²⁹. Although a public blockchain offers an enhanced data visibility, at the same time it is opened to everyone's participation which lowers the risk of collusion. A private blockchain, instead, allows participants to get exclusive and secure access to potentially relevant information. Nonetheless, in both the hypothesis a blockchain consortium would merely represent a new technological means to facilitate collusion by exchanging information. Against this backdrop, the added value of the blockchain technology is represented by the possibility to ensure the authenticity of the information, hence reinforcing the confidence among colluding parties, and to allow a better monitoring of the collusive agreement thanks to the real-time recording of transactions.

More problematic from the antitrust enforcement perspective appears the use of blockchain coupled with smart contracts. Indeed, this combination may sustain the collusive outcome and improve its stability by making the terms of the agreement immutable without the consent of all the users and by automating the execution of the collusion, i.e. automatically activating side payments when certain conditions are met and punishments upon deviations.

However, the combination of blockchain and smart contracts is not only able to sustain an explicit collusion by efficiently enforcing an agreement, but it may also facilitate tacit collusion³⁰. Notably, in order to execute the smart contract under certain conditions, the parties need to feed it with external data which allow to trigger the provisions of the contract and which are provided by "oracles", i.e. programs retrieving and verifying external data through methods such as web APIs or market data feeds. The members of a blockchain consortium may choose to rely on each other as record keepers for the oracle service, hence improving the monitoring of participants' behavior. Therefore, it has been argued that, by generating decentralized consensus, blockchain inevitably leads to greater knowledge of aggregate business condition on the blockchain, which can foster tacit collusion among sellers³¹.

²⁹ I. LIANOS, 'Blockchain Competition – Gaining Competitive Advantage in the Digital Economy: Competition Law Implications', in P. Hacker, I. Lianos, G. Dimitropoulos, and S. Eich (eds), *Regulating Blockchain: Political and Legal Challenges* (Oxford: Oxford University Press, 2019), 329; C. Pike and A. Capobianco, 'Antitrust and the trust machine', (2020) OECD Blockchain Policy Series <www.oecd.org/daf/competition/antitrust-and-the-trust-machine-2020.pdf>.

³⁰ DENG, 'Smart Contracts and Blockchains: Steroid for Collusion?'

³¹ CONG and HE, 'Blockchain Disruption and Smart Contracts'.

3. *Looking for a legally relevant agreement. Sketches from contract law*

Reduced to the bone, the vivid debate recently evolved in the antitrust sector can be traced back to a fundamental question: under what conditions can a tacit or factual understanding among two or more market actors be said to exist and to be legally relevant? After all, the positions advocating for a necessary revision of traditional antitrust remedies all seem to take the move from the perceived difficulty of framing into the concept of agreement – traditionally understood as meeting of the minds – more sophisticated forms of inter-individual coordination facilitated by an automatized, and thus depersonalized, meeting of algorithms³².

Read in this light, general private law theories may offer a contribution to the discussion, considering in particular that the element represented by the parties' common intention stems as a standard requirement for the validity and efficacy of any bi- or multi-lateral legal transaction, to the point of being frequently presented as inherently connected to the very definition of what a 'contract', in juridical terms, is³³.

Though a detailed comparative scrutiny of single national laws on such foundational aspects would go far beyond the scope of this article³⁴, it appears nonetheless useful for our analysis to resort to the general indications coming from major pieces of model law, here considerable as expression of the shared roots and approaches detectable, at least from an academic perspective, throughout the jurisdictions of the Western legal tradition³⁵.

Starting from the common core of European systems, Art. 2:101, para. 1, of the Principles of European Contract Law (PECL) is particularly clear in stating that

³² OECD, 'Algorithms and Collusion: Competition Policy in the Digital Age', 39.

³³ H. KÖTZ, 'Comparative Contract Law', in M. Reimann and R. Zimmermann (eds), *The Oxford Handbook of Comparative Law* (2nd ed., Oxford: Oxford University Press, 2019), 902. See also PEEL, *Treitel on the Law of Contract*, 1, describing the contract as an agreement giving rise to obligations which are enforced or recognized by the law.

