**PA Persona e Amministrazione**
*Ricerche Giuridiche sull'Amministrazione e l'Economia*

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# Algorithms, competition law, public interest

Abstract

The growth of artificial intelligence applications and algorithm-based systems has had a profound and far-reaching impact on the market and the economy in general. This has resulted in benefits for consumers, undertakings and the community as a whole. Nevertheless, a considerable number of technological innovations can be employed for the purpose of illicit and anti-competitive practices that may ultimately serve to undermine the public interest. This article presents a taxonomy of the key anti-competitive assumptions based on the application of artificial intelligence and algorithm implementation, demonstrating the major concerns in the legal domain. Accordingly, it recommends the implementation of legal measures to protect both business and consumer interests. These measures should ensure transparency, accountability and responsibility in regard to economic actors employing algorithmic systems and artificial intelligence, with the goal of safeguarding collective and individual interests in a fair and equitable manner.

Keywords: Artificial intelligence, algorithms, competition law, public interest, economic law.

Index: 1. Introduction. - 2. AI and algorithms in information science: meaning, function and application. - 3. AI and algorithms in the public domain: neutrality, transparency, comprehensibility. - 4. The new algorithmic anticompetitive practices: assumptions and remedies in EU law. - 5. Conclusions.

## 1. Introduction

The rise of artificial intelligence (AI) and algorithms[1] has led to the emergence of a dynamic and compelling area of research in economic law for scholars in this field[2]. The increased self-learning and extended data processing capabilities of these technologies, the potential damage they may cause[3] in the consumer law sector[4] and, more generally, to the well-being of society, are used as starting points for proposals to change current legal rules and regulatory

1 This paper draws extensively from the research activity conducted at the University of Pisa, Department of Law during the 2022 and 2023 academic years, particularly at the Livorno campus, where I teach competition law as part of the economics degree course. I am greatly indebted to Professor Mauro Giusti for the insights he has provided me in the fields of antitrust law and economic law more broadly. My previous understanding of artificial intelligence and algorithmic processes was not as profound as it is today, having benefited from a research fellowship at the Alma Mater Research Institute for Human-Centered Artificial Intelligence at the University of Bologna. I would like to express my gratitude to Monica Palmirani, Director of the Alma Mater AI Centre, and Marco Dugato, my research supervisor at the University of Bologna. I would also like to extend my appreciation to the colleagues and friends at the Bologna research centre, particularly Salvatore Sapienza. The initial findings of this research were presented at the ICON-S Italian Chapter conference, entitled "The Future of the State", held at the University of Bologna on 16-17 September 2022.

2 In the context of Italian legal doctrine, for an in-depth analysis, please refer to the following sources: M. Rabitti – A. Sciarrone Alibrandi, *La Proposta di Regolamento Europeo sull'Intelligenza Artificiale nel prisma del settore finanziario: uno sguardo critico*, in M. Passalacqua (ed.), *Diritti e mercati nella transizione ecologica e digitale. Studi dedicati a Mauro Giusti*, Milan, 2022, 469 ff.; M. Rabitti, *Intelligenza artificiale e finanza. La responsabilità civile tra rischio e colpa*, in *Riv. trim. dir. ec.*, 3, 2021, 295 ff.; V. Falce, *Data strategy e intelligenza artificiale*, in M. Passalacqua (ed.), *Diritti e mercati nella transizione ecologica e digitale*, *cit.*, 41 ff.; A. Sacco Ginevri, *Ancora su intelligenza artificiale e* corporate governance, *Ivi*, 55 ff.; C. Robustella, *Verso le transazioni algoritmiche: gli* smart contracts *e i modelli negoziali intelligenti*, *Ivi*, 371 ff. In the same volume, see also F. Capriglione, *Preface*, *Ivi*, IX ff. See also, more recently, N. Rangone, *Artificial intelligence challenging core state functions: A focus on law-making and rule-making*, in *Revista de Derecho Público: Teoría y Método*, 8, 2023, 95 ff. For a contribution of the Italian legal doctrine in the field of EU law, see P. Manzini, *Algoritmi collusivi e diritto antitrust europeo*, in *Mer. conc. reg.*, 1, 2019, 163 ff.; and for business law, see M. Filippelli, *La collusione algoritmica*, in *Orizzonti del dir. comm.*, (special issue of) 2021, 375 ff. In European and international legal doctrine, the following can be seen: S. Van Uytsel – S.K. Mehra – Y. Uemura (eds.), *Algorithms, Collusion and Competition Law: A Comparative Approach*, Cheltenham, 2023; P.G. Picht – G.T. Loderer, *Framing Algorithms: Competition Law and (Other) Regulatory Tools*, in *World competition*, 42, 3, 2019, 391 ff.; G. Surblytė-Namavičienė, *Competition and regulation in the data economy: does artificial intelligence demand a new balance?* Cheltenham, 2020, 1 ff.; U. Schwalbe, *Algorithms, machine learning, and collusion*, in *Jour. Comp. Law & Econ.*, 14, 4, 568 ff.; S. Rab, *Artificial intelligence, algorithms and antitrust*, in *Comp. Law Jour.*, 18, 4, 141 ff.; M. Wiggers et al., *Digital Competition Law in Europe*, Alphen aan den Rijn, 2023, 1 ff.; C. Veljanovski, *Pricing Algorithms as Collusive Devices*, in *IIC - International Review of Intellectual Property and Competition Law*, 53, 4, 604 ff.;

C. Kerrigan, (ed.) *Artificial intelligence: law and regulation*, Cheltenham, 2022, 1 ff.; G. Shier et al., *Algorithms and competition: the latest theory and evidence*, in *Comp. Law Journ.*, 20, 1, 2021, 32 ff.; K.T. Hansen, et al., *Collusive Outcomes via Pricing Algorithms*, in *Journ. Eur. Comp. Law & Practice*,

practices in the name of safeguarding the public interest[5]. To be sure, European case law has clearly affirmed the function of competition law in protecting the public interest, understood as safeguarding the sphere of undertakings and consumers. In fact, according to the judgment of the General Court "*[t]he function of those rules is precisely to prevent competition from being distorted to the detriment of the* public interest*, individual* undertakings and consumers*, thereby ensuring the well-being of the European Union*"[6]. The legal system of the European Union confirms the objective of guaranteeing the public interest in fundamental positive norms.

In order to achieve this objective, it is sufficient to recall the stipulation in Article 3(3) TEU that the European Union is to establish an internal market. This is consistent with Protocol No. 27 on the internal market and competition, which is attached to the Lisbon Treaty. The aforementioned Protocol underscores the necessity of establishing a system that ensures that competition

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2021, 12, 4, 334 ff.; A. EZRACHI – M.E. STUCKE, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy*, Cambridge (MA), 2016, 1 ff.

3 For an insightful work on this argument, see M. RABITTI, *Internet of Things, Intelligenza Artificiale e danno: l'incerta attribuzione delle responsabilità*, in L. AMMANNATI (ed.), *Techlaw. Il diritto di fronte alle nuove tecnologie*, Naples, 2021, 155 ff.

4 For an enlightening perspective in consumer law, as a point of intersection between this area of law and the technology of artificial intelligence and algorithms, see G. SPINDLER, *Algorithms, credit scoring, and the new proposals of the EU for an AI Act and on a Consumer Credit Directive*, in *Law and Fin. Mark. Rev.*, 15, 3-4, 2021, 239 ff. More recently, for an in-depth article on this subject, see M. RABITTI, *Intelligenza artificiale e credit scoring*, in M. RESCIGNO (ed.), *L'impresa nell'era dell'intelligenza artificiale: un'evoluzione tranquilla o nulla sarà più lo stesso?*, Milan, 2023, 75 ff.

5 In order to gain a rigorous perspective on the social sciences as a field of research in dialogue with and between law and economics, it is necessary to refer to the studies of J. HABERMAS, *Ein neuer Strukturwandel der Öffentlichkeit und die deliberative Politik*, Berlin, 2022, 1 ff.; ID., (1990) *Moral consciousness and communicative action*, Cambridge, 1990, 1 ff.; ID., (1969) *Theorie und Praxis sozialphilosophische Studien*, Berlin, 1969, 1 ff. Please refer to the following sources for sector-specific studies on artificial intelligence and its impact on the public sphere: D.W. SCHARTUM, *Law and algorithms in the public domain*, in *Etikk i praksis*, 1, 2016, 1 ff.; R. WILLIAMS, *Accountable Algorithms: Adopting the Public Law Toolbox Outside the Realm of Public Law*, in *Current legal problems*, 2022, 75, 1, 237 ff.

