COMPETITION & COLLUSION IN A WORLD OF ALGORITHMIC PRICING: ANTITRUST RISKS & ENFORCEMENT TRENDS

BY BRANDON GOULD, AUGUST GWEON, CORTLIN LANNIN & TERRELL MCSWEENY

Brandon Gould and August Gweon are associates in the antitrust practice group at Covington & Burling LLP. Cortlin Lannin is a partner and co-chair of the Cartel Defense and Government Investigations practice group at Covington & Burling LLP. Terrell McSweeney is a Senior Of Counsel at Covington & Burling LLP and former Commissioner of the U.S. Federal Trade Commission.
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Across many industries, businesses rely on algorithmic pricing systems that analyze large volumes of market data to recommend or set prices. For many years, courts have assessed the effects of algorithmic pricing tools using conventional antitrust principles, following decades of precedent under Sections 1 and 2 of the Sherman Act. With growing computing power and rapid developments in the field of AI, however, algorithmic tools are more accessible and increasingly capable of complex tasks like pricing, leading many to reevaluate traditional approaches to deterring collusive behavior under antitrust law. Competition enforcers are exploring how antitrust laws, including Section 1 of the Sherman Act and Section 5 of the FTC Act, might be used to address the risk of “algorithmic collusion” facilitated by a new generation of sophisticated pricing algorithms, vendors, and AI models.
I. INTRODUCTION

Across many industries, businesses rely on algorithmic pricing systems that analyze large volumes of market data to recommend or set prices. Algorithmic pricing is not a new practice. In certain industries, such as airlines, electricity generation, and hotels, firms have used pricing algorithms for decades. In others, like e-commerce or stock trading, many businesses regard pricing algorithms as essential to their ability to compete. For many years, courts have assessed the effects of algorithmic pricing tools using conventional antitrust principles, following decades of precedent under Sections 1 and 2 of the Sherman Act.

With increasing computing power and technological developments in the field of artificial intelligence ("AI"), algorithmic tools are more accessible and increasingly capable of highly complex tasks. While these innovations in algorithmic tools can lead to many benefits, including, for example, more efficient and lower prices, some have raised questions as to whether traditional approaches to detecting and deterring collusive behavior can keep pace with these technological developments. Competition enforcers, in turn, are exploring how antitrust laws, including Section 1 of the Sherman Act and Section 5 of the FTC Act, should be applied in the context of potential "algorithmic collusion" involving a new generation of sophisticated pricing algorithms, vendors, and AI models.

Pricing algorithms can vary in sophistication and capability, but they typically use large volumes of market data to enhance firms’ ability to make rapid price adjustments. Simple algorithms can recommend prices based on fixed rules (e.g. prices as set fraction of rival’s price) set by their developers or users. By comparison, predictive or machine learning algorithms generate pricing strategies by learning through trial-and-error in dynamic environments and refining their rules to maximize a certain objective (e.g. profit or output) over time. Often, businesses rely upon pricing algorithms designed and sold by a growing industry of third-party vendors, which offer both rule-based and predictive algorithmic pricing services and may provide access to data and expertise.

Just as algorithmic pricing is not new, commentators have voiced concerns about the possibility of “algorithmic collusion” for years, although this term has not always been clearly defined. In 2016, for instance, some commentators argued that increasingly complex pricing algorithms could facilitate “more elusive forms of collusion” that are “beyond the reach of the law.” In contrast, skeptics have argued that there is a lack of real-world evidence that algorithmic collusion poses a significant problem and suggested that, in any event, such collusion would simply be “old wine in new bottles” to which existing principles can be applied. Antitrust cases involving pricing algorithms remain rare. However, antitrust plaintiffs and competition enforcers, presumably motivated by the increased adoption and growing capacity of AI systems, are shifting their attention toward assessing the effects of pricing algorithms on price competition, including, for example, where competitors rely on the same vendor for their algorithmic pricing program.

