THE CHALLENGES OF THIRD-PARTY PRICING ALGORITHMS FOR COMPETITION LAW

*Joseph E. Harrington, Jr.**

The advent of competitors using a pricing algorithm supplied by the same software or data analytics company has created challenges for competition law. To begin, a third party may have an incentive to facilitate an agreement with subscribing firms to charge supracompetitive prices. A third party may even have an incentive to recommend supracompetitive prices without the support or knowledge of firms. Finally, and contrary to a canonical price-fixing agreement, a third party offers efficiencies when its pricing algorithm is capable of identifying prices more attuned to market conditions. These challenges are examined in the context of existing competition law—which is found to be inadequate—and some recently proposed remedies, which are found not to properly account for their impact on procompetitive efficiencies and may not even be effective in preventing anticompetitive harm.

Introduction

One of the implications of the arrival of Big Data and advances in algorithms is that it is now possible for a firm to outsource its pricing decision. With prices driven more by data and less by the judgment of those employees in the firm with nonquantifiable information, pricing can be partially or fully determined by a third party in the form of a software or data analytics company. A third party is likely to have better pricing algorithms than a firm would develop on its own because a third party 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).[1]

At the same time, concerns have been expressed that third-party delegation could facilitate coordinated pricing between competitors. The UK's Competition & Markets Authority has warned: "If a sufficiently large proportion of an industry uses a single algorithm to set prices, this could result in a ... structure that may have the ability and incentive to increase prices."[2] The German Monopolies Commission has noted that

* Patrick T. Harker Professor, Department of Business Economics & Public Policy, The Wharton School, University of Pennsylvania harrij@wharton.upenn.edu. I have been retained by a defendant in private litigation associated with the use of a data analytics company. This study is not funded in whole or in part by any person or entity, either directly or indirectly, related to that litigation. No client or other interested party has a right to review, or has reviewed, this Article.

1 For background on pricing algorithms, the reader is referred to "Algorithms and Collusion: Competition Policy in the Digital Age," OECD, 2017, https://www.oecd.org/en/publications/algorithms-and-collusion-competition-policy-in-the-digital-age_258dcb14-en.html .

2 Competition & Markets Authority, *Pricing Algorithms: Economic working paper on the use of algorithms to facilitate collusion and personalised pricing*, (¶ 5.21, U.K. CMA Doc. 94, 2018), https://assets.publishing.

a third party, when selling a pricing algorithm, possibly "knows or accepts [it] could contribute to a collusive market outcome [and] it is even conceivable that [they] see such a contribution as an advantage, as it makes the algorithm more attractive for users interested in profit maximization."[3] And the OECD has expressed that "concerns of coordination would arise if firms outsourced the creation of algorithms to the same IT companies and programmers [and this] might create a sort of 'hub and spoke' scenario where coordination is, willingly or not, caused by competitors who use the same 'hub' for developing their pricing algorithms and end up relying on the same algorithms."[4]

There is some evidence, and claims of evidence, that these anticompetitive effects have occurred. Data analytics companies A2i Systems and Kalibrate developed pricing algorithms to assist retail gasoline companies in their pricing. After the wide adoption of such pricing software in Germany, a recent study by Assad, Clark, Ershov, and Xu found evidence of an anticompetitive effect: "Adoption increases margins, but only for non-monopoly stations. In duopoly and triopoly markets, margins increase only if all stations adopt, suggesting algorithmic pricing has a significant effect on competition."[5]

Though the claims are still to be scrutinized by the judicial process, plaintiffs in several legal cases in the United States argue that a third party and competitors in a market had an agreement to restrain competition by coordinating on higher prices.[6] In the market for apartment rentals, RealPage is a data analytics company that has developed a pricing algorithm to be used by apartment property owners. Owners subscribe to RealPage and provide it with confidential data, which is used to train the pricing algorithm and recommend rents. Plaintiffs claim that RealPage and subscribing owners have an illegal agreement to raise prices.[7] A recent study by Calder-Wang and Kim offers evidence for both procompetitive and anticompetitive

---

service.gov.uk/government/uploads/system/uploads/attachment_data/file/746353/Algorithms_econ_report.pdf.