6 Judgement of General Court (First Chamber, Extended Composition) of 28 May 2020, *CK Telecoms UK Investments Ltd v European Commission*, Case T-399/16, par. 93 (emphasis added). See also, by analogy, Judgment of the Court (First Chamber) of 17 February 2011, *Konkurrensverket v TeliaSonera Sverige AB*, C-52/09, para. 20 to 22, and of 12 December 2018, *Servier and Others v Commission*, T-691/14, par. 238.

is not distorted. Moreover, Article 102 of the Treaty on the Functioning of the European Union (TFEU) is one of the competition rules referred to in Article 3(1)(b) TFEU, which are necessary for the functioning of the internal market. The objective of these regulations is to prevent the distortion of competition to the detriment of the public interest, individual undertakings and consumers, thereby ensuring the well-being of the European Union.

Nonetheless, the impact of AI systems and algorithms in the field of antitrust law remains an area of legal scholarship that has yet to be fully explored, at least in the field of economic law, where the potential and prospects of new technologies have yet to be accommodated from the perspective of legal dogmatics[7]. Although it has generated considerable significance among policymakers, regulators and courts, there is as yet no consensus among legal scholars on the extent to which norms, measures and policies are appropriate for this particular area of law. The legal literature that has addressed the topic of AI and algorithms has identified three major areas of interest for antitrust law as well as related concerns[8].

Firstly, scholars propose that AI and algorithms could facilitate the identification of new hypotheses regarding the occurrence of anticompetitive con-

7 According to C. Coglianese – A. Lai, *Antitrust by Algorithm*, in *Stanford Computational Antitrust*, II, 2022, 1 ff., "*[m]arkets are changing around the world. Technological innovation produces a steady stream of new products and services that are disrupting old patterns of economic activity and delivering new value to consumers. At the same time, many of these technologies are also creating new opportunities for rent-seeking behavior by firms. With the rapid pace of innovation, the rise of a small number of big technology firms, and the creation of new ways for companies to collude and evade regulators, the nature of antitrust law and its enforcement will also surely change in the years ahead. Rapid changes in the marketplace bring with them increases in public clamoring and calls for legislative action to rein in big tech firms. These developments also present regulators with new reasons to explore using technological innovations to enhance their own performance in overseeing private market activity*".

8 Yet, for a broader approach in the legal field, see S. Rab, *Artificial intelligence, algorithms and antitrust*, *cit.*, 141 ff., which argues that the field of artificial intelligence is reshaping virtually every sector, including antitrust law. And this, according to the author, is based on the idea that machines can be used to simulate human intelligence through so-called machine learning. For a concise taxonomy of algorithms and other IA phenomena in the field of competition law, see A. Ezrachi – M.E. Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy*, *cit.*, 1, According to the authors, a crucial question in competition law today is whether "[c]ould digital commerce and new technologies actually harm us?".

duct, such as abuse of dominance and restrictive agreements in competition[9]. Secondly, it is postulated that the utilisation of AI and algorithms gives rise to novel forms of anti-competitive conduct that challenge the tenets of traditional antitrust law[10] with the introduction of novel elements, such as price discrimination[11], data mining and data acquisition[12]. Thirdly, it is claimed that antitrust malfeasance can exploit markets that implement AI systems and sophisticated algorithms, thereby prompting consumers to engage in transactions that amplify the competitive malfeasance.

This article is based on the premises of the empirical analysis offered by the specialised literature in the field and focuses on the role that AI and algorithms can play as tools facilitating competition-distorting conduct and the resulting implications for antitrust policies and interventions in the the light of public interest[13]. As technological innovation continues to evolve and has a significant impact on the economy[14], it is important to consider the implications of this for antitrust policies and interventions in the name of protecting the pu-

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9 From this perspective, see S. Rab, *Artificial intelligence, algorithms and antitrust*, *cit*., 143, according to author *"[t]he main concern raised to date in the context of competition law is that a specific type of AI – specifically pricing algorithms used by firms to monitor, recommend, or set prices – can lead to collusive outcomes in the market in two particular ways*". For a more detailed analysis of this topic, please refer to S. Mehra, *Antitrust and the Robo-Seller: Competition in the Time of Algorithms*, Minnesota Law Review, 100, 2006, 1323 ff., where stated "*to the extent that the effects of oligopoly fall through cracks of antitrust law, the advent of the robo-seller may widen those cracks into chasms. For several reasons, the robo-seller should increase the power of oligopolists to charge supracompetitive prices: the increased accuracy in detecting changes in price, greater speed in pricing response, and reduced irrationality in discount rates all should make the robo-seller a more skilful oligopolist than its human counterpart in competitive intelligence and sales […] the robo-seller should also enhance the ability of oligopolists to create durable cartels*".

10 See the seminal work of R.A. Posner, *The Chicago School of Antitrust Analysis*, in *University of Pennsylvania Law Review*, 127, 1978, 925 ff.

11 See P. Papandropoulos, *How Should Price Discrimination Be Dealt with by Competition Authorities?*, in *Revue des droits de la concurrence*, 3, 2007, 34 ff.

12 See A. Gautier – A. Ittoo – P. Van Cleynenbreugel, *AI Algorithms, Price Discrimination and Collusion: A Technological, Economic and Legal Perspective*, in *Eur. Journ. Law & Econ*., 50, 2020, 405 ff.

13 In legal scholarship, for a discussion of the concept of the public interest in competition law see V. Meli, *Il public interest nel diritto della concorrenza della UE*, in *Merc. Conc. Reg*., 3, 2020, 439 ff.; N. Dunne, *Public Interest and EU Competition Law*, in *The Antitrust Bulletin*, 65, 2, 2020, 256 ff.

14 Recently, see G. Rotondo, *Innovazione tecnologica nel settore finanziario e sistemi di risoluzione alternativa delle controversie*, in *Dir. merc. ass. fin*., 2022, 135 ff.

blic interest[15], we argue that AI and algorithms can have disruptive implications for the competitiveness and economic growth of States everywhere. In this context, the development of digital platforms is of great significance[16]. A substantial body of research has documented how new business models are evolving as a consequence of digital innovations[17] utilising artificial intelligence (AI) and algorithms[18]. It is important to bear this in mind in the context of the legal realm.

To be sure, this can be clearly observed in the sharing economy context, where digital platforms such as Airbnb and Booking have assumed a prominent role. However, we feel that there is a lack of knowledge in legal science regarding the processes by which these changes occur and, most importantly, a dearth of understanding of the content itself and the consequences that will ensue in many instances in the public interest domain. We are aware that an understanding of the causes necessitates an appreciation of digitisation movement[19], while an insight into the content and consequences is contingent upon a mindfulness of AI and algorithms and the expectations they engender.

In our opinion, it is irrefutable that these new platforms confer benefits upon consumers[20], and this means an enrichment of the public interest of

15 Italian doctrine undoubtedly contributes to the ongoing debate surrounding innovation in the context of public intervention in the economic sector. In order to provide a focused analysis, we will limit our attention to a single insightful work, namely M. Passalacqua, Numquam nega, raro adfirma: *Il rinnovato intervento dello Stato nell'economia*, in *Merc. Conc. Reg.*, 2021, 55 ff. From the public interest point of view the book of D. Siclari, *Gli intermediari finanziari tra regole di mercato e interesse pubblico*, Naples, 2011.

16 On the topic, see A. Canepa, *I mercanti dell'era digitale. Un contributo allo studio delle piattaforme*, Turin, 2020, 1 ff.; O. Lobel, *The law of platform*, in *Minnesota Law Review*, 2016, 105 ff.

17 In the economic law, on this topic, see M. Rabitti – M.C. Paglietti, *A Matter of Time. Digital-Financial Consumers' Vulnerability in the Retail Payments Market*, in *European Business Law Review*, 33, 4, 2022, 581 ff.