³⁴ See as a general reference for basic comparative materials, H. BEALE, B. FAUVARQUE-COSSON, J. RUTGERS, and S. VOGENAUER, *Cases, Materials and Texts on Contract Law* (3rd ed., Oxford: Hart Publishing, 2019), Pt. 2.

³⁵ For methodological remarks on the value of uniform law models, N. JANSEN and R. ZIMMERMANN, 'European Contract Laws: Foundations, Commentaries, Synthesis', in IDD. (eds), *Commentaries on European contract laws* (Oxford: Oxford University Press, 2018), 1; P. Sirena, 'Die Rolle wissenschaftlicher Entwürfe im europäischen Privatrecht' (2018) *Zeitschrift für Europäisches Privatrecht* 838.

«[a] contract is concluded if: (a) the parties intend to be legally bound, and (b) they reach a sufficient agreement», with this latter element identified in presence of terms that “have been sufficiently defined by the parties so that the contract can be enforced, or can be [otherwise] determined” (Art. 2:103)³⁶. The substantial identification of the notion of contract with the requirement of agreement is even more explicit in the text of the Draft Common Frame of Reference (DCFR), according to which “[a] contract is an agreement which is intended to give rise to a binding legal relationship or to have some other legal effect” (Art. II. – 1:101)³⁷. On the other side of the Atlantic Ocean, the Restatement (Second) of the Law of Contracts issued by the American Law Institute³⁸, though clarifying that the notion of agreement (i.e. a “manifestation of mutual assent on the part of two or more persons”) «has in some respects a wider meaning than contract» (§ 3)³⁹, defines this latter concept as «a promise or a set of promises for the breach of which the law gives a remedy, or the performance of which the law in some way recognizes as a duty» (§ 1), in this way giving relevance to the «manifestation of intention to act or refrain from acting in a specified way» as expressed by the promisor and addressed to the promisee (§§ 2.1-3)⁴⁰. On a same tune, the Uniform Commercial Code (UCC) defines the “Contract”, as «the total legal obligation that results from the parties’ agreement» (§§ 1-201(12)), considering this latter element as «the bargain of the parties in fact, as found in their language or inferred from other circumstances, in-

³⁶ O. Lando and H. Beale (eds), *Principles of European Contract Law* (PECL), Parts I and II (Le Hague-London-Boston: Kluwer Law International, 2000).

³⁷ C. von Bar, E. Clive and H. Schulte-Nölke (eds), *Principles, Definitions and Model Rules of European Private Law. Draft Common Frame of Reference* (Outline edition, Munich: Sellier, 2009).

³⁸ American Law Institute, *Restatement of The Law Second, Contracts* (1981).

³⁹ American Law Institute, *Restatement of The Law Second, Contracts* (1981), §3 and Comment (a), where it is explicated that «[t]he word ‘agreement’ contains no implication that legal consequences are or are not produced».

⁴⁰ American Law Institute, *Restatement of The Law Second, Contracts* (1981), §2 and Comment (a), where it is explicated that «[i]f by virtue of other operative facts there is a legal duty to perform, the promise is a contract; but the word “promise” is not limited to acts having legal effect. Like ‘contract,’ however, the word ‘promise’ is commonly and quite properly also used to refer to the complex of human relations which results from the promisor’s words or acts of assurance, including the justified expectations of the promisee and any moral or legal duty which arises to make good the assurance by performance».

cluding course of performance, course of dealing, or usage of trade» (§§ 1-201(3))⁴¹.

While these introductory notes confirm that the legal validity of a contract ubiquitously mandates a series declarations (or expressions) of will communicated, and eventually shared, by the contractors, it must nonetheless be stressed that the approach taken by legal systems in the application of these agreement-related requirements operates without any considerations of their concrete understanding and of the actual intentions the parties⁴². Indeed, irrespectively of the way by which each single jurisdiction formalizes this point in its blackletter rules, the test adopted by courts and contractual interpreters to ascertain the presence of a binding juridical act, and to identify its relevant terms, rests on a merely external standard, based on the indications ascribable to materialized expressions, or other conducts, of the would-be parties, and without the need (and even the abstract possibility) of giving weight to their subjective states of mind⁴³.

