Virtual Competition:

Human Liability Vis-À-Vis Artificial Intelligence's Anticompetitive Behaviours

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The progressive demise of bricks-and-mortar and the rise of the online merchant are not to be ostracized per se, as the virtual nature of potential anticompetitive behaviours will not change the substance of the antitrust enforcement. The fil rouge of the present contribution is to be found in the pivotal role of human liability as the logical premise for whatsoever theory of harm. All those challenges coming from the interaction between Big Data and Artificial Intelligence are thus to be welcomed as the future of competition law goes hand in hand with the technological progress of innovative markets.

I. Introduction

'That's the p(rog)ress, baby! And there's nothing you can do about it!'.[1] In the last two decades at least in four cases algorithms have proved to overcome human abilities in playing chess, Jeopardy, Go and poker. If the first human defeat was merely the triumph of computational brute force in a scenario game, in the last case the algorithm created by Carnegie Mellon University has proved capable of analysing a situation made of information asymmetries better and faster than a brilliant thinking human mind.[2]

The progressive shift from human actors to Artificial Intelligence (AI) in many aspects of everyday life seems to be shaking also the foundations of the antitrust world. Phenomena raising concerns and attracting scrutiny from competition authorities both in the United States (US) and the European Union (EU) are mainly related to price fixing algorithms, which might dismantle the traditional criteria to assess agreements and concerted practices under, respectively Article 1 of the Sherman Act and Article 101 of the Treaty on the Functioning of the European Union (TFEU).

In this respect, some commentators do still stay on the lookout when it comes to new theories of harm and undue concerns about innovation,[3] whereas others have preannounced that 'competition as we know it is going to change'[4] as antitrust law, premised on human intent and liability, may be inadequate to prevent companies from breaching competition law in the digital economy era.

From a methodological point of view, the article aims at providing food for thought in a context of scarcity of antitrust literature and lack of Commission decisions and courts' case law on the matter. Al-

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1 A readapted quote from 'Deadline - U.S.A.', directed by Richard Brooks (1952). Similar comparison recently made also by US Federal Trade Commissioner Terrell McSweeny at University of Oxford Center for Competition Law and Policy, where she said 'We shouldn't outlaw pricing algorithms. Algorithms are right up there with the printing press in terms of their contributions to our modern economy'.

2 For further readings, see Enrique Dans, 'Machine learning and competitions' (Medium Corporation, 26 May 2017) <https://medium.com/enrique-dans/machine-learning-and-competitions-293dfea8202c> accessed 22 March 2018; Ryota Kanai, 'We Need Conscious Robots' (Nautilus, 27 April 2017) <http://nautil.us/issue/47/consciousness/we-need-conscious-robots> accessed 22 March 2018.

3 Malina McLennan, 'Whish urges restraint on algorithmic collusion' (GCR, 5 July 2017) <http://globalcompetitionreview.com/article/1144015/whish-urges-restraint-on-algorithmic-collusion> accessed 22 March 2018.

4 Ariel Ezrachi and Maurice E Stucke, *Virtual Competition. The Promise and Perils of the Algorithm-Driven Economy* (Harvard University Press 2016); for further readings, see David J Lynch, 'Policing the Digital Cartels' *Financial Times* (2017) <https://www.ft.com/content/9de9fb80-cd23-11e6-864f-20dcb35cede2> accessed 22 March 2018.

beit hot, the topic is still highly theoretical as well as the proposed analysis, which tilts the balance towards a modern use of the existing antitrust toolkit to address future algorithmic challenges.

This article is divided into four main parts. Largely inspired by Ezrachi and Stucke research, the first part describes the four potential collusive scenarios in which pricing algorithms might play a pivotal role for antitrust enforcement purposes. The second section presents the author's proposal to assess (human) liability for algorithms' anticompetitive conducts and questions the main counterarguments put forward by the available antitrust literature. The third section, as integration of the previous part, provides food for thought so as to potential efficiencies stemming from the use of algorithms and their likelihood to revive the exemption process under Article 101(3) TFEU. The fourth part introduces both market-based and regulatory-based measures to counteract the potential anticompetitive drifts of pricing algorithms. The conclusion offers a summary of the core point presented in the article.

II. Theories of Harm in Fast-Moving Digitalised Markets

An algorithm may be defined as a decision-making software turning digital inputs into digital outputs. As the technology rapidly evolves, brand new algorithms are self-learning, amending their own rules depending on past experience. According to the emerging literature on Antitrust and Artificial Intelligence (AAI), such technologies have given rise to 'robo-selling', described as the combined effect of mass data collection, algorithmic processing and automated pricing.[5] Interactions between Big Data and AI are not inherently good or bad, but their effects on society cannot be considered neutral.[6] The antitrust assessment of price bots will thus depend on how firms implement them (liability), how markets are structured (transparency/concentration) and whether collusive outcomes are pursued or not (enforceability).[7]

In this first section, the author will thus critically explore the evolving theories of harm in fast-moving digitalised markets. Four predictable scenarios[8] in which algorithms promote collusion will thus be presented in ascending order, from least to most challenging in terms of establishing human liability for their anticompetitive conducts on the market

1. First Scenario: The Classic Digital Cartel

A digital cartel is merely the modern version of the smoke-filled room agreements, meaning that humans agree to collude and devices execute the collusion, acting as proxies to implement and monitor the anticompetitive conducts. In this respect, antitrust rules are infringed by the same fact a meeting of minds had occurred in advance. Indeed, such devices simply facilitate outcomes humans would otherwise have achieved by distributing price lists or communicating through trade associations. The straightforward rationale behind it is that if price-fixing cartels are illegal when implemented in the bricks-and-mortar world, they *a fortiori* are when implemented online. In all these cases, firms cannot escape liability on the grounds that their prices were determined or adjusted by machines. The latter is the conclusion reached by the US Department of Justice in the so-called *Poster Cartel* saga,[9] where online poster retailers have been held responsible with their co-conspirators for breaching Article 1 of the Sherman Act by having coded an algorithm to set prices of certain posters sold on Amazon Marketplace. In facsimile cases, the pricing software does merely play the role of the hangman executing a pre-determined collusive will. As the anticompetitiveness of the agreement is *in re ipsa*, such practices will be dealt as per se antitrust infringements.[10]

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5 Salil K Mehra, 'Robo-Seller Prosecutions and Antitrust's Error-Cost Framework' (Spring 2017) 2 CPI Antitrust Chronicle May; Salil K Mehra, 'De-Humanizing Antitrust: The Rise of the Machines and the Regulation of Competition' (Temple University Legal Studies Research Paper No 2014-43, 2014).