18 On this argument, see E. Bani – B. Pachuca-Smulska – E. Rutkowska-Tomaszewska (eds.), *Public and Private Law and the Challenges of New Technologies and Digital Markets*, München, 2020, 1 ff.

19 See, for example, O. Budzinski – A. Stöhr, *Competition policy reform in Europe and Germany – institutional change in the light of digitization*, in *Eur. Comp. Journ.*, 15, 1, 15 ff.

20 See C.R. Sunstein, *From consumer sovereignty to cost-benefit analysis: an incompletely theorized agreement? Competition, Free Markets, and the Law*, in *Harvard Journ. Law and Publ. Pol.*, 1999, 23, 1, 203 ff.

individuals and society more generally. Yet, there is a risk that, in accordance with the rationale of AI and algorithms, platforms that succeed in capturing a market segment will strengthen their position over time, thereby creating *de facto* monopolies and significant distortions to competition[21]. This may produce negative rather than beneficial effects precisely in the context of the public interest.

In addition, the implementation of sophisticated systems based on AI and algorithms has resulted in the emergence of interpretive challenges associated with the introduction of new regulatory conditions. These new conditions, which exert a profound influence in the public interest, are primarily the consequence of three key factors: (*i*) the autonomous function of AI[22]; (*ii*) the problem of complexity and transparency[23]; and (*iii*) the need for huge amounts of data (*i.e.* big data)[24]. From this perspective, empirical studies demonstrate that these factors require regulators and policymakers in the antitrust field to rethink their approach to competitiveness, especially to protect interests of public relevance.

In light of these considerations, it can be argued that in order to ensure a more effective antitrust system and thus enable competition in the name of public interest[25], technology-based systems such as AI and algorithms must necessarily be transparent and accountable[26]. Arguably, such systems must be

21 See, *ex multis*, H. PIFFAUT, *Algorithms: The Impact on Competition*, in *Bus. Law Int.*, 23, 2022, 5 ff.; A. GAUTIER – A. ITTOO – P. VAN CLEYNENBREUGEL, *AI Algorithms, Price Discrimination and Collusion*, *cit.*, 405 ff.

22 See A. EZRACHI - M.E. STUCKE, *Artificial intelligence & collusion: When computers inhibit competition*, in *Uni. Ill. Law Rev.*, 2017, 1775 ff.

23 See F. BENEKE – M.O. MACKENRODT, *Artificial intelligence and collusion*, in *IIC-intern. Rev. of Intellectual Property and Comp. Law*, 50, 109 ff.

24 See F. DI PORTO, *The Big Data Revolution*, in *Conc. e Merc.*, 5, 2016; B. MÄIHÄNIEMI, *Competition Law and Big Data: Imposing Access to Information in Digital Markets*, Elgar, 2020, 1 ff.

25 For a traditional yet insightful approach, see G.J. STIGLER, *Perfect Competition, Historically Contemplated*, in *Journal of Political Economy* 65, no. 1, February 1957, 1 ff.

26 From this point of view, see C. COGLIANESE – D. LEHR, *Transparency and algorithmic governance*, in *Adm. Law Rev.*, 2019, 71, 1, 1 ff.; see also M. BUSUIOC, *Accountable artificial intelligence: Holding algorithms to account*, in *Public Admin. Rev.*, 2021, 81, 5, 825 ff.; H.W Liu – C.F. LIN – Y.J. CHEN, *Beyond State v Loomis: artificial intelligence, government algorithmization and accountability*, in *Intern. Journ. Law and Inform. Tech.*, 27, 2, 2019, 122 ff.; S.K. KATYAL, *Private accountability in the age of artificial intelligence*, in *UCLA Law Rev.*, 66, 2019, 54 ff.

made visible and explainable, and ultimately controllable by State regulators and judges, in order to enable the economic choices of market players to be shaped and thus ensure the realisation of the public interest in practice.

## 2. AI and algorithms in information science: meaning, function and application

Legal scholars have long been aware of the phenomenon of AI and algorithms[27] and have conducted extensive research into the technical and applicative features of these recent computer science achievements. In courts and tribunals around the world, there is a growing awareness among judges and experts of the functioning of AI and algorithmic systems. In the following pages, we provide a brief overview of the state of the art in this growing awareness, with the aim of claiming a solid basis for understanding the significance of the new systems from the perspective of public interest and better grasping their application in the field of competition law. Moreover, we propose a critical analysis of the potential risks associated with the application of AI and algorithms in the framework of the legal domain and suggest a number of improvement strategies.

First of all, from this point of view it is of the huge importance to comprehend how algorithms and AI work within the context of informational science[28] as it postulates that machine learning algorithms represent the initial stage in the operation of a system equipped with AI[29]. This scientific theory as-

27 See L. Ammannati – A. Canepa (eds.), La finanza nell'età degli algoritmi, Turin, 2023; L. Ammannati, *I 'signori' nell'era dell'algoritmo*, in *Dir. pubbl.*, 2, 2021, 381 ff.; L. Ammannati – A. Canepa – G.L. Greco (eds.) – U. Minneci, *Algoritmi, Big Data, piattaforme digitali*, Turin, 2021; F. Mattassoglio, *Algoritmi e regolazione: mito o realtà*, in A. Antonucci – M. De poli – A. Urbani (a cura), *I luoghi dell'economia. Le dimensioni della sovranità*, Torino, 2019, 57 ff.; Ead., *Algoritmi e regolazione. Circa i limiti del principio di neutralità tecnologica*, in Riv. Reg. Merc., 2018, 2, 226 ff.; A. Nuzzo, *Algoritmi e regole*, in *An. Giur. Econ.*, 2019, 42 ff. For a scientific yet accessible survey, one may consult F. Bassan, *Potere dell'algoritmo e resistenza dei mercati in Italia*. *La sovranità perduta sui servizi*, Soveria Mannelli, 2019.

28 For a pioneering paper, cf. G. Stigler, *The Economics of Information*, *in Journal of Political Economy*, 69, 3, 1961, 213 ff.

29 Many definitions of artificial intelligence can be found in the literature. These include various approaches that are based on human behaviour or thinking. The Turing test, introduced by Alan Turing in 1950, in which the actions generated by the system or robot must not be

sumes that each component of the algorithm is derived from the management of a substantial quantity of data[30]. The management of big data is predicated upon a series of specific activities, including the ordering, instrumentation, segmentation, systematisation and correlation of data and information[31]. This enables the posing of questions and the obtaining of answers, thereby facilitating the resolution of problems[32].

It is clear that the application of an intelligent system to the rationale of the public sphere can only be fully appreciated once the process of codifying and normalising the legal text in a formalism that is comprehensible to the computer programme has been completed[33]. Indeed, the implementation of an AI-equipped system represents a crucial step in aligning the legal system with the information age[34]. Once the computer programmer has provided the system with the inputs and the rules to be applied, depending on the type of

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distinguishable from those generated by humans. Such a test for systems interacting with humans would mean, for example, that a person could no longer determine whether an interlocutor on the telephone is a human being or software.

30 See V.M. Schonberger – K. Cukier, *Big Data: A Revolution that Will Transform How We Live, Work and Think*, Boston, 2013, 1 ff. The term "big data" refers to data sets that are so voluminous that they cannot be handled by conventional tools. Instead, innovative technologies and methods are required to collect, process, and analyse them, enabling the prediction of trends in behaviour and the formulation of more efficient decisions. The definition of big data emphasises three properties or characteristics: volume, velocity, and variety. Recently, two additional dimensions of big data have been analysed: veracity and value. For a more comprehensive definition, please refer to A. De Mauro – M. Greco – M. Grimaldi, *A formal definition of Big Data based on its essential features*, in *Library Review*, 65, 3, 2016, 122 ff.; A. Sardi – E. Sorano – V. Cantino – P. Garengo, Big data and Performance Measurement Research: Trends, Evolution and Future Opportunities, in *Measuring Business Excellence*, 2020, 1 ff.