3 Monopolkommission, *Algorithms and Collusion, in Biennial Report of Monopolize Competition* ¶ 263, 2018 (Ger.), https://www.monopolkommission.de/images/HG22/Main_Report_XXII_Algorithms_and_Collusion.pdf [hereinafter German Monopolies Commission's Report on "Algorithms and Collusion"].

4 OECD, *Algorithms and Collusion – Background Note by the Secretariat*, 68, DAF/COMP(2017)4 (June 8, 2017), https://one.oecd.org/document/DAF/COMP(2017)4/en/pdf.

5 Stephanie Assad, Robert Clark, Daniel Ershov, & Lei Xu, *Algorithmic Pricing and Competition: Empirical Evidence from the German Retail Gasoline Market*, 132 J. of Political Econ. 723, 723 (2024).

6 The plaintiffs claim a violation of Section 1 of the Sherman Act, which prohibits an agreement among competitors to unreasonably restrain trade. In the context of the European Union, the claimed offense corresponds to a violation of Article 101 of the Treaty on the Functioning of the European Union.

7 Complaint at 11, Bason et al. v. RealPage Inc., No. 3:22-CV-01611 (S.D. Cal. Oct. 18, 2022) [hereinafter RealPage Class Action Complaint ("RealPage and participating Lessors have provided one another with such mutual assurances, agreeing among themselves not to compete on price for the sale of multifamily residential real estate leases. They have effectuated their agreement through two mutually reinforcing mechanisms. First, participating Lessors have agreed to set prices using RealPage's coordinated algorithmic pricing. Second, participating Lessors have agreed to stagger their lease renewal dates through RealPage, to avoid (otherwise natural) oversupplies in rental properties")].

effects.[8] There is similarly a case against Rainmaker, who has developed a pricing algorithm to assist hoteliers in their pricing.[9] In light of what is going on in the markets for apartments, gasoline, and hotels, the antitrust problem of competitors adopting a third party's pricing algorithm is here and now.

This setting poses two challenges for competition law. First, in comparison to firms coordinating to raise their prices, which generally has no redeeming features, the adoption by firms of a third party's pricing algorithm is likely to offer real and substantive efficiencies. Second, intent is important in competition law and, where the harm is supracompetitive prices, this has required showing that firms had a "conscious commitment to a common scheme."[10] However, the use of a third party means delegating pricing authority, which muddies the issue of whether the firms selling the product or service have intent. The third party may design the pricing algorithm to charge supracompetitive prices without the permission or knowledge of the subscribing firms. Harm then emanates from the unilateral conduct of the third party, so there is no unlawful agreement to restrain competition.

The objective of this Article is to discuss these challenges and explore some recently proposed remedies. After defining the setting in Part I, a high-level framework is provided in Part II for thinking about how harm can come about, which delineates the roles of the third party who is developing and selling the pricing algorithm and the firms who are buying and adopting it. In Part III, current competition law is applied and shown to be inadequate. Recently proposed laws are critically examined in Part IV.

I. Setting

Consider a market which could be conventional, such as for petrol, or online, such as for travel. Companies are figuring out how best to price and look for assistance from software or data analytics companies who supply pricing algorithms for a fee. For the analysis of this Article, it is important to distinguish between two classes of pricing algorithms. The first class is supplied by companies like Feedvisor and RepricerExpress—commonly referred to as repricers—whose algorithms are ubiquitous on platforms such as Amazon Marketplace. These algorithms specify the response of a firm's price to rival firms' prices. For example, it may specify setting the price just below the lowest price of a collection of competing firms subject to charging some minimum price. Typically, a repricer will offer a set of such algorithms and

8 Sophie Calder-Wang & Gi Heung Kim, *Coordinated vs. Efficient Prices: The Impact of Algorithmic Pricing on Multifamily Rental Markets* (The Wharton School, Working Paper, 2023), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4403058.

9 *See generally* Complaint, Richard Gibson et al. v. MGM Resorts Int'l et al., No. 2:23-cv-00140 (D. Nev. Jan. 25, 2023) [hereinafter Rainmaker Class Action Complaint] (demonstrating pricing algorithm use on the Las Vegas market); *see generally* Complaint, Altman et al. v. Caesars Entertainment, Inc. et al., No. 2:23-cv-02536, (D.N.J. May 9, 2023) (demonstrating pricing algorithm use on the Atlantic City market).