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5 See e.g. Michal S. Gal, Limiting Algorithmic Coordination, 38 BERKELEY TECH. L. J. 173, 176 (2023) (“Algorithms have been used for some decades to set prices [but] what makes them of interest now is that markets are being populated by new generations of pricing algorithms . . . capable of autonomously discovering a profit-maximizing price scheme.”).


11 Compare Ulrich Schwabe, Algorithms, Machine Learning, and Collusion, 14 J. COMPETITION L. & ECON. 568, 600 (2019) (“If [algorithms] become as complex as humans also with respect to strategic interactions on dynamic markets as they already are . . . in playing chess or go, then problems [related to collusion] could arise.”) with Christophe Carugati, Competition in Generative Artificial Intelligence Foundation Models 15 (Bruegel, Working Paper No. 14, 2023) (“If developers teach their [large language models (“LLMs”)] to achieve an anticompetitive outcome and train them on confidential data, [LLMs] could serve as instruments for explicit or hub-and-spoke collusions. Even without these assumptions, [LLMs] can learn to achieve the best strategy and generate output through text or computer code, which can lead to an anticompetitive tacit agreement.”).
II. RESPONSES FROM US COMPETITION ENFORCERS & POLICYMAKERS

Competition enforcers in the US have expressed concern about the possibility that pricing algorithms can facilitate collusion and harm competition.\(^\text{12}\) Lina Khan, Chair of the Federal Trade Commission, recently claimed that “A.I. tools” can “facilitate collusive behavior that unfairly inflates prices” for “everything from laundry detergent to bowling lane reservations,” while arguing that the FTC is “well equipped with legal jurisdiction to handle the issues brought to the fore by the rapidly developing A.I. sector, including collusion” and “unfair methods of competition.”\(^\text{13}\) U.S. enforcers have called for changes to how antitrust laws are enforced in industries that rely on algorithmic pricing. For example, a DOJ Antitrust official recently signaled that the Department may expand scrutiny to “large decentralized markets” that traditionally posed lower risks of collusion, reasoning that pricing algorithms may more effectively facilitate and police collusive agreements among numerous market participants.\(^\text{14}\)

Similarly, Doha Mekki, the Principal Deputy Assistant Attorney General for the DOJ Antitrust Division, has called for new enforcement guidance respecting algorithmic technologies, stating: “[W]e are experiencing an inflection point in the use of algorithms, data at scale, and cloud computing. Additional changes are inevitable and likely to come in rapid succession. That is why it is important to revisit outdated guidance before it strays even further from market realities.”\(^\text{15}\)

Not all competition enforcers, however, view pricing algorithms as a reason for departing from traditional antitrust rules. As then-FTC Chair Maureen Ohlhausen put it in 2017, “although antitrust enforcers should always remain vigilant for new forms of anticompetitive behavior, some of the concerns about algorithms are a bit alarmist. From an antitrust perspective, the expanding use of algorithms raises familiar issues that are well within the existing canon.”\(^\text{16}\) Nonetheless, some federal lawmakers have proposed legislative reforms to address their perceived concerns around pricing algorithms. For example, the “Preventing Algorithmic Collusion Act,” a bill introduced in the Senate on February 2, 2024, would create a presumption of a price-fixing agreement when competitors share commercial information through a pricing algorithm, impose disclosure and auditing requirements for companies that use pricing algorithms, and ban the use of competitors’ commercial data to train pricing algorithms.\(^\text{17}\)

III. IDENTIFYING AND MITIGATING COMPETITION RISKS OF PRICING ALGORITHMS

Competition enforcers and scholars have identified several ways in which they believe that algorithmic pricing could enable collusion, especially if multiple competitors adopt similar pricing algorithms or rely on the same vendor for systems in order to fix prices. First, cartels could use a shared pricing algorithm to implement traditional price-fixing agreements. As an early example, in 2015, the Department of Justice charged two e-commerce vendors with a conspiracy to fix posters prices on Amazon Marketplace.\(^\text{18}\) The conspirators implemented their agreement by writing “computer code that instructed algorithm-based software to set prices in conformity with this agreement” with the “goal of coordinating changes to their respective prices.”\(^\text{19}\)