6 Ariel Ezrachi and Maurice E Stucke, 'How Pricing Bots Could Form Cartels and Make Things More Expensive' *Harvard Business Review* (2016) <https://hbr.org/2016/10/how-pricing-bots-could-form-cartels-and-make-things-more-expensive> accessed 22 March 2018.

7 Giovanni Pitruzzella, 'Big Data and Antitrust Enforcement' (2017) Italian Antitrust Review, 1 so as to the interaction between information, innovation and market outcomes.

8 Ezrachi and Stucke, *Virtual Competition* (n 4); see, also OECD, 'Algorithms and Collusion - Note from the European Union' (2017) DAF/COMP/WD.

9 *USA v David Topkins* [2015] no 3:15-cr-00201 and *USA v Daniel William Aston and Trod Limited* [2015] no 3:15-cr-00419. The same conduct has been targeted by the CMA's officials in UK, where online vendors of entertainment merchandise had fixed prices by configuring and using 'commercially-available automated re-pricing software'.

10 Ezrachi and Stucke, *Virtual Competition* (n 4).

2. Second Scenario: The 'Inadvertent' Hub-and-Spoke

This is a slightly trickier situation in which online retailers (ie the spokes) using 'inadvertently' the same third-party provider's (ie the hub) pricing algorithms might find themselves facing cartel allegations for price-fixing. Unlike the first scenario, the price 'bot is not merely a means to execute a digital cartel, but it is the use of the same pricing algorithm by competitors to monitor prices that leads to the (more or less) inadvertent collusive outcome. In the recent *Eturas* case,[11] the administrator of a Lithuanian online travel-booking comparison platform dispatched an electronic notice to its travel agents, announcing a new software that put a cap on discount rates applicable to clients. It has been established that where firms independently sign up to using multiplayer third-party platform's algorithm that pursues anticompetitive outcomes, they may be held liable for engaging in classic hub-and-spoke behaviour if they do not publicly distance themselves from the practice or proved to have acted systematically as mavericks on the market in blatant disregard of the aims of the concerted practice.[12] In such triangular conspiracies, also algorithm developers should thus be leery of the anticompetitiveness of their price-bots so as to turn aside from allegations of engaging in vertical or promoting horizontal collusion. By the same token, the latter might be the case of Boomerang Commerce, a technology platform which provides online retailers with a price-optimisation software able to evaluate competitors' pricing strategies, adjusting them according to a profit-maximisation logic. Let's assume Boomerang's customers competing at horizontal level provide the hub with data and pricing authority, knowing that their rivals are doing the same and that the hub's conduct is anticompetitive, they are likely to be found liable for engaging in classic hub-and-spoke conspiracy along with the third-party vendor's pricing algorithms. However, what about instances where the algorithm is not designed to facilitate collusion, but may nonetheless alter the market price? Could it for this same reason be treated as restriction by object? In this respect, an ongoing case in the US[13] is examining *Uber*'s (ie the hub) surge-price algorithm, which is deemed to have increased the price of the journey as the demand increases, leading to horizontal coordination between each individual driver (ie the spokes). The intricacies of the latter scenario are mainly related to the fact that while the effects on the market may equate to a disguised form of horizontal coordination, the conditions for establishing a hub-and-spoke conspiracy may be absent. Therefore, in addressing such conducts - as evidence of their unlawfulness does not *prima facie* meet the eye - a more thorough effects analysis might be required.[14]

3. Third Scenario: The Tacit Algorithmic Collusion

As in bricks-and-mortar premises, (virtual) tacit collusion drives the antitrust assessment into more uncertain territory albeit explored by trustbusters. In the third scenario, each firm independently implements a pricing-algorithm that constantly monitors and adjusts prices according to market information. Although this leads to de facto tacit collusion, particularly in oligopolistic markets prone to coordination, there is no agreement between companies that might amount to actionable infringement of competition law. The *discrimen* between lawful and unlawful conducts relies on whether use of such devices remains part of rational, unilateral and independent strategies carried out by a competitor to adapt intelligently to new market information (ie conscious parallelism) or not.[15] In the US, the *Martha's Vineyard* case[16] perfectly illustrates what might be called the 'petrol station' dilemma. A price cut posted outside one petrol station will soon be matched by the others. And if one station raises prices, it can always cut them again if the others do not follow. Markets with such transparency and concentration levels are particularly prone to tacit collusion, because the potential profits from cheating on an unspoken deal, be-

11 Case C-74/14 *Eturas UAB and Others v Lietuvos Respublikos konkurencijos taryba* [2016] ECLI:EU:C:2016:42.

12 Catalin S Rusu, 'Eturas: Of Concerted Practice, Tacit Approval, and the Presumption of Innocence' (2016) 7(6) Journal of European Competition Law & Practice 396 – 398; Pierre de Bandt and Julie Probst, 'Proving Concertation in the Context of Online Platforms: A Comment on the Eturas Case' (2017) 1(1) CoRe 74 – 79.

13 *Meyer v Kalanick* [2016] 1:15-cv-09796.

14 Ezrachi and Stucke, *Virtual Competition* (n 4).

15 Case C-40/73 *Suiker Unie and others v Commission* [1975] ECLI:EU:C:1975:174.

16 *White v Packer Co Inc* [2011] 10-1130.

fore others can respond, are small.[17] Despite such a collusive scenario, collected evidence did nothing to explain whether the parallel pricing was achieved by agreement or mere interdependent decisions.[18] The dilemma at hand has been considered the Achilles' heel of the antitrust enforcement both in the US and the EU due to the inherent intricacies so as to the standard of proof to tackle such parallel behaviours either offline and online.[19]

4. Fourth Scenario: Dystopian Virtual Reality

This last scenario seems reminiscent of science fiction novels in which AI is able to make autonomous decisions and learn through experience. In antitrust terms it means pricing algorithms achieving collusive outcome with no anticompetitive intent or meeting of minds between humans. The computer executes whichever strategy it deems optimal to streamline profit on the basis of ongoing feedback collected from market information. Such a collusive attitude might thus have a slippery slope effect culminating in the artificially intelligent device finding that coordination on prices is the best strategy, regardless of potential safeguards implemented by developers. This scenario would potentially leave trustbusters powerless to enforce competition law, given the fact that there would be no evidence of human intent to establish liability.[20] The intricacies related to the latter will be conveniently explored in the following paragraph.

III. The Role of Human Liability on Artificial Intelligence's Anticompetitive Behaviours

Despite rising fines, prison sentences, and attractive leniency programmes, cartels persist. Their virtual nature seems to render collusion more aseptic and currently available competition tools inadequate to detect it. In the words of Ezrachi and Stucke: 'unlike humans, computers do not fear detection, possible financial penalties, or incarceration, and they do not respond in anger'.[21] By increasing the distance between humans and the day-by-day illicit activities, the perception of wrongdoing is reduced helping individuals wash their hands of the anticompetitive behaviour of their artificially intelligent devices. In this respect, especially the fourth futuristic scenario raises particular concerns to the extent that firms are likely to escape liability as AI seems autonomous in its market's anticompetitive conduct.