10 Monsanto Co. v. Spray-Rite Serv. Corp., 465 U.S. 752, 768 (1984).

a firm chooses an algorithm from that set and specifies its parameters (e.g., the parameters could be the minimum price and how much to undercut the lowest price of rival firms). Notably, the pricing algorithms are simple and generic and are not trained for the particular market where they'll be used. The primary service of the third party is implementing (as opposed to designing) the pricing algorithm using an automated response to rival firms' prices. The analysis of this Article does not pertain to this class of pricing algorithms. While there are still competition policy challenges with such pricing algorithms, they play out differently than what will be discussed here.[11]

The second class of pricing algorithms, which will be our focus, comprises those trained on historical data specific to the firm and market, and the resulting pricing algorithm delivers a price conditional on current firm and market data. Examples include the pricing algorithm provided by RealPage for setting apartment rental rates, Rainmaker for setting hotel rates, A2i systems for setting retail petrol prices, and Airbnb for setting property rental rates ("Smart Pricing").[12]

At a high level, there are two general approaches to training or designing a pricing algorithm: estimation-optimization and reinforcement learning. Estimation-optimization involves specifying an objective, such as firm profit or revenue, using historical data to estimate how that objective depends on a firm's price and then choosing a price to maximize that estimated objective. Relevant data includes past prices, past sales, and demand shifters (e.g., consumer income and seasonal time effects), which are used to estimate a firm's demand function and with that its objective function (such as revenue or profit). Given that estimated objective function, an optimization routine searches for the best price. Reinforcement learning involves using past choices (such as prices) and past performance (such as profit or revenue) along with state variables (such as demand, cost, inventories, and rival firms' prices) to find the price that is associated with the highest performance given the current state. Quite relevant for our ensuing analysis is the specified objective (under estimation-optimization) or performance metric (under reinforcement learning) that is used by a third party, for it can be determinative with regard to the pricing algorithm recommending supracompetitive prices.[13]

---

11 *See, e.g.*, Zach Y. Brown & Alexander MacKay, *Competition in Pricing Algorithms*, 15 Am. Econ. J.: Microeconomics 109 (2023) (demonstrating issues surrounding the commitment provided for pricing algorithm harms as relevant to repricers); *see, e.g.,* Leon Musolff *Algorithmic Pricing Facilitates Tacit Collusion: Evidence from E-Commerce*, *in* Proceedings of the 23rd ACM Conference on Economics and Computation (2022) (also demonstrating issues surrounding the commitment provided for pricing algorithm harms as relevant to repricers).

12 Preventing Algorithmic Collusion Act, 118th Cong. § 2(9) (proposed Jan. 30, 2024) [hereinafter Preventing Algorithmic Collusion Act of 2024] (reasonably defining this type of pricing algorithm as "any computational process, including a computational process derived from machine learning or other artificial intelligence techniques, that processes data to recommend or set a price or commercial term that is in or affecting commerce").

13 *See* Joseph E. Harrington, Jr., *The Effect of Outsourcing Pricing Algorithms on Market Competition*, 68 Management Science, 6355, App. A (2022) (for a brief review of theoretical papers using these two approaches).

The setting to keep in mind is that a third party develops a pricing algorithm, and firms decide whether to continue to set their own price or to contract with a third party to perform or assist in pricing. Contracting with a third party requires a firm to pay a fee and provide proprietary data to be used in training the pricing algorithm and generating a price from it.[14] Thus, a third party will have data from its subscribers, which it can augment with other data that is either publicly available or it collects itself. It is important to keep in mind that adopting a third party's pricing algorithm does not necessarily mean adopting the price that the pricing algorithm delivers, for the firm is not literally delegating its pricing authority to a third party. One should think of the pricing algorithm as recommending a price and the firm deciding whether to adopt it.

If a firm uses the services of a third party, price is then influenced by two agents: the third party who recommends a price based on its pricing algorithm, and the firm that decides whether to adopt the recommended price. An important element to our ensuing analysis is recognizing to what extent the interests of the third party and a firm are aligned. A firm—who is a buyer of a pricing algorithm—is interested in maximizing the profit from selling the product or service being priced by the pricing algorithm. A software or data analytics company—who is a supplier of pricing algorithms—is interested in maximizing the profit from licensing the pricing algorithm. These objectives are distinct but not unrelated, for the more profit that a pricing algorithm generates for a buyer, the higher is their willingness to pay (WTP), and that could be translated into higher profit for a third party through more subscriptions and charging a higher fee. We will find that their interests are not fully aligned, and that will have implications for whether a pricing algorithm is designed to produce supracompetitive prices.