As put by Lord Clarke in a relevant precedent of English contract law, “[w]hether there is a binding contract depends not upon [the parties’] subjective state of mind, but upon a consideration of what was communicated between them by words or conduct, and whether that leads objectively to a conclusion that they intended to create legal relations”⁴⁴. In more general terms, this is the core idea detectable at the bottom of the guiding principle of the “objective theory of contract”: «[T]he intentions of the parties to a contract or alleged contract are to be ascertained from their words and conduct rather than their unexpressed intentions»⁴⁵. Transposed to the notion of agreement, this approach «necessarily dictates that there is no absolute requirement of a subjective meeting of the minds»⁴⁶, being it only possible for a third party judge to

⁴¹ Uniform Commercial Code, Art. 1. General Provisions, Part II.

⁴² See G. CHRISTANDL, ‘Formation of Contracts’, in N. Jansen and R. Zimmermann (eds), *Commentaries on European contract laws* (Oxford: Oxford University Press, 2018), 231.

⁴³ PEEL, *Treitel on The Law of Contract*, para. 1-002, explicitly defines a purely subjective approach as simply “unworkable.”

⁴⁴ *RTS Flexible Systems Ltd v Molkerei Alois Müller GmbH & Co KG*, [2010] UKSC 14, 45.

⁴⁵ J.M. PERILLO, ‘The Origins of the Objective Theory of Contract Formation and Interpretation’ (2000) 69 *Fordham Law Review* 427.

⁴⁶ In these exact terms, M. FURMSTON and G. TOLHURST, *Contract Formation: Law and Practice* (2nd ed., Oxford:

rely on how a reasonable individual would understand and interpret the evidence of what the parties said and did⁴⁷.

These general points have concrete impacts on several operational aspects of contract regulation, starting from the fundamental issue of its conclusion: at what condition is it possible to treat a mutual understanding of two or more individuals as a valid and binding contract?

3.1 The objective approach to contractual agreement: Applications in contract formation

The more traditional way through which the juridical analysis materializes the requirement of the consent applies a conventional procedure which links together the exchange of an offer (with which the offeror univocally indicates its intention to be bound to definite contractual conditions), with the correlative acceptance by the offeree⁴⁸.

Though a number of scholars stresses that this method of discovering the existence and content of an agreement is not always consistent with modern commercial dynamics, and may result in an inappropriate tool when it comes to unveil the real will of the contractors⁴⁹, it must be noted that its application still appears effective in caselaw, where it operates as a flexible and reliable model⁵⁰, that has also proven capable of being adapted to the technological changes of the twentieth century (telex, fax, the advent of the Internet and email)⁵¹.

Oxford University Press, 2016), 6.

⁴⁷ *Norwich Union Fire Insurance Society Ltd v WM H Price Ltd* [1934] AC 455, 463.

⁴⁸ See as a relevant formalization of these rules, DCFR, Artt. II-4:201 - II-4:211.

⁴⁹ S.J. BAYERN, 'The Nature and Timing of Contract Formation', in L.A. Di Matteo and M. Hogg (eds), *Comparative Contract Law: British and American Perspectives* (Oxford: Oxford University Press, 2015) 77; M. SIEMS, 'Unevenly Formed Contracts: Ignoring the Mirror of Offer and Acceptance' (2004) *European Review of Private Law* 771.

⁵⁰ FURMSTON and TOLHURST, *Contract Formation*, 7.

⁵¹ D. NOLAN, 'Offer and Acceptance in the Electronic Age', in A. Burrows and E. Peel (eds), *Contract Formation and Parties* (Oxford: Oxford University Press, 2010), 61; and on the ground of an in-depth comparative analysis, A.M. BENEDETTI and F.P. PATTI, 'La revoca della proposta: atto finale? La regola migliore, tra storia e comparazione' (2017) *Rivista di diritto civile* 1293, 1334.

