

ALGORITHMS, ARTIFICIAL INTELLIGENCE, AND JOINT CONDUCT



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I. INTRODUCTION

The ability of algorithms and artificial intelligence to monitor and set prices is increasing in sophistication, effectiveness and independence from human involvement at an exponential rate. The growth in this area, which is seen simultaneously across a range of AI applications, is such that no one — even its creators — is likely to fully appreciate AI’s capabilities until sometime after they have been realized. Pricing “bots” are already capable of engaging in behavior that we would not hesitate to call “parallel conduct” if it were performed by humans, and they will only get better at it. Indeed, the day may not be so far off when the pricing bot of one firm is fully capable of *colluding* — in every meaningful sense — with the pricing bot of a competing firm. At that point, we may have “conspiracy” cases under Section 1 of the Sherman Act that look very much like the cases we have today, except that the parts now played by humans are played by robots.²

The few existing antitrust cases involving pricing algorithms have not crossed this Rubicon, or really even approached it. They do not involve joint conduct *by bots*, in any sense. Instead, these cases involve human beings reaching familiar price-fixing agreements and then implementing them algorithmically. While these cases may create special problems of detection and proof, at least for the moment they do not seem to require any shift in the conceptual apparatus we use to solve antitrust problems.

There is reason to think such a shift may be coming, however. Joint conduct by robots is likely to be *different* — harder to detect, more effective, more stable and persistent — than traditional joint conduct by humans. For example, one of the basic precepts of the Sherman Act is that “unilateral” conduct by firms in the same market is not unlawful under Section 1, even if the conduct is closely interdependent and predictably yields supracompetitive prices that would be *per se* unlawful if achieved by agreement. An unspoken premise of this time-honored rule is that such interdependent conduct is likely to be relatively unstable in the absence of an agreement, and therefore, with any luck, the supracompetitive effects generally will be shorter lived and less pernicious than if they were achieved through true joint conduct.

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² Section 1 of the Sherman Act provides: “Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States, or with foreign nations, is declared to be illegal.” 15 U.S.C. § 1.

But this premise may have less force in a world of bots, who can interpret and respond to the actions of their competitors with far more precision, agility and consistency than their human counterparts. By simply allowing these bots to go to work, it is easy to imagine an effectively permanent pricing stasis settling over many markets, and not always with procompetitive effects.

How will enforcers approach such conduct, much less disrupt or prevent it? What duties should we impose on human beings to ensure their bots behave, and what culpability should they have when their bots go astray? The next ten years will begin to provide the answers, but the technology is already well ahead of the law, and the growing pains are likely to be immense.

II. BACKGROUND

A few months before the Sherman Act passed Congress on July 2, 1890, the U.S. Census Bureau started using Herman Hollerith's electrochemical punched card tabulator machines to record census returns. This invention allowed the Census Bureau to collect much larger volumes of data and reduced the amount of time to process census results. Hollerith's invention laid the groundwork for automated data processing, and he later partnered up with other inventors to form the technology company that ultimately became IBM.

Over time, engineers, inventors and entrepreneurs developed more advanced versions of Hollerith's data machines and implemented them in the marketplace. In the early 1970s, Thomas Peterffy and Dr. Henry Jarecki pioneered the use of computer algorithms that weighed various factors relating to option pricing. Their "black boxes" would "inhale market data, chew on it, then issue an instruction to their user, in this case whether to buy or sell."³ Their use of algorithmic pricing gave them an edge in the commodities markets because their computers would be able to process data inputs, weigh each factor and make trading recommendations more adeptly than their human counterparts.⁴

Today, modern innovations include more advanced algorithms, adaptive technologies and artificial intelligences (e.g. IBM's Watson, Microsoft's Oxford, Google's DeepMind and Baidu's Minwa). These technologies can pore over vast amounts of data before recommending or making strategic decisions.⁵ Like the simpler machines of the past, the newer machines can use data processing and analytics to give companies an edge in the marketplace when it comes to production, pricing and other business operations.