Before moving on, it is important to qualify our analysis by noting that the supplier of a pricing algorithm is presumed not to be a platform. This then excludes, for example, Uber requiring drivers to price as prescribed by its pricing algorithm or Airbnb recommending a price to its property owners through its "Smart Pricing" algorithm. While some of the analysis in this Article is relevant to when the third party is a platform, it departs from the case of platforms in two critical ways. First, the objective is different when the supplier of a pricing algorithm is a platform. A platform benefits from attracting more buyers and sellers and having more transactions, and that will affect its design of the pricing algorithm. For example, a platform may want to restrict how sellers can price in order to prevent collusion so as to keep prices low and attract more buyers and result in more transactions.[15] That a platform's objective is different from that of a software or data analytics company can also affect the fee it sets for its pricing algorithms. For example, Airbnb does not charge for Smart Pricing. Second, a platform can impose restrictions on firms

14 Throughout the Article, I will refer to what the third party charges as its fee to distinguish it from the price charged by firms using the pricing algorithm.

15 *See generally* Justin P. Johnson, Andrew Rhodes & Matthijs Wildenbeest, *Platform Design When Sellers Use Pricing Algorithms*, 91 Econometrica 1841 (2023) (exploring how a platform can do so when the seller uses repricing algorithms).

that other companies cannot. It would be difficult for a data analytics company like RealPage to require an apartment owner to charge the price recommended by its pricing algorithm, whereas a platform like Uber could do so (and, in effect, does so) as a condition of having access to the platform. As these important features are not present in our analysis, this Article is appropriate when the third party who is supplying pricing algorithms to sellers is not the platform on which sellers are operating. Rather, the third party is a company whose primary service to these firms is supplying a pricing algorithm.

As we move forward, the setting to keep in mind is one with a third party that has designed a pricing algorithm tailored for a particular market, and suppliers in that market are deciding whether to adopt the pricing algorithm and, if so, whether to implement the recommended prices. The third party is interested in maximizing its profit from selling the pricing algorithm, while firms are interested in maximizing their profits from using the pricing algorithm.

II. Sources of Harm

Suppose that some or all competitors in a market subscribe to the pricing algorithm of the same third party. Each of them supplies their data, which the third party uses along with other data to train the pricing algorithm. The pricing algorithm then recommends a price for each firm based on current data for the firm and the market. For supracompetitive prices to result, two conditions must be satisfied: 1) the pricing algorithm has to recommend supracompetitive prices; and 2) the firm has to adopt the recommended supracompetitive price. Let us consider each of these conditions.

In asking whether the pricing algorithm recommends supracompetitive prices, our analysis will focus on when that occurs with the conscious intent of the third party, in which case we want to ask: When does a third party have an incentive to design the pricing algorithm to produce supracompetitive prices? A cursory examination of the problem has suggested to some commentators (such as the German Monopolies Commission quoted above) that a third party may want to design the pricing algorithm to maximize the collective profits of its subscribers. The argument is that by generating more profits, the third party can charge higher fees. However, the analysis in Harrington's 2022 study shows that is not necessarily the case and thus supracompetitive prices need not emerge, for reasons I will now explain.[16]

The setting in Harrington is one in which a third-party developer supplies a pricing algorithm that allows its subscribers to engage in more price discrimination—tailoring prices to narrow market segments—or more dynamic pricing—adjusting price to high-frequency demand shocks—than a firm could do on its own.[17] That is the efficiency delivered by a third party towards solving a firm's pricing problem. In

16 *See* Harrington, *supra* note 13, at 6355.

17 *Id.*

order to maximize its own profit, the third party designs the pricing algorithm to maximize the WTP of firms and then charges a fee equal to that WTP (or some fraction of it). An equilibrium is characterized in which the third party optimally designs its pricing algorithm to maximize its profit from selling it and firms optimally adopt the pricing algorithm and pay the fee. Firms' adoption decisions are independent, so each firm makes its adoption decision taking as given what other firms are going to do; hence, there is no agreement between the firms or with the third party.