A closer look at the operational rules which inspire the concrete application of this procedural test shows that while its historical origins were inextricably connected with the ambition to identify an actual meeting of the minds of the contracting parties, modern system of laws assigns greater importance to practical and equitable considerations⁵². It is only on these latter grounds that is possible to understand, just to list a couple of relevant examples: (a) the so-called “postal rule”, according to which English law considers the acceptance valid and binding already from the moment of its shipment, and thus treats the contract as validly concluded even in the absence of an actual knowledge by the offeror of the positive response by the offeree⁵³; (b) the stricter limits posed by modern legal systems to the power of revocation of the offer, inspired by the rational of safeguarding to the reliance of the offeree, and less justifiable from a purely subjective perspective, rooted on the intention of the offeror⁵⁴.

Consistently with this line of reasoning, it is today widely accepted that the presence of a consent among two or more individuals may be identified and evidenced not only through the formal exchange of explicit statements, but, among other means, by any form of conduct that is capable of showing agreement⁵⁵. The rule has been traditionally applied in commercial contexts, as in cases of a prompt acceptance implied in the immediate performance rendered by the offeree, or in scenarios of prolonged negotiations resulting in mutual performance, even in the absence of an identifiable formal meeting of offer and acceptance⁵⁶.

⁵² A.T. VON MEHREN, ‘The Formation of Contracts’, in *International Encyclopedia of Comparative Law*, vol. VII, *Contracts in General* (Tübingen-Leiden-Boston: Mohr Siebeck, 2008), 82: “In the early 19th century this issue – along with many others that arise in connection with the formation of contracts – was approached not in terms of practical and equitable considerations but of ‘meeting of the minds’”.

⁵³ *Adams v. Lindsell* [1818] 1 B&Ald 681; *Dunlop v. Higgins* [1848] 1 HLX 381. See E. MCKENDRICK, *Contract law. Text, Cases, and Materials* (7th ed., Oxford: Oxford University Press, 2016), 106.

⁵⁴ S. GARDNER, ‘Trashing with Trollope: A Deconstruction of the Postal Rules in Contract’ (1992) 12 *Oxford Journal of Legal Studies* 170.

⁵⁵ See Art. 2:204 PECL and Art. II-4:204 DCFR, which identically state that «[a]ny form of statement or conduct by the offeree is an acceptance if it indicates assent to the offer». On a same tune, see Unidroit Principles on International Commercial Contracts (2016), Art. 2.1.1; American Law Institute, Restatement of The Law Second, Contracts (1981), § 19; UCC, § 2-204 («A contract for sale of goods may be made in any manner sufficient to show agreement, including conduct by both parties which recognizes the existence of such a contract»).

⁵⁶ See Unidroit Principles on International Commercial Contracts (2016), Art. 2.1.1, Comment 2.

As it will be discussed in the following paragraph, when transposed to modern negotiation settings, the application of this latter rule appears potentially apt to coordinate the traditional juridical approach to contract formation with more problematic issues recently discussed in the light of the growing diffusion of computerized transaction protocols capable of automatically executing the terms of a contract⁵⁷.

3.2 The objective approach to the agreement-requirement and the smart contract

Confronted with the always increasing number of digitally automatized transactions concluded on daily bases in a heterogeneous series of market contexts, legal scholars have started questioning the compatibility of these innovative forms of ‘contracts’ with the traditional private law doctrines⁵⁸.

As for what it is here at stake, the idea of a contract whose terms are encoded in algorithmic language and that is capable of being ‘smartly’ (i.e. automatically) executed at the mere objective detection of a pre-defined triggering factor (operating as a kind of “digital condition precedent”)⁵⁹, might at first sight seem to deprive of its traditional value a standard requirement such as that of a meeting of the minds, that would be no longer effectively shared by the interested individuals⁶⁰. Specifying this argument through an exemplary remark, one may wonder whether the programming code through which the smart contract is designed may actually represent an “understandable language” supporting, in credible terms, a mutual understanding

⁵⁷ According to the well-known definition of ‘smart contract’ elaborated by Nick Szabo with specific reference to the case of the vending machine (see N. SZABO, ‘Smart contracts’ (1994) <www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/smart.contracts.html>).