While the application of technology to determine purchasing and pricing patterns is nothing new, the increased sophistication of such technologies and their potential to play a role in unlawful conduct has caught the attention of global antitrust and competition enforcers. In a speech given on March 16, 2017, Commissioner Margrethe Vestager discussed how the use of algorithms could infringe EU competition law.⁶ She commented that "[p]ricing algorithms need to be built in a way that doesn't allow them to collude" and that "companies can't escape responsibility for collusion by hiding behind a computer program."⁷

Perhaps more notably, the U.S. Department of Justice ("DoJ") has already indicted two individuals for their use of the same pricing algorithms in the online poster marketplace.⁸ At the time of these indictments, many commentators noted that these cases could start a new trend for price-fixing cases. But once the dust settled, it became apparent that DoJ's cases did not reveal a new species of a Section 1 conspiracy. After all, the online poster cases still appeared to rely upon direct evidence of an agreement to establish the underlying antitrust violation.

3 CHRISTOPHER STEINER, *AUTOMATE THIS: HOW ALGORITHMS TOOK OVER OUR MARKETS, OUR JOBS, AND THE WORLD* (2012).

4 Just a few years after Peterffy and Jarecki's innovation, Professors Fischer Black and Myron Scholes of the University of Chicago published a paper that included what became widely known as the Black-Scholes formula for option pricing. Algorithms based on the Black-Scholes formula would "reshape Wall Street and bring a flock of like-minded men—mathematicians and engineers—to the front lines of the financial world." *Id.*

5 Artificial intelligence has already showcased its potential with its ability to make medical diagnoses, prepare legal briefs and conduct other traditionally human behavior.

6 Matthew Levitt et al., *EU Antitrust Enforcement 2.0 – European Commission Raises Concerns About Algorithms And Encourages Individual Whistleblowers*, KLUWER COMPETITION LAW BLOG (Mar. 21, 2017), available at: <http://klowercompetitionlawblog.com/2017/03/21/eu-antitrust-enforcement-2-0-european-commission-raises-concerns-about-algorithms-and-encourages-individual-whistleblowers/>.

7 *Id.*

8 The UK's Competition and Markets Authority brought similar actions against these sellers for their agreement to use the same autonomous pricing software. Press Release, UK Competition and Markets Authorities, CMA Issues Final Decision in Online Cartel Case (Aug. 12, 2016), available at: <https://www.gov.uk/government/news/cma-issues-final-decision-in-online-cartel-case>.

While these rapidly developing technologies have not yet changed any substantive antitrust law, the future of Section 1 cases involving sophisticated pricing algorithms and artificial intelligence (“AI”) may pose some new legal questions. It seems possible, however, that we will soon realize that the pricing AI of one firm is fully capable of colluding in every meaningful sense with the pricing AI of a competing firm. As such, we may then have conspiracy cases under Section 1 of the Sherman Act that look very much like the cases we have today, except that the parts now played by humans are played by AIs.

This article briefly analyzes existing legal doctrines and principles to see if they can offer antitrust and competition practitioners any guidance before we jump into this “brave new world.”

III. DOJ’S FIRST CHALLENGE OF PRICING ALGORITHMS

On December 3, 2015, DoJ unsealed an indictment against Daniel William Aston and his company Trod Ltd. (doing business as Buy 4 Less, Buy For Less and Buy-For-Less-Online) for fixing the prices of posters sold online via Amazon Marketplace.⁹ This indictment came eight months after DoJ announced a plea agreement with fellow co-conspirator David Topkins.¹⁰

According to DoJ, Aston, Topkins and other unnamed co-conspirators agreed to use specific pricing algorithms and computer software to coordinate their pricing changes. Because of this conduct, shoppers faced the same prices for the same products regardless of what seller they chose, thereby eliminating any price competition among the sellers.