Some commenters also suggest that, by decreasing monitoring costs and response times, pricing algorithms can overcome barriers to cartel formation in markets that are otherwise less conducive to collusion.\(^\text{20}\) Pricing algorithms can analyze historical and real-time data on...
market conditions, including competitors’ prices, with speed and accuracy far surpassing their human counterparts. They further argue that algorithmic pricing could alter the likelihood of cartel formation in markets with unpredictable demand from buyers, differing cost structures among sellers, or infrequent interactions between competitors — factors that typically make deviations more rewarding, less detectable, and more difficult to punish effectively. In such markets, they suggest that pricing algorithms could help anticipate demand, identify deviations, and interact with competitors at superhuman speeds while requiring fewer interactions to collude.

Other commentators dispute whether pricing algorithms present unique risks to competition, while also pointing out that pricing algorithms can enhance competitive conditions, including through more efficient and lower prices, to the benefit of consumers. For example, by continuously analyzing market prices, pricing algorithms can increase price transparency and spur more intense price competition. Firms can also use pricing algorithms to provide dynamic, personalized pricing and better predict consumer demand, allowing them to efficiently match supply with demand and generate savings that can be reinvested in product improvement.

Outsourcing of pricing algorithms in today’s heightened regulatory environment can potentially raise additional investigation and litigation risks, including, for example, if many competitors in the market use the same algorithm vendors. Third-party vendors are well-positioned to both collect and distribute large amounts of commercial data required to train and deploy pricing algorithms. These arrangements could theoretically facilitate hub-and-spoke agreements to fix prices in some circumstances. For example, in 2016, a U.S. district court declined to dismiss a complaint alleging that Uber drivers conspired to coordinate prices using Uber’s pricing algorithm as the hub. There, the court found plausible plaintiffs’ allegations that the Uber drivers delegated their fare pricing decisions to Uber’s pricing algorithm, instead of competing on price, because of the algorithm’s “capacity to generate supracompetitive prices.”

Finally, some commentators have suggested that sophisticated pricing systems might be used to facilitate tacit collusion or increase the likelihood of price coordination without an express agreement, which the Federal Trade Commission might claim is an unfair method of competition under Section 5 of the FTC Act. These commentators have suggested that there may be issues even when competitors adopt the same pricing algorithms unilaterally due to the rapid response times and analytical capabilities of pricing algorithms. Additionally, even when competitors use different vendors, commentators point out that more advanced algorithms may “learn” how to sustainably raise prices by monitoring how competitors’ algorithms respond to their prior unilateral pricing recommendations.


26 Liza Lovdahl Gormsen, Algorithms & Competition Law, 1 CPI Antitrust Chron. 21, 22 (July 2020); see Org. for Econ. Coop. & Dev., supra note 6, at 16-17.


28 Harrington, supra note 8, at 2 (“A third party developer is likely to have better pricing algorithms than would be created internally because it has more expertise and experience, access to more data, and stronger incentives to invest in their development (as the pricing algorithm can be licensed to many firms.”).

29 Ezrachi & Stucke, supra note 9, at 48-49.


32 Id.

33 Bruno Salcedo, Pricing Algorithms & Tacit Collusion 2 (Jan. 11, 2016) (unpublished manuscript), https://brunosalcedo.com/docs/collusion.pdf; Gal, supra note 20, at 87 (arguing that “the analytical qualities of algorithms can be utilized to determine the decision processes of other algorithms, provided that the former have sufficient information about the decisions made by the latter under changing market conditions,” meaning that “the mere (direct or indirect) observation of the algorithm by competitors may, by itself, serve to facilitate coordination”).
On the other hand, other commentators have argued that pricing algorithms make collusion less likely by lowering barriers to market entry or otherwise making collusion more difficult to achieve. For instance, by making pricing decisions—a task typically managed by firms’ revenue departments—less costly, pricing algorithms can make it easier for smaller firms to compete at scale. Additionally, as Ai Deng has argued, pricing algorithms’ rapid monitoring and response times can increase the likelihood that firms engage in price wars or otherwise misinterpret market signals, making collusion less durable. Finally, by enabling firms to provide dynamic, personalized pricing, pricing algorithms may tend to increase product heterogeneity, further reducing the likelihood of collusion.