⁵⁸ See J. LINGWALL and R. MOGALLAPU, ‘Should Code Be Law: Smart Contracts, Blockchain, and Boilerplate’ (2019) 88 *University of Missouri-Kansas City Law Review* 285; P. DE FILIPPI and A. WRIGHT, *Blockchain and the Law. The Rule of Code* (Cambridge MA-London: Harvard University Press, 2018), 74.

⁵⁹ P. PAECH, ‘The Governance of Blockchain Financial Networks’ (2017) 80 *Modern Law Review* 1073, 1082.

⁶⁰ R. O’SHEILDS, ‘Smart Contracts: Legal Agreements for the Blockchain’ (2017) 21 *North Carolina Banking Institute* 177.

between the contracting parties⁶¹.

At closer look, notwithstanding the undoubtful fascination that may be generated by the idea of contracts concluded and performed without the need of any human intervention, at the present stage of development these digital tools do not seem to greatly differ from old-fashioned analogical contracts, at least as for what concerns the legally relevant elements mandated for their valid formation (e.g. “offer and acceptance procedures, consideration, intention to create legal relations, and capacity”)⁶².

Indeed, although the academic debate is more recently focusing on a possible future development of systems capable to autonomously conclude negotiations, drafting contractual clauses on the basis of available (big) data and constantly adapting their content through machine learning technologies⁶³, the current praxis of smart contract is not associated with (nor requires the interventions of) artificial intelligence⁶⁴, but rather operates in a strictly deterministic way, with the automatic fulfilment of the specific obligations correlated to the set of conditions encoded in the software⁶⁵. In

⁶¹ WEBER, ‘Smart Contracts’, 304-305, who, though observing that “[i]n real life, parties do indeed not often fully understand the programming language of a smart contract (and thereby its contents)”, is nonetheless willing to conclude that “[p]ersons who enter into a smart contract accept the binding force of the technical conditions even if they do not really understand all details of the technology.”

⁶² In explicit terms, referring to English contract law, M. DUROVIC and A.U. JANSSEN, ‘The Formation of Blockchain-based Smart Contracts in the Light of Contract Law’ (2018) 26 *European Review of Private Law* 753; but with a look extended to continental legal systems, P. Sirena and F.P. Patti, ‘Smart Contracts and Automation of Private Relationships’ (2020) Bocconi Legal Studies Research Paper Series <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3662402>.

⁶³ L.H. SCHOLZ, ‘Algorithmic contracts’ (2017) 20 *Stanford Technology Law Review* 128, 164; S. WILLIAMS, ‘Predictive Contracting’ (2019) 1 *Columbia Business Law Review* 621.

⁶⁴ J.M. LIPSHAW, ‘The Persistence of “Dumb” Contracts’ (2019) 2 *Stanford Journal of Blockchain Law & Policy* 1; S.A. MCKINNEY, R. LANDY and R. WILKA, ‘Smart Contracts, Blockchain, and the Next Frontier of Transactional Law’ (2018) 13 *Washington Journal of Law, Technology & Arts* 313, 322; and for a more specific overview of the technological aspects of the smart contract, V. GATTESCHI, F. LAMBERTI and C. DEMARTINI, ‘Technology of Smart Contracts’, in L.A. Di Matteo, M. Cannarsa and C. Poncibò (eds), *The Cambridge Handbook of Smart Contracts, Blockchain Technology and Digital Platforms* (Cambridge: Cambridge University Press, 2019), 37.