31 For a detailed examination of the distinction between data and information, please refer to the work of D.U. Galetta, *La trasparenza, per un nuovo rapporto tra cittadino e pubblica amministrazione: un'analisi storico-evolutiva, in una prospettiva di diritto comparato ed europeo*, in *Riv. It. Dir. Pubbl. Comun.*, 2016, 1019 ff.; see also F. Manganaro, *Trasparenza e digitalizzazione*, in *Dir. e Proc. Amm.*, 2019, 5 ff; as well as G. Carullo, *Open data partecipazione democratica*, in *Ist. Feder.*, 2019, 689 ff.

32 In this context, it is appropriate to cite the work of U. Galetta – J.G. Corvalan, *Intelligenza Artificiale per una Pubblica Amministrazione 4.0?, Potenzialità, rischi e sfide della rivoluzione tecnologica in atto*, in *federalismi*, 2019, 1 ff.

33 In more recent times, we may consider one of the earliest works in the field of AI and competition law. For further insight, see L. Wolfgang Bibel, *AI and the Conquest of Complexity in Law*, in *Artificial Intelligence and Law*, 12, 3, 2004, 159 ff.

34 *Ivi*, 163.

algorithm used by the AI, one will either arrive at a conditional automated solution if it follows the causal logic of determinist algorithms, or at a solution resulting from the process generated in the learning phase[35].

In the first instance, the algorithm is subject to a technical rule, which, nevertheless, remains a general one constructed by the human operator and not by the machine. This rule is then applied by the latter to the specific case in question[36]. The consequence is the possibility of adapting the traditional tools developed by legal science to the application of technology, with the objective of ensuring adequate protection for companies affected by unlawful measures in terms of competition[37].

In contrast, in the second case, the content of the data provided during the programming phase assumes a central role in the determination of the output by the algorithm. This is because the machine learning system, through the use of a logical-mathematical model, becomes capable of translating the acts into computer parameters that are suitable for providing the appropriate answers. The evolution of such algorithms has led to the development of increasingly complex information science systems, which have given rise to machine learning algorithms and subsequently machine learning applications[38].

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35 In their publication I. Goodfellow – Y. Bengio – A. Courville, *Deep Learning,* MIT Press, Cambridge, 2016, 5, observe that "*the difficulties faced by systems relying on hard-coded knowledge suggest that AI systems need the ability to acquire their own knowledge, by extracting patterns from raw data*". In other words, the technique of machine learning was developed precisely to overcome the limitations of conditional programmes in which the knowledge of the context relevant to the decision is manually encoded by a human being. For a comprehensive overview, please refer to G. Carullo, *Decisione amministrativa e intelligenza artificiale,* in *Diritto dell'Informazione e dell'Informatica*, 3, 2021, 431 ff.

36 For further insight, one may refer to the Italian State Council's decision of 8 April 2019, no. 2270, which asserts that "*administrative discretion, if it cannot be delegated to the software, is to be found at the time of the tool's development*".

37 The subject was examined from both traditional and new perspectives by A.G. Orofino, *La patologia dell'atto amministrativo elettronico: sindacato giurisdizionale e strumenti di tutela*, in *Foro Amministrativo*, 2002, 2256 ff.; F. Saitta, *Le patologie dell'atto amministrativo elettronico e il sindacato del giudice amministrativo*, in *Diritto dell'Economia*, 2003, 615; S. Puddu, *Contributo ad uno studio sull'anormalità dell'atto amministrativo informatico*, Naples, 2006, 179 ff.

38 One might consider the application of machine learning to the field of creditworthiness within the context of the financial sector. For further details on this topic, see M. Rabitti, *Credit scoring via machine learning e prestito responsabile*, in *In Liber amicorum per Aldo A. Dolmetta*, Pisa, 2023, 333 ff.

It is appropriate to affirm that the algorithm gives a learning model to be applied to the dataset accessible to the machine in order to arrive at a solution through the analysis of past experience of similar situations. The aforementioned categories can be further subdivided into three distinct types. The first category is supervised learning, which is a training mode where the data used is labelled. Each input is known to the respective output, which is used to teach the algorithm the rules of the model. Unsupervised learning, which draws on data that has not been previously classified, reprocesses it, identifies possible correlations and creates new knowledge by extrapolating a rule that was not previously defined when the algorithm was set up. Reinforcement learning, in which the machine learns from the results of its own actions or those of others, distinguishing successes and failures and improving its effectiveness. The category of machine learning encompasses systems based on so-called deep learning[39], which, more than any other algorithmic system, requires so-called big data to function optimally[40].

It can be observed that there is a distinction to be made between automated operations based on the mere acquisition and management of data[41], and those that are capable of performing acts and real operations of evaluation and judgement[42], like to human decisions. In such cases, everything

39 Deep learning is a subset of machine learning that places particular emphasis on the learning of successive layers of increasingly meaningful data representations. It is based on neural networks and, in essence, is inspired by the structure and function of the brain, which are collectively referred to as artificial neural networks.

40 The term "big data" is typically employed when the dataset is of a considerable size and complexity, necessitating the development of novel tools and methodologies for the extraction, management, and processing of information within a reasonable time frame. Indeed, as Moore's law states, technological evolution allows the storage and management of datasets of continuously increasing size. In a 2001 study, analyst Douglas Laney defined the growth model as three-dimensional (the 3V model), whereby the volume (of data), speed and variety (of data) increase with time.

41 On this topic, see F. Sartori, *La consulenza finanziaria automatizzata: problematiche e prospettive*, in *Riv. trim. dir. econ.*, 3, 2018, 253 ff.; M.T. Paracampo, *Robo-advisor, consulenza finanziaria e profili regolamentari: quale soluzione per un fenomeno in fieri?*, in *Riv. trim. dir. econ.*, 4 (suppl. 1), 2016, 256 ff.

42 In accordance with Article 4 of Regulation (EU) 2016/679 and the Guidelines on Automated Individual Decision-Making and Profiling for the Purposes of Regulation 2016/679, defined by the Working Group established pursuant to Article 29 of Directive

is reducible to information[43]. Consequently, machine-learning algorithms perform perception and computation operations, which, although initiated from settings that are actually provided in human form, create their own highly complex learning pathways through cognitive evaluations, even in the absence of human supervision. This results in an output that is determined in total autonomy by the machine, and which may be unexpected[44].

## 3. AI and algorithms in the light of public interest: neutrality, transparency, comprehensibility

The framework that has been outlined allows us to observe the emergence of a new phenomenology. This is characterised by machines that are governed by AI and are able to carry out operations at a speed and complexity that exceeds any human capacity and continues to grow exponentially[45]. In this context, as we shall see, the application of the new information technologies to the economic transactions of market operators assumes great relevance. Technology can no longer be regarded as the means of carrying out a course of action arranged by a human operator, but rather becomes the agent-instrument capable of making decisions relevant to the human person and his rights[46]. It is evident that in order to extract the information potentially expressed by the data and to allow effective knowability[47], it is necessary for the economic operator to provide the regulatory authorities with the necessary tools to analyse them correctly and

95/46/EC, it is necessary to consider the differences and possibilities of using these potentialities of algorithmic activity together.

43 J.M. VICTOR, *The EU General Data Protection Regulation: Toward a Property Regime for Protecting Data Privacy*, in *Yale Intern. Jour.,* 153, 2013, 522 ff.

44 G. ORSONI – E. D'ORLANDO, *Nuove prospettive dell'amministrazione digitale:* Open data *e algoritmi*, in *Istituzioni del federalismo*, 2019, 610 ff., it is stated that machine learning, which characterises the relevant mechanism of operation, *causes* the decision rule to emerge automatically from the specific data being analysed, sometimes in ways that no programmer can explain.

45 A. SIMONCINI, *L'algoritmo incostituzionale: intelligenza artificiale e il futuro delle libertà*, in *Biolaw Journal*, 1, 2019, 63 ff.

46 *Ibid*, 69.

47 On this matter, see F. DI PORTO, *La regolazione degli obblighi informativi. Le sfide delle scienze cognitive e dei big data*, Naples, 2017, 1 ff.

effectively. The reliability of the data acquired by AI systems will inevitably impact the validity of the logical schemes underlying the computerised inference[48].

It follows from this that the processing of data by AI, which exploits the logic of determinist algorithms, is never a neutral process (let alone a neutral one[49]). This is because the result is always an expression of the technical progress achieved by man, who imparts a direction of meaning to the processes at work by transferring computer knowledge and legal norms to the system by means of a language comprehensible to the machine. In conclusion, the argument of the neutrality of technology is untenable. This is because it cannot be resolved by means of good design or good use. Indeed, during the planning, design and development phase, humans influence the functionality of the algorithm and directs its technological progress[50].