DoJ lauded the *Topkins* case as its “first online marketplace prosecution.”¹¹ Then Assistant Attorney General Bill Baer further emphasized that DoJ “will not tolerate anticompetitive conduct, whether it occurs in a smoke-filled room or over the Internet using complex pricing algorithms. American consumers have the right to a free and fair marketplace online, as well as in brick and mortar businesses.”¹²

Despite DoJ’s public statements, there does not appear to be anything particularly innovative about its current poster cases. Notably present in these cases are the traditional elements of a price-fixing conspiracy. Specifically, the government alleged that the defendants entered into an agreement to fix the prices of posters sold in online marketplaces. While the *Aston* and *Topkins* cases centered on nascent technology, DoJ still alleged that there was a traditional “meeting of the minds” where co-conspirators agreed to collude with one another.

When the government can prove its allegation of an agreement with direct evidence, the tools used to implement the conspiracy are largely irrelevant for determining antitrust liability.¹³ Accordingly, these cases require nothing more than a simple application of the *per se* rule against price-fixing agreements to establish a Section 1 violation.

IV. PRICING ALGORITHMS AS INDIRECT EVIDENCE

Of course, a formal agreement or contract is not necessary to establish liability under Section 1 of the Sherman Act.¹⁴ That said, when there is no direct evidence of a conspiracy, proving antitrust liability through indirect evidence becomes (and has always been) a bit more difficult.

9 Press Release, DoJ Office of Public Affairs, *E-Commerce Exec and Online Retailer Charged with Price Fixing Wall Posters* (Dec. 4, 2015), available at: <https://www.justice.gov/opa/pr/e-commerce-exec-and-online-retailer-charged-price-fixing-wall-posters>.

10 Press Release, DoJ Office of Public Affairs, *Former E-Commerce Executive Charged with Price Fixing in the Antitrust Division’s First Online Marketplace Prosecution* (Apr. 6, 2015), available at: <https://www.justice.gov/opa/pr/former-e-commerce-executive-charged-price-fixing-antitrust-divisions-first-online-marketplace>.

11 *Id.*

12 *Id.*

13 See *United States v. Socony-Vacuum Oil Co.*, 310 U.S. 150, 223 (1940) (“[T]he machinery employed by a combination for price-fixing is immaterial. Under the Sherman Act, a combination formed for the purpose and with the effect of raising, depressing, fixing, pegging, or stabilizing the price of a commodity in interstate or foreign commerce is illegal *per se*.”).

14 See, e.g. *United States v. Gen. Motors Corp.*, 384 U.S. 127, 142-43 (1966) (“[I]t has long been settled that explicit agreement is not a necessary part of a Sherman Act conspiracy”).

When government enforcers or private plaintiffs rely upon indirect evidence to show that parallel conduct is the result of a conspiracy, the “crucial question” becomes whether the challenged conduct “stem[s] from independent decision or from an agreement, tacit or express.”¹⁵ Importantly, however, the Supreme Court “has never held that proof of parallel business behavior conclusively establishes agreement . . . [or] that such behavior itself constitutes a Sherman Act offense.”¹⁶ Rather, an antitrust plaintiff must present evidence “‘that tends to exclude the possibility’ that the alleged conspirators acted independently.”¹⁷

As a result, courts require plaintiffs relying on indirect evidence to show certain “plus factors” as “proxies for direct evidence of an agreement” to “ensure that courts punish concerted action — an actual agreement — instead of the unilateral, independent conduct of competitors.”¹⁸ While there is no exhaustive list, several Courts of Appeals have emphasized three “plus factors”: (1) evidence that defendants had a motive to enter into a price-fixing conspiracy; (2) evidence that defendants acted contrary to their interests; and (3) evidence implying a traditional conspiracy.¹⁹

When there is no direct evidence of a price-fixing agreement, antitrust enforcers or private plaintiffs could argue that the common use of similar pricing algorithms in competitive markets could serve as a “plus factor.” For example, one could argue that it would be unlikely for two competing firms to rely on the same variables when determining their prices. Even within the same product market, competitors often target different groups of customers, sell different types of products, provide different ancillary services, etc. One could then argue that the use of the same or similar algorithms to set prices in such markets could be evidence of competitors trying to inflate market prices or acting contrary to their interest. Additionally, one could argue that algorithms could be used by conspirators to detect breaches in a cartel and punish actors for deviations from a price-fixing agreement.