The question is: Does the third party build in a supracompetitive markup in the pricing algorithm? The analysis shows that it is not the case and, more specifically, average price is the same as when there is no third party. The reason is that a third party wants to maximize firms' WTPs and that is different from maximizing firms' profits. With independent adoption decisions, a firm's WTP is the profit it earns from adopting the pricing algorithm minus the profit from not adopting it, holding fixed other firms' adoption decisions (who will be adopting). While a higher markup raises the profit from adopting the pricing algorithm (as all firms are pricing higher), it also raises the profit from not adopting because it can profitably undercut the high prices set by rival firms who are adopting. It is shown in Harrington's 2022 study that raising the average markup above the competitive level raises the profit from not adopting more than from adopting, so it would actually lower a firm's WTP and thus lower the profit that the third party can extract from adopting firms. At least in this setting, with firms making independent adoption decisions, the average markup is not supracompetitive even when all firms adopt the third party's pricing algorithm.

While the average price is not higher because of a third party, it is furthermore shown in Harrington (2022) that the pricing algorithm is not the same as firms would develop on their own. Specifically, the pricing algorithm has price respond to demand variation—whether from different market segments or changes over time—in a manner consistent with a monopoly. In this way, it can raise the profits from adopting while not at the same time raising the profit from not adopting and thereby raising the WTP for the pricing algorithm. While a nonadopting firm can exploit adopting firms when the pricing algorithm has a higher average price by setting a higher price itself, it cannot exploit how the pricing algorithm conditions on demand variation because that demand information is proprietary to the third party (and is the source of the efficiency that the third party delivers).

To be clear, the takeaway is not that a third party will never have an incentive to design the pricing algorithm to result in an average price exceeding the competitive price. Rather, the takeaway is that the incentives of a third party are not necessarily aligned with firms, and it requires careful analysis to assess whether a third party is interested in designing its pricing algorithm to be supracompetitive. The presumption should not be that all competitors using the same third party's pricing algorithm is necessarily going to create an incentive for a third party to design the pricing algorithm to be supracompetitive.[18]

18 Another source of concern is that commitment through the adoption of a pricing algorithm could result in supracompetitive prices by creating a price leader-follower arrangement. *See id* at 6900 (showing

Key to the preceding analysis is that firms make independent adoption decisions. Suppose instead that there is an agreement between the third party who develops the pricing algorithm and competitors in a market who adopt it. Now it is appropriate for the third party to design it to maximize firms' profits. The concern about a supracompetitive pricing algorithm making it attractive for a firm not to adopt it—so it can exploit adopting rival firms' high prices—is no longer relevant when firms have an agreement. Subject to the constraint that all firms find it optimal to comply with the agreement by adopting the pricing algorithm and charging the recommended price, the third party will choose the monopoly pricing function as it is, in effect, acting as a cartel manager.

The case of an agreement is examined in Harrington's 2025 study.[19] By comparing the pricing algorithms when firms make coordinated and independent adoption decisions, some testable predictions are generated that can allow us to determine whether there is an agreement. If adoptions are coordinated, then adopters' prices will be increasing in the adoption rate (i.e., the fraction of firms who adopt) and, on average, adopters will price higher than non-adopters. In contrast, if firms' adoption decisions are independent then adopters' prices do not change with the adoption rate and, on average, adopters and non-adopters price the same. In this manner, properties of the pricing algorithm can indicate whether it was designed for firms who have an agreement.

Based on the analysis thus far, a third party does not have an incentive to raise the average price unless there is an agreement between the firms and the third party. However, this is only the first investigation into third-party conduct and much more work needs to be done. I will highlight two important assumptions that future research should address. First, it has been assumed that firms know the incremental profit from adopting or not adopting the pricing algorithm. That is a strong assumption, and we need to explore how to model the process by which firms form beliefs about the value of a third party's pricing algorithm and how they might learn about that value over time. Second, the analysis allowed firms to decide whether or not to adopt the pricing algorithm but, once they adopted it, they were constrained to set the recommended price.[20] Let us discuss loosening that assumption.