Cognitive machines that operate by means of learning algorithms and make use of complex mathematical tools for the computer analysis of reality are able to autonomously adapt their behaviour to changes in the context in which they operate[51]. Consequently, if automation becomes complete and reaches high degrees of intensity through the use of deep learning, the machine will be able to autonomously arrive at a final result characterised by a high degree of objectivity, thus free of any margin of human conditioning[52]. Furthermore, the utilisation of algorithms confers additional benefits to companies

48 On this aspect, in particular when the storage of data may imply an anti-competitive phenomenon, see M.T. Maggiolino, *L'intelligenza artificiale e l'accesso ai dati: un ruolo per il codice del consumo e per il diritto dell'antitrust*, in U. Ruffolo, *Intelligenza Artificiale: il diritto, i diritti, l'etica*, Milan, 2020, 301 ff.

49 In the non-academic context, the argument is made that M. Mazzotti, *Algorithmic Life*, in *www.lareviewofbooks.com*, 2017, posits that we should view the technical features of an algorithm as the outcome of a process. In other words, we require a historical and genealogical understanding of the algorithm.

50 For a critical point of view, see F. Pasquale, *New Law of Robotics. Defending Human Expertise in the Age of AI*, Cambridge, MA, 2020.

51 M.E. Stucke, *Behavioral Economists at the Gate: Antitrust in the Twenty- First Century*, in *Loyola University of Chicago Law Journal*, 38, 13, 2007, 563 ff.

52 For further insight, please refer to V. Neri, *Diritto amministrativo e intelligenza artificiale: un amore possibile*, in *Urb. e App.*, 5, 2021.

operating within the market. In particular, one clear consequence is the significant reduction in the time required to complete a financial transaction[53]. The application of AI to a vast array of economic activities enables the completion of complex transactions in a remarkably short period, thereby enhancing the efficiency of market initiatives[54].

In the context of economic operator decision-making, the advantages of utilising AI are also evident in terms of the efficient acquisition and transformation of data[55]. The system, when implemented in this way, will generate economic and financial negotiations that will be the result of processes skilfully reworked in the learning policy inherent in the AI system[56]. From the perspective of the legal sphere, we posit that the introduction of intelligent systems, when properly supervised by regulators, can generate value in the public interest by promoting competitiveness. This is to the extent that it can reduce the time required for market transactions and exponentially increase the knowledge base from which economic operators can make informed decisions, which in turn benefits consumers[57].

It is important to note that the development of AI does not entail the imitation or copying of human cognitive processes, given that it is currently impossible for a machine to reproduce human reasoning[58]. This implies that the machine is unable to make decisions independently, as its limitations lie in its inability to evaluate data and inputs based on their reliability, as a human

53 The issue of speed as one of the peculiarities of the power of algorithms is noted by L. Casini, *Politica e amministrazione: 'The Italian style'*, in *Riv. trim. dir. pubbl.*, 2019, 19 ff.

54 L.M. Azzena, *L'algoritmo nella formazione della decisione amministrativa: l'esperienza italiana*, in *Rev. Bras. Estud. Pol.*, 123, 2021, 503 ff.

55 C. Benetazzo, *Intelligenza artificiale e nuove forme di interazione tra cittadino e pubblica amministrazione*, in *Federalismi.it*, 16, 2020, 1 ff.

56 For a more detailed and nuanced proposal, please refer to P. Forte, *Diritto amministrativo e Data Science. Appunti di intelligenza amministrativa artificiale (AAI)*, in *P.A. Persona e Amministrazione*, 2020, 259 ff.

57 G. Fasano, *L'intelligenza artificiale nella cura dell'interesse generale*, in *Giorn. dir. amm.*, 6, 1 November 2020, 715 ff.

58 D.U. Galetta – J.G. Corvalan, *Intelligenza Artificiale per una Pubblica Amministrazione 4.0?*, *cit.*, 7.

economic agent would do[59]. Consequently, the criticality encountered originates at the outset of the system's implementation. This is due to the fact that the AI is capable of generating erroneous or misleading results as a consequence of erroneous or prejudicial data being entered during the design phase of the logic-mathematical system. Furthermore, the intelligent system itself is unable to comprehend the correctness or suitability of the aforementioned data[60].

We argue that such critical issues have the potential to significantly impair competitiveness unless regulators take appropriate action through the implementation of effective policies designed to oversee and rectify computerised economic processes. It is questionable whether the purported neutrality of machine-learning algorithms can be understood in an absolute sense. This is because the system incorporates the conditioning of the individual who created it and the prejudices already rooted in society, which may result in solutions that could lead to a higher level of social discrimination than that of the human programmer[61]. In addition, the selection of software that is not compatible with the specific objective of the economic transaction[62], the incorporation of data entered voluntarily by individuals during the transaction process on digital platforms (online browsing, electronic payments, etc.), and the continuous variability of the rules can result in incongruous and misleading outcomes[63].

In our view, these risks can be effectively mitigated by providing the system with consistent, correct, and unambiguous terms. However, above all, it

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59 For a further discussion of this topic, see B. CAROTTI, *Algoritmi e poteri pubblici: un rapporto incendiario*, in *Giorn. dir. amm.*, 26, 1, 2020, 5 ff. The A. elucidates the interconnectivity between the algorithmic problem in public administration and its knowability, the possibility of accessing and comprehending the rationale behind its implementation, and the mechanisms of protection and accountability.

60 On this point, see G. CARULLO, *Gestione, fruizione e diffusione dei dati dell'amministrazione digitale e funzione amministrativa*, Turin, 2017, 12 ff.

61 G. AVANZINI, *Decisioni amministrative e algoritmi informatici. Predeterminazione analisi predittiva e nuove forme di intelligibilità*, Rome, 2018, 24 ff.

62 V. NERI, *op.* cit., 592.

63 See F. DE LEONARDIS, *Big Data, decisione amministrativa e "povertà" di risorse della pubblica amministrazione*, in E. CALZOLAIO (ed.), *La decisione nel prisma dell'intelligenza artificiale*, Milan, 2020, 137 ff.; F. COSTANTINO, *Risks and opportunities of public administrations' recourse to big data predictions*, in *Dir. pubbl.*, 2019, 43 ff;

is essential to ensure that market regulators are able to know and understand the AI systems and algorithms underlying economic transactions by competing firms. The issue is to render transparent the logical path followed by the machine, through the externalisation of the argumentative process that correlates the elementary information to the conclusive determination elaborated by the computer[64]. This intrinsic technological limitation, commonly referred to as the "black box"[65], represents a potential conflict between the process of administrative computerisation through the use of machine learning algorithms and the inescapable guarantees of knowability and transparency[66] .

In light of the syntactic and intrinsic opacity of algorithms, the objective of transparency can be achieved through two avenues: by making the source code[67] visible and by ensuring the effective intelligibility of the algorithmic procedure in all its phases, with the aim of understanding the phenomenon itself. The justification must extend to the indication of the authors, the procedure used for processing, the decision mechanism, including the priorities assigned in the evaluation and decision-making procedure, and the data selected as relevant[68].

In order for the reasoning apparatus to be able to verify that the criteria, assumptions and outcomes of the computerised procedure comply with the requirements and purposes laid down by law or by decisions of the market regulator, it must include all the necessary elements[69]. Nevertheless, while the algo-

64 V. Neri, *op.* cit., 587.

65 F. Pasquale, *The Black Box Society: The Secret Algorithms that Control Money and Information*, Cambridge, MA, 2015, 1 ff.

66 It has been established in case law that the statement of reasons must be considered to be supplemented by the necessary application of the legal parameters that predetermine the assumptions of the act, as indicated by the cause of the act itself. For further information, please refer to State Council, Section VI, 24 November 2020, no. 8218; and State Council, Section VI, 30 November 2020, no. 7537.

67 In this context, it is recommended that the reader consult F. Patroni Griffi, *La decisione robotica e il giudice amministrativo*, in *www.giustiziaamministrativa.it*, 2018, 3 ff.