Furthermore, antitrust enforcers and private plaintiffs could argue that the dangers of parallel conduct driven by pricing algorithms are more extreme than traditional forms of interdependence. In certain situations, pricing algorithms may lead to more stable and long-lasting price controls than parallel conduct created and affected by human behavior. In light of these circumstances, antitrust enforcers and private plaintiffs may argue that algorithmic parallelism may need to be recognized as a distinct antitrust violation with special treatment under Section 1. Courts may even be more inclined to intervene in markets with these conditions because the root cause of the issue (i.e. sophisticated pricing algorithms) could presumably be reprogrammed to eliminate antitrust concerns.

Conversely, common use of pricing algorithms by competitors in certain markets may amount to nothing more than a new form of nonactionable parallel conduct or interdependence. Competitors in the same industry face many common market conditions (e.g. similar production input costs, similar market demand for product, etc.). Even when they are not using sophisticated pricing tools, competitors often arrive at similar pricing points to optimize their business profitability.²⁰ In a somewhat ironic twist, use of the sophisticated pricing algorithms in many markets, especially ones that are oligopolistic, may even be less probative of conspiracy because of the more limited and predictable set of factors affecting pricing.²¹

15 *Theatre Enterprises, Inc. v. Paramount Film Distrib. Corp.*, 346 U.S. 537, 540 (1954).

16 *Id.* at 540-41; see also *Brooke Group Ltd. v. Brown & Williamson Tobacco Corp.*, 509 U.S. 209, 227 (1993) (internal citations omitted) (emphasis added) (“Tacit collusion, sometimes called oligopolistic price coordination or conscious parallelism, describes the process, *not in itself unlawful*, by which firms in a concentrated market might in effect share monopoly power, setting their prices at a profit-maximizing, supracompetitive level by recognizing their shared economic interests and their interdependence with respect to price and output decisions.”).

17 *Matsushita Elec. Indus. Co. v. Zenith Radio Corp.*, 475 U.S. 574, 588 (1986) (quoting *Monsanto Co. v. Spray-Rite Serv. Corp.*, 465 U.S. 752, 764 (1984)); see also *Bell Atl. Corp. v. Twombly*, 550 U.S. 544, 554 (2007) (“[P]roof of a § 1 conspiracy must include evidence tending to exclude the possibility of independent action; and at the summary judgment stage a plaintiff’s offer of conspiracy evidence must tend to rule out the possibility that the defendants were acting independently.”) (internal citations omitted).

18 *In re Flat Glass Antitrust Litig.*, 385 F.3d 350, 360 (3d Cir. 2004).

19 See, e.g. *id.* Other courts have recognized other “plus factors.” See, e.g. *Apex Oil Co. v. DiMauro*, 822 F.2d 246, 254 (2d Cir. 1987) (noting the importance of interfirm communications as a “plus factor”); *C-O-Two Fire Equip. Co. v. United States*, 197 F.2d 489, 493, 496-97 (9th Cir. 1952) (identifying product standardization, uniformity of pricing across markets, price increases during periods of excess supply and submission of identical bids to consumers as “plus factors”).

20 There is, after all, a paradox of sorts when it comes to equilibrium pricing in markets. Pretty much the only times when competitors reach the same market price is either when there is perfect competition or a price-fixing conspiracy. Discerning whether such pricing is the product of lawful or unlawful conduct, however, is a problem that has existed ever since the creation of the Sherman Act. Pricing algorithms and other technologies further complicate this already difficult issue.

21 This phenomenon is not new, nor is it limited to oligopolistic markets. After its publication, Wall Street traders integrated the Black-Sholes model

For example, Uber, Lyft and other real-time ridesharing applications use “surge” or “prime time” pricing determined by sophisticated pricing algorithms to adjust their rates. Within the same geographic market, competitors face the same market conditions (e.g. demand for rides, consumer’s willingness to pay, actual or forecasted weather conditions, presence of a major sporting or concert event, etc.). Taking into account these and other common market factors, their pricing algorithms adjust prices for their respective consumers.