IV. IMPLICATIONS FOR BUSINESSES

Enforcers and private plaintiffs may explore theories of competitive harm from algorithmic pricing based on existing statutes. For example, private plaintiffs have already sought to characterize the use of algorithmic pricing by competitors as indicative of a per se violation of Section 1 of the Sherman Act for horizontal price fixing. In the alternative, some plaintiffs argue that businesses’ use of third-party, vendor-provided pricing algorithms may violate the Rule of Reason under Section 1. Finally, the Federal Trade Commission may seek to use Section 5 of the FTC Act to reach algorithmic pricing conduct that it disfavors, but that does not violate the Sherman Act.

A. Section 1 of the Sherman Act

Private plaintiffs brought several Section 1 cases last year in industries that use algorithmic pricing. They have argued that the use of pricing algorithms constituted per se illegal price fixing agreements or, alternatively, that the use of pricing algorithms constituted illegal information sharing agreements under the Rule of Reason. Plaintiffs seeking per se treatment for algorithmic pricing bear the often-difficult burden of showing a horizontal agreement among competitors, either through direct or circumstantial evidence. Plaintiffs pursuing per se claims may also attempt to establish a “hub-and-spoke” conspiracy through a series of agreements between and among competitors and a common algorithmic vendor. If plaintiffs can establish the existence of a per se illegal agreement, further analysis of competitive effects is unnecessary. Under the Rule of Reason, on the other hand, plaintiffs may more easily show the existence of an agreement, such as vertical agreements between firms and their algorithmic pricing vendors, but they will then face the more complex and fact-intensive burdens of establishing harm to competition in a relevant market.

Two recent district court cases demonstrate these dynamics. In In re RealPage, plaintiffs alleged that dozens of property owners used RealPage’s revenue management software to inflate rental prices. Plaintiffs argued that the property owners (and RealPage) had entered into a per se illegal horizontal price fixing agreement. DOJ submitted a “Statement of Interest” in support of plaintiffs’ position that the allegations should be accorded per se treatment. If in the alternative, plaintiffs claimed the owners’ use of RealPage itself involved a price-fixing agreement that violated the Rule of Reason. Importantly, the federal district court rejected the per se theory urged by the plaintiffs and DOJ. The court allowed plaintiffs to pursue their Rule of Reason claims because it was duty-bound at the motion to dismiss stage to accept plaintiffs’ allegations. Similarly, in Gibson v. MGM Resorts, class action plaintiffs alleged that four Las Vegas hotels’ use of a vendor’s pricing algorithms constituted a per se illegal price-fixing agreement or a hub-and-spoke conspiracy under Section 1. A district court dismissed the per se claims but granted plaintiffs leave to amend to amplify their pleading of claims under the Rule of Reason.

B. Section 5 of the FTC Act

Allegations of anticompetitive algorithmic pricing are likely to continue to arise in private Sherman Act cases, and it remains to be seen whether they will have any success. Government enforcers may also turn to other tools when they identify concerns with algorithmic pricing. In particular, Section 5 of the FTC Act prohibits “unfair methods of competition,” which, in theory, reaches anticompetitive conduct outside the Sherman Act’s scope. Although the FTC has rarely used Section 5 as an independent theory of liability, courts have recognized that “unfair methods of compe-

34 Francisco Beneke & Mark-Oliver Mackenrodt, Remedies for Algorithmic Tacit Collusion, 9 J. ANTITRUST ENF’T 152, 161 (2020).
36 Nicolas Petit, Antitrust & Artificial Intelligence: A Research Agenda, 8 J. Eur. COMPETITION L. & PRAC. 361, 361 (2017) (“When transactions are customised . . . each bargain with a customer can be seen as a finite, one shot game, which is incompatible with tacit collusion.”).
tition” under Section 5 encompasses conduct beyond the reach of the Sherman Act, such as invitations to collude. The precise contours of the reach of Section 5 have not been defined by the courts.