68 For further information, please refer to the Italian State Council, Section VI, 13 December 2019, no. 8472.

69 *Ibid.*

rithmic path of a deterministic algorithm can be readily comprehended, the machine path of a deep AI architecture remains opaque and cannot be fully observed. Consequently, knowledge of the operations performed by the machine must necessarily be approximated.

It is not coincidental that a new mission in the field of data science, designated as Explainable AI (XAI), has emerged with the objective of rendering automated decisions knowable[70], explainable and comprehensible[71]. This initiative is designed to counteract the black box of machine learning by pursuing the right to explanation. Our position is that, on the path towards the use of AI systems in the public sphere, particularly in the context of economic competition, the legal values of transparency, publicity and administrative accountability of algorithmic tools must serve as the central reference for the protection of the public interest. In our opinion, these values should serve as the foundation for the deployment of AI and algorithms in the competitive environment. This is to ensure that regulators maintain control over market players.

## 4. The new algorithmic anticompetitive practices: assumptions and remedies in EU law

It is challenging to ignore the potential impact of the growing volume of accessible data and the enhancements to algorithms on the behaviour of companies in the market[72]. A more comprehensive understanding of consumers and the utilisation of sophisticated algorithms may facilitate the implementation of customised pricing strategies by firms. The enhanced visibility and predictability of competitors' actions, coupled with the capacity of algorithms to respond almost instantaneously to market fluctuations, may

70 A. Barredo Arrieta – N. Diaz Rodriguez et al., *Explainable Artificial Intelligence (XAI): Concepts, Taxonomies, Opportunities and Challenges toward Responsible AI*, in *Information Fusion*, 58, 2020, 82 ff.

71 L. Edwards – M. Veale, *Slave to the Algorithm? Why a 'Right to an Explanation' is probably not the remedy you are looking for*, in *Duke Law & Tech. Rev.*, 18, 2017.

72 P. Van Cleynenbreugel, *Article 101 TFEU's association of undertakings notion and its surprising potential to help distinguish acceptable from unacceptable algorithmic collusion*, in *Antitrust Bulletin*, 2020.

facilitate the coordination of unfair commercial practices[73]. Furthermore, in this field, AI tends to attract an increasing amount of data as its learning capacity grows, while at the same time, algorithms become more sophisticated. Consequently, service providers who are able to gain a competitive advantage in this market process are able to create *de facto* monopolies[74].

It can be noted that, on an empirical level, legal and economic doctrine has managed to isolate two relevant phenomena based on the use of algorithms that have the potential to be highly detrimental to competition. Given the potential impact of such anti-competitive practices on consumers, it is important to consider them in greater depth[75]. This section will therefore examine these practices in greater detail. In recent years, empirical observation of such practices has received significant attention from experts and has also attracted a certain amount of media attention among regulators and policy makers, who have begun to propose enforcement and legislative solutions to counter such phenomena.

In the context of antitrust law, price discrimination is defined as the application of different monetary values for the same or similar products to consumers. Although there is no consensus among scholars, the most significant concerns about algorithmic price discrimination practices relate to the vast

73 On fairness, see the pioneering article of D. Kahneman – J.L. Knetsch – R.H. Thaler, *Fairness as a Constraint on Profit Seeking: Entitlements in the Market*, in *American Economic Review*, 76, 4, 1986, 728 ff. See also T.J. Horton, *Unraveling the Chicago-Harvard Antitrust Double Helix: Applying Evolutionary Theory to Guard Competitors and Revive Antitrust Jury Trials*, in *University of Baltimore Law Review*, 41, 2012, 615 ff. On the same topic, see also M.E. Stucke, *Is Intent Relevant?*, in *Journal of Law, Economics & Policy*, 8, 2012, 801 ff.; L.A. Stout, *Cultivating Conscience: How Good Laws Make Good People*, Princeton, 2011, 238 ff., arguing that societal norms of fairness and prosocial behaviour are both common and necessary in a market economy.

74 See P. Manzini, *Algoritmi collusivi e diritto antitrust europeo*, *cit.*, 164. In the author's view, the greatest risks to competition arise from algorithms that can induce or reinforce horizontal collusive coordination, that is, between companies operating at the same market level.

75 For further information, please refer to the OECD publication "Algorithms and Collusion: Competition Policy in a Digital Age", Paris, 2017, Part 4.2.1. This document highlights the limited understanding of the impact of algorithms on potential competition. On the one hand, the algorithm can be used to detect potential entry threats, thereby enabling incumbent firms to implement an effective and rapid counter-reaction. Conversely, the exponential growth in data that can be collected by algorithms may enable potential competitors to gather the information they need to launch attacks on new markets.

quantities of personal data disclosed by online consumers[76]. In comparison to traditional demographic records, this data could provide a significantly more comprehensive archive of valuable information, which sellers could utilise to set discriminatory prices. In essence, algorithms could exploit big data to generate accurate profiles of consumers and gain a deeper understanding of their purchasing behaviour[77].

The information is then incorporated into marketing applications or pricing policies in order to obtain customised product recommendations[78]. The utilisation of AI-enabled pricing algorithms and access to comprehensive archives on consumer behaviour enables more precise price discrimination. Indeed, several models analysed by experts have demonstrated the capacity to discriminate prices to a high degree of specialisation[79]. With regard to collusive practices, companies are accustomed to employing strategies that incorporate a reward-punishment scheme. These strategies reward companies that adhere to the supra-competitive outcome and penalise them when they deviate from it[80].

In this regard, it is evident that AI technologies possess the potential to analyse and monitor the market in ways that are unprecedented in the recent past. Indeed, sophisticated AI tools are capable of continuously monitoring the behaviour of competing firms and implementing rapid price changes in order to adapt to the prevailing market conditions. Consequently, when repeatedly interacting with each other and their environment, pricing algorithms can learn to implement collusive strategies based on reward and punishment schemes, which result in over-competitive prices in the medium and long term[81].

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76 On this topic, see F. Di Porto, *In* Praise of an Empowerment Disclosure Regulatory Approach to Algorithms, in *International Review of Intellectual Property and Competition Law*, 2018, 507 ff.

77 R. Woodcock, *Personalised pricing as monopolisation*, in *Connecticut Law Rev.*, 51, 2019.

78 On this topic, see P.A. Diamond, *A Model of Price Adjustment*, in *Journal of Economic Theory*, 2, 1971, 156 ff.

79 F. Beneke – M.O. Mackenrodt, *Remedies for algorithmic tacit collusion*, *cit.*, 156 ff.

80 J. Harrington, *Developing competition law for collusion by autonomous artificial agents*, in *Jour. Compet. Law & Econ.*, 2018, 14, 3, 331 ff.

81 For further insight, please refer to the comprehensive research by A. Ezrachi – M.E. Stucke, *Virtual Competition*, *cit.*, *passim*, which has served as a significant source of inspiration

Still, this type of algorithm would be capable of maintaining anticompetitive outcomes without the need for human intervention in pricing policies[82]. In contrast to traditional cartels, this type of algorithmic does not necessitate any explicit collusive agreement[83]. The algorithms themselves are not programmed with the intention of colluding, nor are they influenced to favour cartel formation[84]. Conversely, such algorithms adopt an anticompetitive strategy through an autonomous decision-making process. This phenomenon has been designated tacit algorithmic collusion. It is commonly referred to by scholars as the ability of certain algorithms to effectively learn how to implement collusive strategies over an extended period of time[85].

Although algorithmic price discrimination and tacit algorithmic collusion necessitate the extensive utilisation of data and mathematical models of AI,

for subsequent works. Among these, we would like to draw your attention to the following: F. Beneke – M.O. Mackenrodt, *Remedies for algorithmic tacit collusion*, in *Jour. Antitrust Enforcement*, 2021, 9, 152 ff. S.K. Mehra, *Antitrust and the Robo-Seller: Competition in the Time of Algorithms*, *cit.*, 1323 ff.; For further reading, see M.S. Gal, *Algorithms as Illegal Agreements*, 34, *Berk Technol. Law Journ.*, 34, 2019, 67 ff.; J.E. Harrington Jr., *Developing Competition Law for Collusion by Autonomous Price-Setting Agents*, *Journ. Comp. Law & Econ.,* 14, 3, 2018, 331 ff.