In this section, the author will thus address the question whether it is feasible to convincingly assert that self-learning pricing algorithms constitute nothing more and nothing less than de facto (virtual) employees operating under direction or control of companies which coded or 'hired' them.

The Commission has recently warned companies against the possibility to escape responsibility for collusion by hiding behind a computer program, bringing into the arena the role of human liability and intent in all those cases involving Artificial Intelligence. It seems thus that the antitrust watchdog will not be willing to hear defendants ceaselessly denying any relationship and responsibilities between them and the computer or pointlessly invoking breaches of fundamental rights [ieArticle 6 (2) of the European Convention on Human Rights (ECHR) and Article 48 (1) of the Charter of Fundamental Rights of the European Union (EU Charter)]. However, quoting the words of David Currie, a top official at the UK Competition and Markets Authority (CMA) : 'How far can the concept of human agency be stretched to cover these sorts of issues?'.[22]

Starting from the ABC of the antitrust enforcers' toolkit, the crucial factor for establishing liability is to identify the existence of an 'agreement' between the economic players. The notion has been forged over time by the courts and depicted as 'meeting of

17 'Price-bots can collude against consumers. Trustbusters might have to fight algorithms with algorithms' *The Economist* (6 May 2017) <https://www.economist.com/news/finance-and-economics/21721648-trustbusters-might-have-fight-algorithms-algorithms-price-bots-can-collude> accessed 22 March 2018.

18 *Monsanto Co v Spray-Rite Serv Corp* [1984] 465 US 752, 763 where the US Supreme Court held that 'Plaintiffs must establish that it is plausible that defendants are engaged in more than mere conscious parallelism, by pleading and later producing evidence pointing toward conspiracy, sometimes referred to as "plus factors"'.

19 Ezrachi and Stucke, *Virtual Competition* (n 4).

20 ibid.

21 Ezrachi and Stucke 'How Pricing Bots Could Form Cartels and Make Things More Expensive' (n 6).

22 Speech given by CMA Chairman, David Currie, at the Concurrences Innovation Economics Conference, King's College London, 3 February 2017 <https://www.gov.uk/government/speeches/david-currie-on-the-role-of-competition-in-stimulating-innovation> accessed 22 March 2018.

minds',[23] 'concurrence of wills'[24] or 'conscious commitment'[25] to pursue a given line of conduct on the market.[26] In the absence of a smack-dab formal agreement, the category of 'concerted practice' applies. The latter has been defined as a form of coordination which, without having reached the stage of a clear-cut agreement, knowingly substitutes for the risks of competition practical cooperation between undertakings.[27] It is settled case law that for establishing the participation in a concerted practice under EU competition law, in addition to concertation between undertakings, subsequent conduct on the market and a cause-effect link between the two must be proven.[28] Since the latter is barely ascertainable by direct evidence (ie smoking-gun), recourse to presumptions[29] is justified by the necessity to ensure the effectiveness of EU competition rules, since without them the proof of an infringement could be rendered excessively difficult or impossible in practice.[30] Against this background, at a theoretical level, the dividing line between the two forms of collusion depends on the degree of intensity of the conduct and its implementation,[31] whilst in practice, the dichotomy between agreement and concerted practice blurs[32] or overlaps[33] in favour of a no-frills enforcement of competition law. In this respect, direct and indirect evidence has been used in conjunction[34] and in light of the doctrine of the single overall agreement.[35] Whereas the standard of proof for the participation in a concerted practice is a procedural matter governed by national law in light of the principles of procedural autonomy, effectiveness and equivalence,[36] establishing liability of an undertaking for such anticompetitive practices on account of pricing algorithms will remain a substantive assessment to be carefully carried out in light of existing EU case law.

As in bricks-and-mortar scenarios, the core issue is thus to demonstrate wrongdoing regardless of the fact that pricing decisions are made at a machine level rather than by direct human intervention. As Mehra puts it, only three outcomes are conceivable when attributing responsibility for anticompetitive actions, namely blaming i) the robo-seller itself, ii) the humans who deploy it or iii) no one.[37] While the third option is not feasible for manifest enforcement reasons, the current debate revolves around the circumstance that, as AI develops further, the links between the robo-seller (ie the algorithm) and its principal (ie the human being) become weaker and the ability of algorithms to act and price autonomously

23 *Interstate Circuit Inc v United States* [1939] 306 US 208, 810; *Am Tobacco Co v United States* [1946], 328 US 781, 809-10, para 810.

24 Case T-41/96 *Bayer AG v Commission* [2000] ECLI:EU:C:1997:283, para 173.

25 *Monsanto Co v Spray-Rite Serv Corp* [1984] 465 US 752, 768; Case *In re Flat Glass*, 385 F 3d, para 357.

26 C-40/73 *Suiker Unie* (n 15).

27 Joined Cases C-89/85 *Wood Pulp II* [1993] ECLI:EU:C:1993:120, para 71.

28 Case C-49/92 *Commission v Anic Partecipazioni SpA* [1999] EU:C:1999:356, paras 118 and 121; Case C-199/92 P *Hüls v Commission* [1999] EU:C:1999:358, paras 161-162.

29 ibid, C-49/92 *Commission v Anic Partecipazioni SpA* . The so-called 'Anic presumption', consisting of the presumption of a causal connection between the concertation and the market conduct of the players. See also, Opinions of Advocate General Kokott in *T-Mobile Netherlands and Others* (C-8/08, EU:C:2009:110, para 89) and *Akzo Nobel and Others* v *Commission* (C-97/08 P, EU:C:2009:262, para 72).

30 Case C-74/14 *Eturas* [2016] ECLI:EU:C:2015:493, Opinion of AG Szpunar. Paraphrasing his words, as a general rule, these presumptions do not shift the burden of proof into the addressee of the competition authority's decision. However, they allow the enforcer to draw a certain conclusion on the basis of common experience. The resulting prima facie determination may be rebutted by contrary evidence, failing which that conclusion will be considered as adequate to discharge the burden of proof, which continues to lie with the administrative authority.

31 Okeoghene Odudu, 'The Boundaries of EC Competition Law: The Scope of Article 81' (Oxford Scholarship Online, March 2012).

32 C-49/92 *Commission v Anic Partecipazioni SpA* (n 28) paras 132-133 and Joined Cases T-305-7, 313-318, 325, 328-9, 335/94 *Limburgse Vinyl Maatschappij NV and others v Commission* [1999] ECLI:EU:T:1999:80, para 697.