Whether it is because of an agreement or not, let us suppose the third party designs the pricing algorithm to produce supracompetitive prices. Anticompetitive effect

---

when demand variation is sufficiently small so the gains from price discrimination are exceeded by the gains from creating price leadership, where a third party sells the pricing algorithm to one firm to make it into a price leader). *See also* Brown & MacKay, *supra* note 11, at 143 (considering firms designing their own pricing algorithms and showing the emergence of price leadership as firms choose different frequencies at which they update their prices).

19 Joseph E. Harrington, Jr., *An Economic Test for an Unlawful Agreement to Adopt a Third Party's Pricing Algorithm*, 40 Econ Pol'y 263 (2025).

20 *See* Harrington, *supra* note 13, at 6890 (allowing a firm to decide whether to adopt a pricing algorithm but, if it adopts it, then it is assumed to charge the recommended price). This assumption makes the result that average price is not higher under independent adoptions all the more surprising. Even though firms are committed to implementing the recommended price, the third party still does not design the pricing algorithm to produce supracompetitive prices.

still requires that firms choose to implement the recommended supracompetitive prices. Under what conditions will they do so? There are two scenarios to consider: where firms know that the prices are supracompetitive, and where firms do not know (or are uncertain that) prices are supracompetitive.

Suppose firms know that prices are supracompetitive. Unless there is an agreement of some sort, a firm will be inclined to charge less than the recommended price because it can earn higher profit from doing so; that is, the rise in its demand will raise profit more than the reduction in its markup will lower profit. Thus, consider firms that have an agreement, as alleged in the RealPage and Rainmaker complaints,[21] to adopt the third party's pricing algorithm and to charge the recommended prices. We then have the usual collusive arrangement, but here it is a third party's pricing algorithm that is determining collusive prices. As always, there is a short-run incentive for firms to undercut the collusive price. Hence, compliance requires monitoring firms to determine whether they have complied and punishing them in the event of noncompliance. If recommended prices are specific to each firm, publicly observing them is insufficient for each firm to learn whether other firms have complied. However, the third party is uniquely placed to assess compliance. It knows what price a firm was supposed to charge and, as part of the regular sharing of data by the firm to the third party, it will learn what price was actually charged. Furthermore, should there be evidence that a firm charged below the recommended price, a third party is in a good position to threaten and impose punishment. It could share its observation of noncompliance with other firms and thereby risk the collapse of the agreement; that prospect might incentivize firms to comply. If the pricing algorithm is delivering value beyond supracompetitive markups—such as more effective price discrimination—a third party could threaten a noncompliant firm with cancelling its license to use the service. This discussion is consistent with an observation originally made in Ezrachi and Stucke, which is that a third-party developer of a pricing algorithm can act as the hub in a hub-and-spoke cartel.[22] There are many advantages to colluding firms having a hub in the form of an upstream supplier, including a data analytics company who is supplying an input in the form of a pricing algorithm.[23]

---

21 RealPage Class Action Complaint at 46, "RealPage and participating Lessors have provided one another with ... mutual assurances, agreeing among themselves not to compete on price for the sale of multifamily residential real estate leases." Rainmaker Class Action Complaint at 88, "The contract, combination, or conspiracy alleged herein has consisted of a continuing agreement among Defendants to use pricing algorithms provided by Rainmaker Group that have caused Plaintiffs to pay inflated amounts for hotel rooms in the Las Vegas Strip market."

22 Ariel Ezrachi and Maurice E. Stucke, *Artificial Intelligence and Collusion: When Computers Inhibit Competition*, 2017 Univ. of Ill. L. Rev. 1775, 1788 (2017). A hub-and-spoke cartel is where an agreement among competitors ("spokes") to restrain competition is augmented by the assistance of an upstream supplier or downstream customer ("hub"). There need not be any direct communication between competitors as an agreement among them (referred to as the "rim") is achieved by each spoke communicating solely with the hub.

23 Luke Garrod, Joseph E. Harrington, Jr. & Matthew Olczak, Hub-and-Spoke Cartels: Why They Form, How They Operate, and How to Prosecute Them (2021) (describing the advantages of colluding firms having a hub).