82 A. Ezrachi, *The Competitive Effects of Parity Clauses on Online Commerce*, in *European Competition Journal*, 11, 488, 2015.

83 See P. Manzini, *Algoritmi collusivi e diritto antitrust europeo*, *cit.*, 166. In the context of EU law, explicit collusion is clearly encompassed by the scope of Article 101 of the Treaty on the Functioning of the European Union (TFEU). This is the case regardless of whether the result is the consequence of an agreement between the relevant parties, whereby the undertakings in question have expressed a common intention to behave on the market in a certain way.

84 With regard to this matter, the following judgments of the Court of First Instance of 17 December 1991, Case T-7/89 Hercules Chemicals v Commission [1991] ECR II 1711, paragraph 256, and of 20 March 2002, Case T-9/99 Hfb Holding and Others v Commission [2002] ECR II 1487, paragraph 199, are pertinent to the existing case law.

85 E. Calvano – G. Calzolari – V. Denicolo – S. Pastorello, *Artificial Intelligence, Algorithmic Pricing and Collusion*, *cit.*, *passim*. The majority of contemporary AI systems are designed to generate agents that exhibit rational thinking and action. In order to realise systems that think rationally, logic-based representations and reasoning systems are often employed. The fundamental assumption is that rational thinking will result in rational action if the reasoning mechanisms employed are accurate. A further group of definitional approaches concerns the direct generation of rational actions. In these systems, the underlying representations are often not readily comprehensible to humans. In many cases, they employ an objective function that characterises the utility of states. The objective of the system is therefore to maximise this objective function, which is to determine the state that has the highest utility or, in the case of uncertainty, to maximise the expected future reward. To illustrate, if the objective function for a cleaning robot is defined as the cleanliness of the work surface minus the costs of the actions performed, in the ideal case, this leads the robot to select the optimal actions to keep the work surface as clean as possible.

this does not imply that these practices will be disseminated to the same type of market[86]. Furthermore, at the microeconomic level, algorithmic discrimination enables prices to be closer to the consumer's willingness to pay. Consequently, consumers will be willing to pay a higher price and have a lower surplus. Furthermore, an expansion of demand may occur, and the overall impact of algorithmic discrimination depends on the relative importance of these two effects. In the context of algorithmic collusion, prices become excessively competitive, resulting in increased profits for firms and reduced consumer surplus.

In economic theory, two conditions have been identified as prerequisites for the occurrence of price discrimination. Firstly, it is necessary that undertakings are able to set their own prices. This implies that a firm must possess some degree of market power or, at the very least, the capacity to levy differential prices[87]. Secondly, the sustainability of discrimination hinges on the ability of the consumer who purchases the good at a lower price to resell it to another party at a higher price[88].

The phenomenon of price discrimination can be classified into various categories, contingent upon the extent of information possessed by the firm regarding the consumers in question[89]. In the case of personalised price discrimination, the firm has access to complete information on each consumer, which enables it to deduce their willingness to pay. Even when the firm has only partial information, it may still use it to divide consumers according to observable characteristics about their willingness to pay and apply different prices to different groups of consumers.

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86 M. Helfrich – F. Herweg, *Fighting collusion by permitting price discrimination*, in *Economic Letters*, 2016, 148 ff.

87 L. Stole, *Price discrimination and imperfect competition*. *Handbook of Industrial Organisation,* 2003, 3, 34 ff.

88 R. Woodcock, *Personalised pricing as monopolisation*, in *Connecticut Law Rev.*, 51, 2, 2019, 311 ff.

89 See the insightful contribution of J. Stiglitz, *Imperfect Information in the Product Market*, in R. Schmalensee – R. Willig (eds.) *Handbook of Industrial Organization*, 1, Amsterdam, 1989, 769 ff.

This form of pricing can occur in both customised and group pricing scenarios. In the former, the firm utilises observable consumer information to adjust the price or, more generally, the offer, thereby extracting a larger surplus. It is widely acknowledged that the availability of more detailed consumer information allows for more precise consumer segmentation. Another form of discrimination is based on the fact that the company offers different packages, *i.e.* combinations of price and quantity/quality, which allows consumers to select their preferred option.

The utilisation of algorithms based on AI technologies could potentially facilitate the emergence of price discrimination, or at the very least assist companies in optimising the range of options they propose to consumers. Nevertheless, it remains unclear to what extent current AI knowledge allows for the implementation of price discrimination[90]. Another phenomenon of interest in the field of antitrust is that of algorithmic collusion. In the specialist literature, this term is used to refer to two different hypotheses.

The initial hypothesis concerns the implementation of an existing collusive strategy, defined or agreed upon by human operators, by algorithms. The second hypothesis is that algorithms engage in tacit collusion. This type of antitrust tort occurs when algorithms learn to collude autonomously (or quasi-autonomously) with minimal human intervention. One hypothesis put forth by legal doctrine in this context is that the advancement of machine learning algorithms and their prevalence in pricing applications, coupled with the availability

90 See A. Ezrachi – M. Stucke, *Virtual competition*, *cit.*, p. 46. The authors propose the hypothesis that a number of companies utilise the same computer tool for the definition of their pricing policies, without there being any agreement to that effect. The identity of the algorithm used would imply a substantial equality of calculation results and thus an alignment of business options (prices and other transaction conditions). The hypothesis appears to be somewhat theoretical, if not implausible, given that the possibility of different companies independently choosing the same software seems unlikely.

of vast quantities of data[91], will render this type of tort sustainable in markets even in the absence of significant levels of oligopolistic concentration[92].

Studies on tacit algorithmic collusion have demonstrated that algorithms can engage in collusive behaviour in an oligopoly. However, subsequent studies have revealed that the initial findings were not robust and were no longer applicable in the presence of minor fluctuations in costs, prices, and other parameters.

Recently, it has been shown that simple learning agents can learn to collude by achieving supra-competitive profits in a stylised environment with sequential pricing[93].

Finally, further specialised studies have provided evidence that machine learning algorithms can be trained to play sophisticated collusive strategies. In particular, they permitted the operation of several machine learning algorithms in an oligopoly context with a fixed marginal cost and where price dispersion was low, and firms tended to charge symmetric prices[94].

As is well known, Western legal systems have long established their own legal frameworks to counter anti-competitive phenomena and practices in accordance with the principles of antitrust law. One might consider the traditional apparatus of legislation in the United States, exemplified by the Sherman

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91 D.D. Sokol – R. Comerford, *Does Antitrust Have a Role to Play in Regulating Big Data?*, in R.D. Blair – D.D. Sokol (eds.), *The Cambridge Handbook of Antitrust, Intellectual Property, and High Tech*, Cambridge, 2017, 271 ff.

92 F. Beneke – M.O. Mackenrodt, *Remedies for algorithmic tacit collusion*, *cit.*, 156 ff.

93 See, for example, S.S. Izquierdo – L.R. Izquierdo, *The "Win-Continue, Lose-Reverse" Rule in Cournot Oligopolies: Robustness of collusive outcomes*, in F. Amblard – F. Miguel – A. Blanchet – B. Gaudou (eds.), *Advances in artificial economics,* Berlin, 2015, 33 ff.

L. Waltman – U. Kaymak, *Q-learning agents in a Cournot oligopoly model*, in *Journal of Economic Dynamics and Control,* 2008, 32, 10, 3275 ff.

94 E. Calvano – G. Calzolari – V. Denicolo – S. Pastorello, *Artificial Intelligence, Algorithmic Pricing and Collusion*, *cit.*, *passim.*

Act[95], and the more recent set-up by the European Union, as evidenced by Articles 101 and 102 TFEU[96].

In light of the aforementioned findings, this section will focus on the legal assumptions of the competition sector, providing critical considerations in light of the current legislative framework. Furthermore, it will advance conclusions regarding potential remedies to the problems identified throughout the investigation, particularly those related to new anti-competitive practices based on AI and algorithms.

In order to provide a concrete framework for analysis, we will utilise the European legal order as a reference model. In this system, it is evident that Article 101 of the Treaty on the Functioning of the European Union (TFEU) prohibits the coordination between undertakings. This article essentially defines three categories of unlawful collusion: agreements, decisions by associations of undertakings, and concerted practices[97]. From this perspective, it is important to recognise that none of the existing categories, as currently understood in EU competition law, are suitable for the purpose of applying them to the new anti-competitive practices based on AI and algorithms[98].