33 Case IV/37.614/F3 *PO/Interbrew and Alken-Maes* [2003] OJ L200/1, para 223 where the Commission noted that 'the concepts of agreement and concerted practice are variable and may overlap. Realistically, it may even be impossible to make such a distinction, since an infringement may simultaneously have the characteristics of both forms of prohibited behaviour, whereas, taken separately, some of its elements may correctly be regardedas one rather than the other form. It would also be artificial from an analytical point of view to split what is clearly a continuous, collective enterprise with a single objective into several forms of infringement. A cartel may for instance constitute an agreement and a concerted practice at the same time'.

34 T-305-7, 313-318, 325, 328-9, 335/94 *Limburgse Vinyl Maatschappij NV* (n 32).

35 For further readings, see David Bailey, 'Single, Overall Agreements in EU Competition Law' (2010) 47(2) CMLR 473-508.

36 In this respect, with reference to private enforcement, the level playing field provided by the Antitrust Damages Directive 2014/104/EU along with Regulation 1/2003 decentralising competence from the Commission to the National Courts, is likely to further enhance the role of national judges and might contribute to a statistical increase in private actions before the Courts. The European Commission's objective seems thus to create an effective system of private enforcement through damages actions as a complement to, not a substitute for, public enforcement.

37 Salil K Mehra, 'Antitrust and the Robo-Seller: Competition in the Time of Algorithms' (2016) 100 Minnesota Law Review 1323-1375.

puts in question the liability of the individuals or firms who benefit from the algorithmic anticompetitive outcome.[38] In this respect, the evergreen dilemma is related to the appropriateness of and whether classic oligopoly behaviour can be prosecuted as an unlawful agreement in the much-feared algorithmic data-driven economy.[39] In this respect, Judge Posner has warned against the danger of law provisions treating tacit collusion as if it were express collusion.[40] In the same vein, Kaplow argues that the current approach to horizontal agreements may be too formalistic and incapable of addressing harmful interdependence among firms.[41] More recently, Ezrachi and Stucke in their opera magna *Virtual Competition. The Promise and Perils of the Algorithm-Driven Economy*,[42] after describing four predictable scenarios in which algorithms promote collusion, left open to interpretation and critics some entertaining and thought-provoking arguments which may be summoned up as follows i) assessing whether any illegal action could have been foreseen or predetermined by the firms which benefit from the algorithm is a challenging task as it requires a careful consideration of the programed instructions of the price-bot, available safeguards, reward structure and the scope of its activities. Therefore, can a benchmark for illegality be easily established?; ii) competition agencies should consider the extent to which humans can control algorithms' anticompetitive activities. The circumstance that price-bots are designed by humans implies that they intentionally create them to harm consumers?; iii) could liability be automatically charged jointly on the algorithms' designer, the physical person that used them and on the firm who benefitted from their decisions? The debated issue has thus broader implications so as to whether algorithmic interactions or 'meeting of algorithms' should be treated similarly to a 'meeting of minds' and whether the current antitrust toolkit is sufficient to address antitrust concerns stemming from robo-seller phobia.

In this regard, the analysis proposed hereinafter is based on the logical premise that, in cases where the meeting of minds takes place at machine level (ie scenario 4), it was arguably initiated at human level. Price bots are to be seen as a fully integrated part of a business, implemented by companies to boost pre-existing or future pricing strategies, monitor the market and detect deviation in hypothetical collusive scenarios in the same manner as a particularly skilful employee might do through ordinary means. The fact that collusion is robotised does not change its intrinsic pernicious nature, as price-fixing, market sharing or information exchange is the concern - not the use of an algorithm to carry it out. Once companies code or implement what may be considered virtual assistants, they must be fully accountable for the anticompetitive outcomes that might derive from their performance on the market. A well-established case law shows as undertakings have already been held liable based on the acts of their employees.[43] In particular, according to Becu et al jurisprudence,[44] employees perform their duties for and under the direction of the undertaking which employs them, therefore they are part of it. As part and parcel of a company, the latter is liable for any employee's anticompetitive conduct on the market.

In the recent case *VM Remonts*,[45] the European Court of Justice addressed a preliminary reference from the Supreme Latvian Court so as to what extent a company can be liable for the actions of one of its service providers. The Court, while remarking that the relationship between an undertaking and its employees is not, in principle, comparable to the relationship between that undertaking and the service providers which supply services to it, has nonetheless stated that, it is possible, in certain circumstances, for a service provider which presents itself as independent to be in fact acting under the direction or control of an undertaking that is using its services. That would be the case, for example, in circumstances in which the service provider had only little or no autonomy or flexibility with regard to the way in which the activity concerned was carried out, its notional independence disguising an employment

38 OECD, 'Algorithms and Collusion: Competition Policy in the Digital Age' (2017).

39 George Alan Hay, 'Anti-Competitive Agreements: The Meaning of "Agreement"' (Cornell Legal Studies Research Paper No 13-09, 2013).

40 Richard Posner, 'Oligopoly and the Antitrust Laws: A Suggested Approach' (1968) 21 Stanford Law Review 1562-1606.

41 Louis Kaplow, 'On the Meaning of Horizontal Agreements in Competition Law' (2011) 99 Cal L Rev 683.

42 Ezrachi and Stucke, *Virtual Competition* (n 4).

43 Joined Cases C-100/80 and 103/80 *Musique Diffusion Française and Others v Commission* [1983] ECLI:EU:C:1983:158 and Case C-68/12 *Slovenská sporiteľňa* [2013] ECLI:EU:C:2013:71.

44 Case C-22/98 *Becu and others* [1999] EU:C:1999:419, para 26.

45 Case C-542/14 *VM Remonts and Others* [2016] ECLI:EU:C:2016:578.

relationship.[46] Furthermore, such direction or control might be inferred from the existence of particular organisational, economic and legal links between the service provider in question and the user of the services, just as with the relationship between parent companies and their subsidiaries.[47] In such circumstances, the undertaking using the services could thus be held liable for the possible unlawful conduct of the service provider.

This judgment is of utmost importance as it lays the basis for the likely approach being taken by the Commission in the future to make companies liable for their algorithms' unlawful conducts. In particular, the Court established that Article 101(1) TFEU must be interpreted as meaning that an undertaking may, in principle, be held liable for a concerted practice on account of the acts of an independent service provider supplying it with services only if one of the following conditions is met: i) the service provider was in fact acting under the direction or control of the undertaking concerned; or ii) the undertaking was aware of the anticompetitive objectives pursued by its competitors and the service provider and intended to contribute to them by its own conduct; or iii) the undertaking could reasonably have foreseen the anticompetitive acts of its competitors and the service provider and was prepared to accept the risk which they entailed. The third condition is in itself telling so as to human liability may be solidly established for algorithmic anticompetitive conducts. And indeed, it further confirms the principles set forth in the longstanding jurisprudence of the Court of Justice, namely the ability to predict the likely anticompetitive outcome of the price-bots' collusion and the readiness to accept the risk of it.[48] As seen above, the assessment of evidence and the requisite standard of proof to determine whether one of those conditions is met it is up to the national court. In light of the foregoing, like a de facto employee or an outside (virtual) consultant, an algorithm remains under the firm's direction or control and, therefore the firm is liable for its actions.