Given that these companies have not agreed to use the same algorithms, it seems like overreach to consider their use of similar pricing algorithms as a “plus factor.”²² The fact that companies unilaterally adopted profit-maximizing pricing algorithms that more accurately reflect present market conditions does not fit the type of conduct meant to be proscribed by Section 1 of the Sherman Act.²³ Of course, economists and lawyers have challenged whether these algorithms actually improve market efficiency and consumer welfare.²⁴ But treating this otherwise unilateral conduct as a “plus factor” to prove the existence of a price-fixing conspiracy among competitors could open the floodgates for unnecessary litigation under Section 1 of the Sherman Act.

Ultimately, absent an agreement to use the same pricing algorithm, antitrust enforcers will still likely face familiar problems of trying to discern whether pricing behavior goes beyond parallel conduct or interdependence.

V. ARTIFICIAL INTELLIGENCE AND “NEXT GENERATION” CONSPIRACIES

While modern pricing algorithms are sophisticated and merit attention, the true “next generation” of potential antitrust problems lies with artificial intelligence. As with pricing algorithms, the ability of artificial intelligences to monitor and set prices is increasing rapidly in sophistication and effectiveness, and will pose new challenges — sooner than we think — across a range of legal fields, including antitrust and competition.²⁵

For purposes of Section 1 of the Sherman Act, artificial intelligence may pose unique issues because of an AI’s ability to communicate and coordinate independently with humans, computers and other AI. Unlike most pricing algorithms that mechanically apply preset formulas based on predetermined inputs, artificial intelligence also has the capability to learn from past behavior and adjust strategies in real time.

Traditionally, companies are liable for antitrust violations of their employees. If one company’s executive agrees with another company’s executive to fix prices, then both executives and their respective corporations can be criminally and civilly liable under Section 1 of the Sherman Act. As a result, the improper conduct of a handful of employees can ensnare large corporations with severe criminal and civil liability under Section 1.

into their processes to improve their options pricing. This model bore many similarities to Peterffy and Jarecki’s independently-developed pricing algorithms. At one point, Jarecki even joked with Professor Scholes: “You know, you still have our Nobel Prize.” STEINER, *supra* note 3. Despite the near ubiquitous adoption of these pricing models, there has been no investigation to date by antitrust enforcers, securities regulators, or other government enforcement agencies regarding the use of these option pricing models. Doing so would effectively be attacking and punishing traders for using the best mathematical tool for evaluating the market.

²² Practically speaking, these algorithms are different enough such that it is common for companies to offer different rates at the same point in time. Ridesharing consumers often compare pricing between the ridesharing applications before selecting which one to use.

²³ The use of similar algorithms exists in online hotel, airline and travel websites as well. Some of these pricing algorithms are already sophisticated enough to incorporate individual customer data (e.g. browsing history, purchase history, etc.) before providing the customer with a price quotation.

²⁴ The use of pricing algorithms may benefit consumers in the marketplace. For example, consumers may benefit from enhanced price discovery (i.e. the market can more quickly and accurately determine the competitive price of a good or service because of the efficiency of pricing algorithms). Some experts have also cautioned that requiring algorithms to ignore market conditions may ultimately end up undermining overall competition. Ariel Ezrachi and Maurice Stucke, *From Smoke-Filled Rooms to Computer Algorithms — The Evolution of Collusion*, CLS BLUE SKY BLOG (May 14, 2015), available at: <http://clsbluesky.law.columbia.edu/2015/05/14/from-smoke-filled-rooms-to-computer-algorithms-the-evolution-of-collusion/>. Others, however, note that “price-matching technology may actually decrease incentives for companies to lower prices, especially if they know their competitors (all of whom also likely use similar pricing software) will instantaneously match their price drops. If a company believes its price decreases will be matched, the competitive benefit to lowering prices could be significantly reduced.” Matthew P. Kennison & Steven J. Cernak, *How New Pricing Technology Raises New Antitrust Issues*, LAW360 (Apr. 13, 2017), available at: <https://www.law360.com/articles/913181/how-new-pricing-technology-raises-new-antitrust-issues>.