⁶⁵ See M. CANNARSA, ‘Interpretation of Contracts and Smart Contracts: Smart Interpretation or Interpretation of Smart Contracts?’ (2018) 26 *European Review of Private Law* 773. This latter aspect is at the bottom of the often cited statement that challenges the “smartness” of a smart contract, focusing on its rigid operation according to the IF-THEN parameter, incapable of adapting the programmed performance to relevant contextual circumstances (see on this aspect E. MIK, ‘Smart Contracts: Terminology, Technical Limitations and Real World Complexity’ (2017) 9

more explicit terms, this implies that the automatized process through which the operating system executes a digital performance (“smart contract code”) does not affect the juridical characters of the underlying agreement that binds the legal subjects (“smart legal contract”)⁶⁶.

On these very grounds, it is today a consideration shared by a large strand of legal scholars that the peculiarities (and benefits) of smart contracts can be appreciated mainly in the light of their possible “self-execution” and “self-enforcement”⁶⁷. Other founding doctrines of the law of contract – and in particular those concerning the element of the agreement, and of the process of detection a binding “meeting of the minds” among its parties – appear to be largely less affected by the impact of digital technologies⁶⁸.

A perfect exemplification of this line of reasoning may be identified in the model rules on contract formation provided for in the latest version of the Unidroit Principles on International Commercial Contracts, updated in 2016. In line with the general approach detectable in modern legal systems, this soft law instrument not only considers it possible to ascertain the presence of a mutual consent «by conduct of the parties that is sufficient to show agreement» (Art. 2.1.1), but then explicitly refers to the notion of “parties’ conduct” to cases “where the parties agree to use a system capable of setting in motion self-executing electronic actions leading to the conclusion of a contract without the intervention of a natural person”⁶⁹.

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⁶⁶ On this distinction, J. STARK, ‘Making Sense of Blockchain Smart Contracts’ (2016) <www.coindesk.com/making-sense-smart-contracts/>; B. CARRON and V. BOTTERON, ‘How smart can a contract be?’, in D. Kraus, T. Obrist and O. Hari (eds), *Blockchains, Smart Contracts, Decentralised Autonomous Organisations and the Law* (Cheltenham-Northampton: Edward Elgar, 2019), 101, 111-114; M. DUROVIC and F. LECH, ‘The Enforceability of Smart Contracts’ (2019) 5 *Italian Law Journal* 493, 499.

⁶⁷ K. WERBACH and N. CORNELL, ‘Contracts Ex Machina’ (2017) 67 *Duke Law Journal* 313, 318.

⁶⁸ See in general terms E. MIK, ‘The Resilience of Contract Law in Light of Technological Change’, in M. Furmston (ed.), *The Future of the Law of Contract* (Oxon-New York: Routledge, 2020), 112; and for the explicit observation that in the praxis of smart contracts it is still frequently possible to detect the standard sequence of exchange of offer and acceptance among the parties, G. GITTI, ‘Robotic Transactional Decisions’ (2018) *Osservatorio del diritto civile e commerciale* 619, 622.

⁶⁹ Unidroit Principles on International Commercial Contracts (2016), Art. 2.1.1, Comment 3 and Illustration:

With these considerations in mind, it is possible to turn back to the implications of digital contracts and, more in general, algorithmic based transactions, in the sector of antitrust law.

4. *Instead of a conclusion: So what in antitrust law?*

From an antitrust law perspective, the main concern posed by the growing application of smart technologies regards the possibility to increase the achievement of tacit collusion. Indeed, even if smart technologies were able to better support explicit collusive outcomes, these scenarios can be still scrutinized under current antitrust provisions. In those cases, algorithms and blockchains merely represent new tools that allow undertakings to efficiently reach and protect a coordination which however is established between humans and belongs to them. Hence, the challenge for the authorities is to detect and prove elements showing a coordination among firms, but relevant theories and notions are not threatened by the emergence of new technologies as such. Vice versa, whether these technologies were fit for fostering tacit collusion or even generating new forms of conscious parallelism, they would critically expand the blind spot of antitrust enforcement. Indeed, as illustrated, competition law challenges the means used by market players to reach a collusive outcome, rather than prohibiting collusion as such.