In the case at stake, the Court has, inter alia, disregarded the opinion of Advocate General Wathelet, recommending the creation of a rebuttable presumption of liability regardless of knowledge and consent.[49] Wathelet's proposal for a vicarious-type liability and the conditions set forth by the Court of Justice are not worlds apart. Indeed, their aim is to make companies accountable for antitrust infringements of third parties that cannot be regarded as auxiliary organs forming an integral part of a company.[50] However, for the sake of clarity, what the Advocate General does is to make a step further towards the creation of a brand new presumption and the 'quomodo' to rebut it[51]. Albeit particularly interesting, his take conceals a major drawback, notably the undue shift of the burden of proof on undertakings that would run the risk to be unfair and time consuming at Article 101(1) TFEU level. For this reason, the Court of Justice limits its judgment to the 'an', notably the factual links upon which liability may be established without erasing the constituent element of consent. Under the third condition, it will be thus sufficient for competition authorities to i) show that the consent is given also indirectly through accepting the risk of wrongdoing on account of artificially intelligent devices and ii) provide evidence to demonstrate the anticompetitive object or effects on the market. It will be then up to undertakings to show efficiencies gains and find exemption from their potential anticompetitive conducts at Article 101(3) TFEU level.

As extensively showed above, the rallying cry 'my robot did it' would barely stand up to scrutiny before enforcers and courts given the unlikelihood of both the former and the latter to give rise to phenomena of impunity for anticompetitive conducts on the market. The proposed analysis mirrors a 'reality princi-

46 Case C-413/13 *FNV Kunsten Informatie en Media* [2014] EU:C:2014:2411, paras 35-36.

47 Judgments in C-97/08 P *Akzo Nobel and Others v Commission* (n 29) para 58; Joined Cases C-628/10 P and C-14/11 P *Alliance One International and Standard Commercial Tobacco v Commission and Commission v Alliance One International and Others* [2012] EU:C:2012:479, para 43; Joined Cases C-247/11 P and C-253/11 P *Areva and Others v Commission* [2014] EU:C:2014:257, para 30; Joined Cases C-293-294/13 P *Fresh Del Monte Produce v Commission* [2015] EU:C:2015:416, paras 75-75.

48 C-49/92 *Commission v Anic Partecipazioni SpA* (n 28) para 87.

49 Case C-542/14 *VM Remonts and Others* [2015] ECLI:EU:C:2015:797, Opinion of AG Wathelet.

50 See ibid, para 63.

51 ibid, paras 65-68. According to the Advocate General, undertakings should take 'precautions for use' at three stages, namely i) when hiring the third party service provider, the undertaking shall carefully select it, define the scope of its missions, make clear whether sub-contracting is authorized and, if so, under which conditions; ii) during the execution of the mission, the undertaking shall make sure that its third party service provider remains strictly within the boundaries of its missions such as defined in the contract and iii) when an infringement of competition law is uncovered, the undertaking shall not remain passive. Instead, it shall publicly distance itself from the infringement, make sure it does not happen again and report it to the authorities – this last point being somewhat redundant, since it is consistent with the case law on concerted practices.

ple' according to which algorithms are not alien entities landed to dismantle the foundations of the antitrust world but rather (virtual) assistants for which companies must be held liable of. In this respect, the robo-seller phobia runs the risk to lead to a ceaseless desire to provide techno-sclerotic solutions to address whatsoever human issue. Other than unfounded, this call to arms against algorithmic coordination might entail three itchy broader consequences, namely: i) unduly rendering the present case law as good as scrap paper; ii) creating an undisciplined shopping-list[52] of new elements to qualify a 'meeting of algorithms'; iii) arriving at the conclusion that no-one is potentially liable for algorithms' anticompetitive behaviours. Least but not last, some of the proposed modifications to the existent legal framework entail amendments to the Lisbon Treaty that Member States have repeatedly showed to be unwilling to agree to.

In the opinion of the author, the core issue is rather whether - after establishing liability based on the proposed stringent standard and identifying the conduct as restrictive by object or by effects - algorithms' anticompetitive conducts may generate efficiencies and thus be exempted under Article 101(3) TFEU.

IV. Digitised Efficiencies under Article 101(3) TFEU

Unlike Article 1 of the Sherman Act, the peculiarity of Article 101 TFEU is its bifurcated structure, ie the substantive appraisal of the alleged anticompetitive conduct under Article 101(1) TFEU and the related exemption process under Article 101(3) TFEU. As part of the former, competition agencies must establish whether a given practice restricts competition 'by object' or 'by effects'. Given the likelihood of algorithmic collusion on price to fall within the scope of the object-box,[53] the present analysis will focus on the width of the sliding scale approach laid down by the Court of Justice when assessing restrictions which display a sufficient degree of harm to competition.[54] In particular, in order to determine whether an agreement involves a restriction of competition 'by object', regard must be had to the content of its provisions, its objectives and the economic and legal context of which it forms a part.[55] The more the conduct departs from a clear-cut infringement of competition law the more the analysis goes deeper in the market dynamics.[56] The official recognition of such a truncated-type analysis in the recent case law is to be seen also as a judicial way to indirectly address the slow death of the exemption process under Article 101(3) TFEU stemming from the following short-circuits, notably i) the unduly expansion of the object-box category to conduct which are not prima facie anticompetitive (ie information exchange);[57] ii) the preclusion of national competition authorities from adopting negative decisions[58] and iii) the adoption of different standards for review of efficiency arguments.[59] In fact, without fear of being contradicted, nowadays EU trustbusters in line with the US approach, carry out the overall substantive assessment and the balancing exercise at once, namely at Article 101(1) TFEU level. As asserted by Whish and Bailey,[60] it might be very difficult to run efficiency arguments in favour of a secret, long-running price-fixing cartel. However, even though it is hard to conceive such arguments, it does not mean that it is impossible in law to do so.[61] In the opinion of the author, especially where algorithmic collusion is involved, the lack of any redeeming virtue[62] is not straightforward. And

52 Lawrence Sullivan, Warren Grimes and Christopher Sagers, *The Law of Antitrust: An Integrated Handbook* (West Academic Publishing 2015) 12-13.

53 Richard Whish and David Bailey, *Competition Law* (Oxford University Press 2015).

54 Case C-67/13 P *CB v Commission* [2014] ECLI:EU:C:2014:2204.

55 ibid, para 53.