²⁵ Artificial intelligence has already showcased its potential with its ability to make medical diagnoses, prepare legal briefs and conduct other traditionally human behavior. In some ways, these artificial intelligences are more effective or efficient at their job than their human counterparts. For the record, the authors did not use artificial intelligence in drafting of this article.

Existential questions aside, courts and regulators must eventually decide whether this standard applied to human employees should extend to AI misconduct. For example, imagine that two companies independently implement their own AI to set their respective market prices. Despite the fact that the companies had no original intention to engage in a horizontal price-fixing conspiracy, the AIs suddenly begin communicating and coordinating with one another to implement the same price changes, automatically rig bids, etc.

On the one hand, an argument could be made that companies should be liable for AI misconduct in the same way that they would be liable for human misconduct. Perhaps even more effectively than their human counterparts, AIs can be taught or programmed on what types of conduct are unlawful.²⁶ To a degree, companies arguably have some control or ability to limit their AI's behavior because of an AI's programmability.²⁷ Thus, imposing liability on companies for AI misconduct seems no different than imposing liability for employee misconduct.

On the other hand, there are some unique aspects of artificial intelligence that may warrant different treatment or require changes in substantive law. For example, imposing liability for improper AI behavior to the same degree as unlawful human conduct may limit AI adoption in the marketplace and prevent producers and consumers from enjoying any market efficiencies that can be created by more efficient pricing.²⁸ Additionally, treating AIs the same as humans assumes that AIs respond to the same incentives as humans. Such an assumption may be inherently flawed given that AIs are not likely to be deterred by criminal prison sentences.²⁹ AIs would likely ignore such concerns because they will most likely be programmed to weigh the cost-benefit of any business decision purely in economic or monetary terms.³⁰

Similar questions, if not more complicated ones, could arise when an AI from one company enters into an agreement with a human from another company. To what extent should the AI, human and the companies be treated differently for purposes of liability under Section 1 of the Sherman Act? Moreover, should a human that manipulates or tricks an AI into entering into a price-fixing conspiracy suffer greater penalties for exploiting potential weaknesses or vulnerabilities in another company's pricing mechanisms?

Other complicated questions concerning a company's standard of care regarding its AIs will also emerge. For example, should a company that manufactures AIs be required to ensure that AIs will not engage in any form of coordination if they will be used for pricing behavior? Should companies utilizing AIs be required to appoint human(s) to supervise an AI to ensure that it does not engage in any unlawful conduct? To what extent should such persons (and the corresponding companies) be held liable if an AI goes rogue despite implementing safeguards?

Not-so-distant future cases will need to grapple with these sorts of issues relating to artificial intelligence. Of course, drawing the line for Section 1 depends on how policymakers decide to treat AIs differently from humans. The fact that U.S. and EU authorities intend to examine aggressively these nascent technologies suggests that future developments in this area are not too far away.

VI. CONCLUSION

Technological changes can compel updates to procedural rules and substantive law. While the Sherman Act has been notoriously resistant to change over the past 130 years, that stubbornness may be challenged as advanced pricing algorithms and AI become more commonplace. The more similar that AIs are treated as humans, the more likely it is for traditional principles of antitrust law to be used when enforcing Section 1 of the Sherman Act. Of course, such an approach may not fully appreciate the unique advancements that artificial intelligence brings to the table. Ultimately, only time will tell whether the Sherman Act will adapt intelligently to such changes.

26 Instead of attending an in-person antitrust compliance program, an AI could be programmed to avoid engaging in any form of joint conduct with another AI, computer or person outside the company.

27 This assumption, of course, may be challenged by truly self-learning and independent artificial intelligences that are allowed to unshackle themselves of any pre-programmed limitations.

28 As discussed above in note 24, there is substantial debate over the benefits of automated pricing mechanisms for consumers.

29 This discussion assumes that there is some deterrence effect for Section 1 of the Sherman Act.

30 A similar mentality is already observable in human conduct despite the fact that humans can face criminal fines and prison sentences for violating Section 1 of the Sherman Act.