Against this backdrop, the debate in antitrust circles crucially depends on the reliability of the evolutions of algorithmic collusion as a realistic scenario and the eventual remedies to deploy.

As far as the technological substance of smart contracts and blockchains will continue to operate according to the deterministic logic that inspires it today (under the

«Automobile manufacturer A and components supplier B set up an electronic data interchange system which, as soon as A's stocks of components fall below a certain level, automatically generates orders for the components and executes such orders. The fact that A and B have agreed on the operation of such a system makes the orders and performances binding on A and B, even though they have been generated without the personal intervention of A and B».

IF-THEN parameter of execution, stimulated by a digitalized triggering factor), settled hermeneutical tools nowadays available to the interpreter, analyzed in this article also from a purely contract-law perspective, do not seem to be qualitatively altered. Rather, standard factors commonly applied for the detection of a binding agreement appear still suited to identify cases where the collusive intention of the parties may be ascertained, even in the absence of an explicit intention, as an objective evidence implicitly derivable by their conducts (e.g. the deliberate reliance of two or more market actors on a certain common software or program, applied as a shared pricing-strategy tool).

On these grounds, the wait-and-see approach that has been up to now assumed by national antitrust authorities (and ultimately also by the EU Commission) in the evaluation of possible amendments to existing competition rules and doctrines stands as a logic corollary of the observation that algorithmic pricing, as we currently know it, is more likely to exacerbate traditional risk factors, than to have a disruptive impact on competition law⁷⁰.

As lucidly suggested by Margrethe Vestager already in 2017⁷¹, all the previous considerations shall not be understood as an invitation to disregard possible future technological developments, underestimating the importance of being ready to tackle innovative issues raised by algorithms that, rather than working as mere tools in the hands of humans, will be instead capable of autonomously coordinating among themselves, and learning over time to collude.

At the same time, even assuming that science fiction scenario as a credible future reality, it appears highly questionable that the main focus of a perspective reform of antitrust law should then be put on the legal notions of agreement, and on a necessary extension of its scope capable of encompassing not just “meeting of the minds” but also “meeting of algorithms”. As our analysis has shown, such a radical revision would appear not only inconsistent with the current operational aspects of the agreement-related requirements (which, even in a traditional approach to contract law, cannot be intended

⁷⁰ UK Competition and Markets Authority, ‘Pricing Algorithms’, p. 48.

⁷¹ M. VESTAGER, ‘Algorithms and Competition’ (2017) *Bundeskartellamt 18th Conference on Competition* <https://ec.europa.eu/competition/speeches/index_theme_17.html>.

in a strictly subjective way), but it would probably also prove unhelpful to keep the practice at stake within the traditional antitrust boundaries, since it should be first and foremost investigated whether, and at what conditions, the conduct of a deep learning system could be ascribed to firms or natural persons⁷².

If algorithmic collusion emerges as a real concern, then tacit collusion would become. Therefore, rather than wrestling on the notion of agreement, the debate should be focused on the appropriateness of a regulatory intervention aimed at forbidding collusive outcomes as such, regardless of the means used and of a finding of mutual understanding.

However, the age of digital smart collusion is not arrived yet and is even not foreseeable for the next future. In the meantime, collusive attempts through smart technologies appropriately belong to the regular business-as-usual antitrust enforcement, hence they do not require any reshape of current rules and theories.

⁷² This point raises a series of foundational issues that clearly go beyond the scope of the present research, up to the question of the true legal nature of artificial intelligence, and of the forms and conditions of its possible subjectivization. See, G. TEUBNER, 'Digital Personhood? The Status of Autonomous Software Agents in Private Law' (2018), <https://ssrn.com/abstract=3177096>; G. WAGNER, 'Robot Liability', in S. Lohsse, R. Schulze and D. Staudenmayer (eds), *Liability for Artificial Intelligence and the Internet of Things* (Baden-Baden: Hart-Nomos, 2019), p. 27.