56 Case C-32/11 *Allianz Hungária Biztosító Zrt and Others v Gazdasági Versenyhivatal* [2013] ECLI:EU:C:2013:160, para 36.

57 Case C-8/08 *Mobile Netherland BV v Raad van bestuur van de Nederlandse* [2009] ECLI:EU:C:2009:343.

58 Case C-375/09 *Prezes Urzędu Ochrony Konkurencji i Konsumentów v Tele 2 Polska sp. z o.o., now Netia SA* [2011] ECLI:EU:C:2011:270.

59 Case C-403/08 *Football Association Premier League Ltd and Others v QC Leisure and Others* [2011] ECLI:EU:C:2011:631 and Case C-429/08 *Karen Murphy v Media Protection Services Ltd* [2011] ECLI:EU:C:2011:631.

60 Whish and Bailey, *Competition Law* (n 53).

61 Case T-17/93 *Matra Hachette SA v Commission* [1994] ECLI:EU:T:1994:89, para 85 where the General Court stated that 'in principle, no anti-competitive practice can exist which, whatever the extent of its effects on a given market, cannot be exempted, provided that all the conditions laid down in Article 101 (3) of the Treaty are satisfied'; see also, Case C-439/09 *Pierre Fabre Dermo-Cosmétique SAS v Président de l'Autorité de la concurrence* [2011] ECLI:EU:C:2011:649, para 57 where 'As regards that question, it should be noted that, as an undertaking has the option, in all circumstances, to assert, on an individual basis, the applicability of the exception provided for in Article 101(3) TFEU, thus enabling its rights to be protected, it is not necessary to give a broad interpretation to the provisions which bring agreements or practices within the block exemption'.

62 *Continental TV, Inc v GTE Sylvania* [1977] 433 US 36, 49 quoting *Northern Pacific Railway Co v United States* [1958] 356 US 1.

indeed, despite the above-described collusive outcomes, the use of algorithms is in principle procompetitive.[63] Intelligent software can lower costs and make it easier for consumers to shop around, which can increase the price pressure on firms as consumers find themselves able to access instant pricing information and to switch between suppliers with increasing ease. In this respect, algorithms can monitor the market and adjust prices at a very low marginal cost. Long-term cost reductions may be passed on to consumers in the form of lower prices. Similarly, firms can, for example, use repricing algorithms to compete vigorously with other online sellers, automatically adjusting the prices of their products to beat the live prices of competitors' products. This reduces issues related to excess supply and demand, especially when there are capacity constraints, thereby increasing the overall market efficiency. The final outcome would consist of companies reaching a new competitive equilibrium much faster. Moreover, platforms can use information gathered about consumer preferences and past consumption habits to surface personalised recommendations and curated experiences so as to make search more effective. At a retail level, price-bots are likely to lower barriers to entry when reducing the amount of market knowledge required to enter a different level of the production chain.

Therefore it follows from the above that, given the complexities of the algorithmic collusion dynamics and the lack of case law on the matter, it would be advisable to reconsider a full-blown exemption process at Article 101(3) TFEU level in order to set the house in order. The burden of proving that the efficiencies gains are likely lays on the convicted undertaking, which must put forward convincing arguments and evidence that the agreement has pro-competitive effects.[64] The four conditions[65] laid down in Article 101(3) TFEU are cumulative, as the Court has already stressed in a number of occasions[66] and the Commission has specified in its Guidelines.[67] The invoked benefits produced by an agreement must be something objectively valuable to the EU as a whole, not a private advantage for the parties themselves,[68] ie a mere cost-saving for undertakings in terms of production or distribution *or* where the improvement constitutes a disproportionate distortion of competition in the market.[69] And indeed, any alleged benefits must outweigh the detriments they might produce. Given the fact that academic research on the economic impact of algorithmic pricing is as yet relatively limited and both the Commission practice

63 The EU Courts have stressed that art 101 TFEU aimed not only to protect the interests of consumers but also the structure of the market and, in so doing, competition as such [see C-8/08 *T-Mobile Netherland BV v Raad van bestuur van de Nederlandse* (n 57); Case C-501/06 P *GlaxoSmithKline Services Unlimited v Commission* [2009] ECLI:EU:C:2009:610].

64 Case T-111/08 *MasterCard v European Commission* [2009] ECLI:EU:T:2012:260, paras 194-237 where 'an undertaking is required to support its arguments with a detailed, robust and compelling analysis that relies in its assumptions and deductions on empirical data and facts. It is then up to the Commission or the NCAs to examine whether, on the balance of probabilities, the agreement in question does satisfy those criteria'.

65 The first condition to be met provides that the restrictions in the agreement must either contribute to an overall improvement in the production or distribution of goods or promote technical or economic progress within the Single Market; the second condition consists of the pass-on consumers of the benefits that result from the agreement. The pass-on requirement is described in terms of cost efficiencies, leading to increased output and lower prices, which must be substantiated by evidence of elasticity of demand and the peculiarities of the market *and* qualitative efficiencies. The concept of 'fair share' implies that the pass-on of benefits must at least compensate consumers for any actual or likely negative impact caused to them by the restriction; the third condition is to determine whether the restrictive agreement itself is reasonably necessary in order to achieve the efficiencies and whether the individual restriction of competition flowing from the agreement are reasonably necessary for the attainment of the efficiencies. Efficiencies may be: a) cost efficiencies, which may result from the development of new production technologies and methods, synergies arising from the integration of existing assets, from economies of scale and/or scope *and* from better planning of production; b) qualitative efficiencies, which are opposed to cost reduction, ie research and development agreements, licensing agreements, agreements for joint production of new or improved goods or services; the fourth requirement is that the agreement as a whole must not lead to the elimination of competition. When the latter is eliminated, the competitive process is brought to an end and short-term efficiency gains are outweighed by longer-term losses stemming, inter alia, from expenditures incurred by the incumbent undertaking to maintain its position (ie rent seeking), misallocation of resources, reduced innovation and higher prices. In order to assess whether competition is substantially eliminated, it is necessary to evaluate the extent to which competition will be reduced as a result of the agreement, taking into account the pre and post competition situation.

66 Joined Cases 43/82 and 63/82 *VBVB and VVVB v Commission* [1984] ECLI:EU:C:1984:9; Case C-238/05 *Asnex- Equifax v Asociación de Usuarios de Servicios Bancarios (Ausbanc)* [2006] ECLI:EU:C:2006:734; Case C-68/12 *Protimonopolný úrad Slovenskej republiky v Slovenská sporiteľňa a.s.* [2013] ECLI:EU:C:2013:71.