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95 See D.F. Turner, *The Definition of Agreement under the Sherman Act: Conscious Parallelism and Refusals to Deal*, in *Harvard Law Review*,1962, 655 ff. See also R.A. Posner, *Economic Analysis of Law*, Hague, 2007, 303 ff.; Id., *Review of Kaplow*, *Competition policy and price fixing*, in *Antitrust Law Journ*., 79, 2014, 761 ff.; J. Stigler, *A Theory of Oligopoly*, in *Journ. Pol. Econ*, 44, 72, 1964, 1 ff.; R. Posner, *Oligopoly and Antitrust Laws: A Suggested Approach*, in *Stanford Law Rev.*, 1562, 21, 1969, 1 ff.; L. Kaplow, *An Economic Approach to Price Fixing*, in *Antitrust Law Journal*, 343, 77, 2011; L. Kaplow, *Competition Policy and Price Fixing*, Princeton, 2013, 453 ff..

96 L. Calzolari, *The Misleading Consequences of Comparing Algorithmic and Tacit Collusion: Tackling Algorithmic Concerted Practices Under Art. 101 TFEU*, European Papers, 2021 6, 2, 1193 ff. Also interesting is the work paper of the OECD, *Algorithms and Collusion - Competition policy in a Digital Age,* Paris, 2017, 1 ff.

97 A recent case involving anti-competitive practices based on the misuse of AI and algorithms was recently addressed by the EU Commission. This case is of interest as it concerns the European Union (EU). The decisions of 18 July 2018 pertain to vertical cartels implemented by means of computer systems. For further information, please refer to the EU Commission of 18 July 2018, Asus (AT. 40465), Denon and Marantz (AT. 40469), Phillips (AT. 40181) and Pioneer (AT. 40182). The prohibition is explicitly set forth in Regulation No. 330/2010 of April 20, 2010, L. 102/1, April 23, 2010, art. 4.

98 F. Beneke-M.O. Mackenrodt, *Remedies for algorithmic tacit collusion*, *cit.*, 164 ff.

In terms of legal dogmatics, it is established that the concept of an agreement requires the common intention of the parties to act in a certain way on the market and the existence of a concerted will. This type of coordination, as understood in the traditional sense of competition law, is not limited to price signalling. In fact, it necessitates the utilisation of specific forms of communication to convey the intention to collectively raise prices.

With regard to the prohibition of concerted practices, this offence is most frequently applied to the phenomenon of coordination between undertakings, which, however, cannot be qualified as an agreement. In a broader sense, the concept of concerted practices does not extend to instances where a concerted action, subsequent practice, or causal link can be identified[99]. Consequently, autonomous parallel conduct cannot be considered a concerted practice and is not prohibited by Article 101 of the Treaty on the Functioning of the European Union (TFEU). Moreover, as is understood in the context of contemporary European competition law, this concept does not apply to mere interdependence, let alone one involving the use of autonomous pricing agents. In essence, the concept of autonomous parallel conduct is designed to encompass forms of cooperation that cannot be regarded as agreements. However, it does establish practical coordination between companies in order to avoid the risks of competition[100].

In our view, the most immediate consequence of the aforementioned picture is that EU antitrust law would be severely limited in its capacity to provide market regulators with the necessary legal instruments to regulate and rectify any distortions that may arise from the utilisation of AI and algorithms. Furthermore, even if competition regulators were able to identify sufficient evidence to prove a violation of Article 101 TFEU, it remains unclear what remedies and tools are available in such cases. Despite the uncertainties in application and the necessity for legislation to adapt to the new anti-competitive

99 *Ivi*, 165.
100 *Ivi*, 166.

practices, an interpretative effort may lead to some beneficial results. However, it is important to note that the antitrust system is reluctant to include AI and algorithms in the blacklist of competition-distorting transactions.

In general, it is understood that the provisions for remedies in cases where an infringement of Article 101 of the Treaty on the Functioning of the European Union (TFEU) has been found are set out in EU Regulation No 1 of 2003. Article 7 of the aforementioned regulation stipulates that the European Commission may impose decisions compelling undertakings to bring the infringement to an end. Consequently, in order to achieve this objective, the Commission may issue an order requiring the undertaking in question to implement any behavioural or structural remedies that are deemed to be proportionate to the infringement in question and necessary to bring the infringement to an effective conclusion.

Upon initial examination, the rule indicates that structural remedies are typically regarded as a more robust intervention than behavioural remedies. In particular, structural remedies can be employed to address tacit collusion in a variety of ways. Furthermore, when designing a structural remedy, the competition authority should seek to mitigate the negative effects of tacit collusion, for instance, by creating asymmetries between market participants. Indeed, in many oligopoly models, symmetry is an assumption that reduces the strategic interaction of firms. In addition, a firm's optimal price decision is not solely influenced by the actions of competing firms; rather, it is contingent upon a multitude of variables[101].

These factors include the cost structure of the enterprise, the distribution channels employed, and the extent of cooperation with other enterprises. Consequently, the same pricing algorithm could yield an optimal price when applied to different firms. It can be argued that market asymmetries could prevent or reduce the likelihood of collusive market outcomes through the use of

101 *Ivi*, 167.

pricing algorithms[102]. In our opinion, structural remedies may not only prevent future market violations, but also discourage them. This occurs when the prospect of having to contend with a more competitive market structure, in which profits will be lower, acts as a deterrent to firms pricing independently[103].

The assumption is that firms are "patient" economic actors, which implies that they consider future profits carefully. This is also a necessary precondition for interdependent price stability, thereby ensuring that the remedy has a greater effect on markets that are more prone to collusion. It can be observed that structural remedies are a particularly attractive option, as they address market characteristics that facilitate collusive algorithmic outcomes without the need for intervention in specific areas[104].

Finally, as previously indicated in Article 7 of EU Regulation No 1 2003, the implementation of behavioural incentives can also yield valuable results. It is our contention that the formulation of guidelines can facilitate greater transparency in the functioning of AI and algorithms. Transparency should facilitate more effective regulatory oversight, enabling regulators to verify that software adheres to competitive best practices. Consequently, the objective of such transparency measures should be to eliminate the so-called "black box problem". In practical terms, this implies that transparency-oriented solutions can be implemented in pricing decisions, with the variable of interest being the strategic response to competitors.

## 5. Conclusions

The analysis has revealed how in the antitrust sector new forms of abusive competition can emerge and spread through the acquisition of AI-based systems. The deployment of sophisticated algorithms by companies can give rise to novel infringements that may be underestimated by regulators and result in the emergence of detrimental market distortions. In EU positive law traditional

102 *Ibid.*
103 J.E. Harrington Jr, *A Proposal for a Structural Remedy for Illegal Collusion*, *cit.*, 342.
104 *Ivi*, 347.

regulatory frameworks to control and mitigate the impact of anti-competitive practices are not yet fully aligned with recent IT acquisitions and risk not being adapted to the emergence of new illegal behaviour. A negative outcome could occur in the domain of public interest, where the systemic effect could be to undermine competitiveness and collective welfare[105].

Against this background, the present research first offered a survey of the state of the art on AI and algorithmic systems. This was achieved by conducting an in-depth information science study on the meaning, function, and application of these new tools. The paper then examined the impact of new information tools in the light of the protection of the public interest, exploring the areas of neutrality, transparency and comprehensibility of AI and algorithms. Finally, the analysis turned to the topic of new algorithmic anti-competitive practices. This involved an examination of the legal prerequisites and the suggestion of some remedies on the side of EU law.

Our research led to the conclusion that to ensure the effectiveness of the antitrust system and thus allow competition in the name of safeguarding the public interest, technology-based systems, such as AI and algorithms, must be transparent and accountable. This is necessary in order to make the economic decision-making process of market participants visible, explainable, and ultimately subject to judicial review by regulators and judges.

105 For an insightful contribution, see T.O. Barnett, *Maximizing Welfare through Technological Innovation*, in *George Mason Law Review*, 15, 2008, 1191 ff.