So far, calls for the use of Section 5 to address possible algorithmic collusion have focused on prohibiting specific types of pricing algorithms with a proven capacity to facilitate collusion. For instance, Joseph Harrington has argued that Section 5 gives the FTC a “legal mandate” to prohibit algorithmic collusion by defining a set of pricing algorithms that are either per se prohibited or subject to the rule of reason. The FTC may explore novel approaches to Section 5 enforcement in the context of algorithmic pricing as it becomes more prevalent throughout the economy.

V. CONCLUSION: NEW AI FRONTIERS & EVOLVING ANTITRUST RISKS

Due to their clear advantages for businesses in cutting costs and navigating changing market conditions, the use of pricing algorithms is likely to only grow. As pricing algorithms proliferate in more industries, antitrust enforcers will continue to assess their effect on competition, and private plaintiffs will undoubtedly continue to push for aggressive extension of existing antitrust law. At the same time, pricing algorithms in the hands of consumers could enhance competition by reducing search and transaction costs and increasing price transparency. Improvements in AI technology will also continue unabated, enhancing the capabilities of pricing algorithms and their benefits to businesses and consumers, but also likely amplifying these antitrust concerns. For example, antitrust scholars have speculated that more advanced algorithms powered by cutting-edge AI may autonomously learn to achieve “collusive” price outcomes through repeated market interactions, trial-and-error, and feedback from real-time market data. In the face of rapid technological change, businesses should remain alert to regulatory developments and the potential for investigation and litigation risk arising from their use of pricing algorithms.

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40 See e.g., PAN AM v. United States, 371 U.S. 296, 306-308 (1963) (“[Section 5] was designed to bolster and strengthen antitrust enforcement[,] and the definitions are not limited to precise practices that can readily be catalogued. They take their meaning from the facts of each case and the impact of particular practices on competition and monopoly.”); see also Joseph E. Harrington, Jr., Collusion in Plain Sight: Firms’ Use of Public Announcements to Restrain Competition, 84 Antitrust L. J. 521, 563 (2022) (arguing that a firm’s announcement of how competitors or an industry at large will behave could be an invitation to collude if the announcement “fails to credibly attribute the forecasted conduct to some exogenous factor, such as a change in cost or demand,” the predicted conduct would raising prices, and firms would only follow the announcement if others do so as well.).

41 Emilio Calvano et al., Policy Forum: Protecting Consumers From Collusive Prices Due to AI, 370 Sci. 1040 (2020) (“One route is to make certain pricing algorithms unlawful, perhaps under Section 5 of the FTC Act.”).

42 Joseph E. Harrington, Jr., Developing Competition Law for Collusion by Autonomous Artificial Agents, 14 J. Competition L. & Econ. 331, 358-59 (2019).

43 Gal, supra note 5, at 175.


45 Although the likelihood of autonomous AI collusion remains hotly contested, recent studies of predictive pricing algorithms suggest that autonomous algorithmic collusion is possible in simulated environments and certain real-world markets. See Emilio Calvano et al., Artificial Intelligence, Algorithmic Pricing, and Collusion, 110 Am. Econ. Rev. 3267, 3275 (2020) (testing Q-learning pricing algorithms that use reinforcement learning); Matthias Hettich, Algorithmic Collusion: Insights from Deep Learning 6 (Ctr. for Quantitative Econ., COE Working Paper No. 9421, 2021) (deep reinforcement learning pricing algorithms); Assad, supra note 8, at 14 (self-learning pricing algorithms in German retail gas market).
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