67 See Communication from the Commission, 'Notice — Guidelines on the application of Article 81(3) of the Treaty (Text with EEA relevance)' [2004] OJ C 101, para 42 where 'According to settled case law the four conditions of Article 81(3) are cumulative, i.e. they must all be fulfilled for the exception rule to be applicable'.

68 T-111/08 *MasterCard v European Commission* (n 64) para 234.

69 Case T-65/98 *Van den Bergh Foods v Commission* [2002] ECLI:EU:T:2003:281, para 139 and case law quoted; see also, *Screensport/EBU* (Case IV/32.524) Commission Decision relating to a proceeding pursuant to art 85 EEC Treaty [1991], para 71.

and the EU courts' case law are absent, the present suggestion to revive the exemption process under Article 101(3) TFEU seems reasonable in order to make the existing antitrust toolkit work at its fullest in accordance with the competition law framework laid down in the Treaty.

As argued for liability at Article 101(1) TFEU stage, also the exemption process must be premised on a human basis. Considering that both the infringement and the exemption are granted to undertakings, the decision imposing fine or exempting from it must be addressed to firms given the unlikelihood of robots to be liable and prosecutable. Only if there is consistency between competition law as declared at Article 101(1) TFEU level and competition law as administered at Article 101(3) TFEU level, the system will be effective in prosecuting or exempting conducts carried out by robo-sellermen.

V. Possible Countermeasures Between Competition and Regulation

Although it has been argued at length that the virtual nature of antitrust infringements does not make obsolete the existing competition law framework, the implementation of a balanced mix of ex-ante and ex-post set of measures is nonetheless desirable to reduce the likely anticompetitive outcomes being pursued by artificially intelligent devices.

In this paragraph the author shall thus provide, without warranty of completeness, a hypothetical non-exhaustive list of market-based and regulatory-based solutions which market operators and regulatory agencies might be willing to consider in the near future.

1. Ex-ante Measures

As we train humans with tailored-made compliance programmes conceived for bricks-and-mortar infringements of competition law, so we must do it in order to prevent unlawful conducts at a virtual level. The implementation of such programmes is thus crucial to make companies aware of liability for their virtual assistants' anticompetitive conducts. Other measures might entail also ex-ante regulation within the scope of Standard Setting Organizations (SSO), leading to the introduction of mandatory 'antitrust compliance by design' standards for algorithms' developers or kill switch mechanisms in case of self-learning algorithms circumventing safeguards implemented by coders. Humans will thus be able to interfere in price-setting where intelligent devices learn to overcome the boundaries within which they operate (ie safe interruptibility).[70] Unlike the view taken by Ezrachi and Stucke, the introduction of auditing mechanism for algorithms might also prove useful to understand how price-bots instructed to maximises profits do so through collusion.

There might be a role to play also for merger control rules in markets with algorithmic activities. This implies competition agencies to start investigating risk of coordinated effects potentially also in 4 to 3 or even 5 to 4 mergers as well as conglomerate mergers where tacit collusion may be facilitated by multimarket contacts.

Ex-ante regulation might stem directly from state intervention through disruptive counter-algorithms aimed at limiting speed and frequency with which market players may adjust prices. However, the last measure conceals the drawback of sub-optimal market outcomes, namely the risk to prevent mavericks from administering their discounting strategies. Therefore, such a measure may be tempered by a clause allowing price decrease to be immediately implemented, while price increase subjected to time-limits.

2. Ex-post Measures

Ex-post countermeasures might come from the idea of fighting technology with technology. For instance, in business-to-consumer markets (B2C) the development of consumer algorithms ('digital butlers')[71] able to destabilises supra competitive tacit equilibrium between sellers and their respective price bots might constitute an effective tool to tackle exploitative conducts to the detriment of consumers. Such devices

70 Laurent Orseau and Stuart Armstrong, 'Safely Interruptible Agents' (July 2016) <http://intelligence.org/files/Interruptibility.pdf> accessed 22 March 2018.

71 Ariel Ezrachi and Maurice E Stucke, 'Is Your Digital Assistant Devious?' (Oxford Legal Studies Research Paper No 52/2016, University of Tennessee Legal Studies Research Paper No 304, 2016);. Michal S Gal and Niva Elkin-Koren, 'Algorithmic Consumers' (Spring 2017) 30 Harvard Journal of Law and Technology 309-353.

would be calibrated to find alternative paths to collusion, adjusting their decisional parameters to product and demand differentiation standards, thus constituting an effective countervailing buyer power. Similarly, in business-to-business markets (B2B) sophisticated buyers may have ability and incentives to code or purchase countermeasures that undermine the operation of seller's algorithms. In this respect, the ongoing 'Dieselgate' scandal[72] has given insights on how the automotive industry's technological features are likewise advanced to constitute real countervailing agents to input sellers' algorithms such as Google, Facebook or Amazon.

A fast developing area of interest is the cybersecurity industry, which is likely to provide the market with countermeasure systems such as data perturbation, masking and randomisation software able to track down the unlawful drifts of pricing algorithms.

Pure Intellectual Property law solutions might be problematic as by patenting pricing algorithms, companies would be revealing information about their artificially intelligent devices, thereby rendering arguments around awareness of competitors more likely.

As an overall modus operandi on the part of enforcers, the European Commission might put into place increasingly effective forensic tools able to detect unusual market trends stemming from algorithm-driven strategies. These likewise intelligent devices will be based on the idea of reverse-engineering algorithms in the hands of trustbusters and will have the purpose of understanding the decision-making process functions of their counter-actors. In line with the aims of Regulation 1/2003,[73] which provides the abolition of the notification system and the decentralisation of antitrust enforcement, it is of utmost importance that national competition authorities keep the pace with the European watchdog's enforcement technology standards. The latter process is likely to be further boosted by the recent systematic actions undertaken to render whistle-blower tools ever more anonymous[74] bringing benefits either directly on the enforcement rate and indirectly to the extent that officials will gain inside expertise on how such price software work and are implemented by undertakings.

In addition, as suggested by Ezrachi and Stucke, market studies and market investigations may support agencies' efforts to understand the dynamics which lead to collusion, whether they consist of transparency, predictability and frequent interaction or in any other structural characteristics not yet identified.[75] Afterwards, it might be necessary to intervene accordingly at a soft-law level, integrating the already existing set of Guidelines with specialised sections on how to conduct substantive assessments where algorithmic collusion is involved. In accordance with their decentralised competences post-Regulation 1/2003, it might be necessary to address Guidelines also to national competition authorities with the aim to guarantee uniformity of application of EU rules both at substantive and exemption level.

In light of the above, the (Collingridge)[76] dilemma is to regulate or not to regulate. And indeed, the double-bind problem - when establishing whether regulation is the best solution or not - is twofold, namely i) the impact of pricing algorithms cannot be easily predicted until the technology is extensively developed and widely used, and ii) control or change will be difficult when the technology has become entrenched. It seems thus that at least for now technology developments and market-based solutions are preferable until an evidence-based regulation in light of thorough market studies will be available on the market and the best-placed authorities to deal with these issues will be identified.

VI. Conclusions

What it seems to be a progressive shift from smoke-filled hotel rooms to vapour-filled data centres will in

72 The Dieselgate scandal began in September 2015, when the United States Environmental Protection Agency (EPA) issued a notice of violation of the Clean Air Act to German automaker Volkswagen Group. The agency had found that Volkswagen had installed illegal 'defeat device' for turbocharged direct injection (TDI) diesel engines to activate their emissions controls only during laboratory emissions testing which caused the vehicles' NOx output to meet US standards during regulatory testing, but emit up to 40 times more NOx in real-world driving.

73 Regulation EC No 1/2003 on the implementation of the rules on competition laid down in Articles 81 and 82 of the Treaty [2003] OJ L 1/1.

74 In this respect, see the section 'Whistleblower' on the European Commission website <http://ec.europa.eu/competition/cartels/whistleblower/index.html> accessed 22 March 2018.

75 Ariel Ezrachi and Maurice E Stucke, 'Two Artificial Neural Networks Meet in an Online Hub and Change the Future (Of Competition, Market Dynamics and Society)' (Oxford Legal Studies Research Paper No 24/2017, University of Tennessee Legal Studies Research Paper No 323, 2017).

76 David Collingridge, *The Social Control of Technology* (Frances Pinter 1980).

one way or another hit the headlines in the near future. However, antitrust 'as we know it' is not going to change in its nature or scope, but it will be at most stress-tested in its adaptation ability to new virtual challenges. If it is true that algorithms have the potential to make a computer 'a more skilful oligopolist that its human counterpart'[77] due to the increased accuracy in detecting price changes, the speed with which can be responded to market changes and the reduced likelihood of behavioural biases which undermine collusion, likewise it is true that such algorithms are automatically under the firms' control as soon as they are implemented within their business framework. *Ça va sans dire* that companies are to be considered liable for both any procompetitive outcome on the market and, a fortiori, for any anticompetitive one, since - exempting undertakings from liability - would create an even bigger problem of enforceability giving rise to underenforcement phenomena. The overhasty alarmism behind the rise of pricing algorithms seems more theoretical than factual since, until proven otherwise, such technological evils still remain nothing more and nothing less than virtual market failures.[79] As a reminder, it has to be reported that the only ongoing investigations alleging algorithmic online price-fixing (ie scenario 1-type) have been recently opened by the European Commission in the following cases: *Asus* (AT.40465), *Denon & Marantz* (AT.40469), *Philips* (AT.40181), *Pioneer* (AT.40182), concerning the consumer electronics market. Recently, the President of the Bundeskartellamt, Andreas Mundt, has commented the ongoing antitrust investigation against Lufthansa on its alleged use of pricing-algorithms following the collapse of Air Berlin, saying that the air carrier cannot claim it does not control its price bots' as a defense against allegations that its fare have been hiked.[78] The decisions are clearly highly awaited for the antitrust assessment yet to come. It is worth adding that, similarly to the US, none of the only few existing cases has crossed the Rubicon of the third and fourth scenario or even approached it.

Recalling the US Federal Trade Commissioner Terrell McSweeny words, '[a]lgorithms are right up there with the printing press in terms of their contributions to our modern economy'. Looking ahead, it is believed that the arguments in favour of algorithms pro-competitiveness would constitute the testing workbench for any reasonable and serious theory of harm to be carried out by trustbusters. The balancing exercise to be carried out at Article 101(3) TFEU level might thus be brought to life, given the likelihood of procompetitive effects to outweigh the anticompetitive ones. And indeed, in fast-growing dynamic markets an overly aggressive antitrust enforcement would risk chilling innovation and competition on the merits to the detriment of consumers.

So as to the distinction between by object/effect categories, according to the sliding scale approach taken in *Cartes Bancaires*,[80] even the most pernicious evils of antitrust law such as price-fixing, market sharing and control of outlets[81] (ie by object restrictions or per se violations) would undergo a more thorough or truncated-type analysis which takes into consideration the virtual economic and legal context where alleged infringements of competition law occur. In this respect, the role of competition authorities is of utmost importance so as to keeping pace with technological expertise required to deal with such ever-changing innovative markets. Until the technology develops and academic research improves, a more cautious approach to the matter is advisable in order to avoid, on one hand, a rapid escalation of regulatory measures or, on the other, the raise of formalistic trends leading to an unduly risk of false positives in the enforcement of competition law.

Three key takeaways have thus been put forward in the present article, namely: i) although virtual tacit collusion presents a greater level of legal uncertainty, the most significant challenges will come from self-learning or artificially intelligent algorithms; ii) companies cannot escape liability for their virtual employees' anticompetitive conducts on the market; iii) algorithms' pro-competitive effects are likely to effectively trigger the exemption process under Article 101(3) TFEU.

To conclude, it is still to be questioned whether the interaction between AI and Big Data will be dismantling the foundations of the antitrust world as we

77 Mehra 'Robo-Seller Prosecutions and Antitrust's Error-Cost Framework' (n 5).

79 Nicolas Petit, 'Antitrust and Artificial Intelligence: A Research Agenda' (2017) 8(6) Journal of European Competition Law & Practice 361-362.

78 Flavia Fortes and Matthew Newman, 'Lufthansa can't hide behind algorithms over fare hikes, German agency chief says' (Mlex, 20 March 2018).

80 C-67/13 P *CB v European Commission* (n 54) paras 49-58.

81 Case T-374/94 *European Night Services and others v Commission* [1998] ECLI:EU:T:1998:198.

know it in the near future. In this respect, the debate is alive and kicking but still theoretical, given the scarcity of academic literature and the absence of case law on the matter.[82] Notwithstanding, in the present contribution the author has taken a more conservative approach towards maverick theories of harm when it comes to assess agreements and concerted practices under Article 1 of the Sherman Act and Article 101 TFEU. However, it would be naïf to simply underestimate the extraordinary power of technology and the related challenges yet to come. 'That's the p(rog)ress, baby! And there's nothing you can do about it!'. As we cannot stop it, we can at least try to critically assess it at a human pace.

82 The European Commission has recently released a position paper presenting sounds arguments to build a human-centric European Strategy in order to address future challenges stemming from artificially intelligent machines (See, Commission, European Political Strategy Centre (EPSC), 'The Age of Artificial Intelligence. Towards a European Strategy for Human-Centric Machines' (March 2018) 29 EPSC Strategic Notes <https://ec.europa.eu/epsc/sites/epsc/files/epsc_strategicnote_ai.pdf> accessed 2 April 2018.