Now suppose firms do not have an agreement. If a firm knew the recommended price to be supracompetitive then it would be inclined not to implement it and instead charge something less, knowing they could earn higher profit (and recall there is no agreement to induce compliance). But suppose a firm is uncertain whether the recommended price is supracompetitive. This uncertainty could stem from a lack of knowledge of how the pricing algorithm works, what data was fed into it, and what the current demand state is. For example, a firm may perceive the recommended price to be high (perhaps compared to some historical average), but is that because the pricing algorithm determined that current demand is strong, or because the third party programmed in a supracompetitive markup? Or suppose the firm is making an assessment based on how much profit it is earning. It observes that profit is higher after adopting the pricing algorithm, but is that due to more effective dynamic pricing, which the third party purports to deliver, or is it because they simply raised the markup and enough firms are using the pricing algorithm (and complying with it) to increase profit for all subscribers? To what extent does this uncertainty give a third party latitude to deliver value through a supracompetitive markup? How does it depend on the efficiency it provides? If the efficiency is smaller, is a third party more likely to create value through artificially higher prices? Or does greater efficiency give a third party more room to impose supracompetitive markups and firms will still comply rather than risk having their license cancelled? These open questions call for research investigating the decision of a firm to adopt the recommended price and how firms' conduct affects the design of the pricing algorithm.

III. Application of Current Competition Law

In this Part, we apply existing competition law to some situations involving the supply of a pricing algorithm by a third party. As will be argued, the treatment is not entirely satisfactory. In the next Part, alternative approaches will be presented and discussed.

> *Existing law*: An agreement by firms to adopt a third party's pricing algorithm is per se or by object illegal.

Under current competition law in the U.S., EU, and many other jurisdictions, an agreement among competitors involving prices, in almost any form, is per se or by object illegal. Such an agreement need not pertain to the prices actually paid by buyers but could involve list prices,[24] discounts,[25] surcharges,[26]

24 *See* Joseph E. Harrington, Jr. & Lixin Ye, *Collusion through Coordination of Announcements*, 67 J. Indus. Econ. 209, 213-215 (2019) (observing that agreements on list prices in cement and urethane still allowed firms to offer discounts off list prices).

25 *See* Joseph E. Harrington, Jr., *Posted Pricing as a Plus* Factor, 7 J. Competition L. & Econ. 1, 4-5 (2011) (highlighting that in the market for turbine generators, there was a tacit agreement to stop negotiating prices); *see also* Eturas UAB v Lietuvos Respublikos konkurencijos taryba, 2016 E.C.R. C-74/14, ¶ 28 (2016) (finding an agreement between a third party and travel agencies to limit discounts to 3%).

26 *See* Harrington & Ye, *supra* note 25, at 214 (observing agreements in air cargo, air passenger, and rail service to add a surcharge).

coupons,[27] rebates,[28] reference prices,[29] and even internal prices.[30] Such agreements are unlawful even though their effect on the prices actually paid by buyers may not be established, either theoretically or empirically. To prove an antitrust violation, it is typically sufficient to show there was communication among firms that facilitated firms coordinating any component of firm's prices or any factor directly related to determining prices. A theory of harm for how the agreement could affect the prices paid by buyers and evidence of such harm only becomes necessary in the context of private litigation when determining the magnitude of customer damages.

This prohibition against any and all agreements involving prices is justified on the grounds that such agreements provide little or no countervailing efficiencies and that the most likely intent and effect of the agreement is to raise the prices paid by buyers. It is worth emphasizing that the presumption is not that there are no efficiencies, but only that they are small enough or unlikely enough to justify a per se or by object prohibition. For example, an agreement not to negotiate prices could realize transaction cost savings for both buyers and sellers, and an efficiency could stem from sellers agreeing to a uniform price in the form of reduced search costs for buyers. More generally, agreeing not to compete in one dimension (such as price) will tend to intensify competition in other dimensions (such as quality and service), and it is possible for both firms and consumers to be better off.[31] Though these efficiencies exist, there is little empirical evidence to suggest they are sufficiently common and substantial so as to justify evaluating these practices by the rule of reason or by effect. A per se or by object prohibition of all agreements pertaining to firms' pricing processes seems warranted.[32]

However, the matter is not so clear when it comes to an agreement involving a third party's pricing algorithm. Two points are pertinent to this issue.

Point #1: There can be substantial efficiencies from adopting a third party's pricing algorithm.

---

27 *See generally United States v. Stop & Shop Cos.*, Crim. No. B 84-51 (D. Conn. Nov. 8, 1984) (involving an agreement to stop doubling the value of coupons).

28 *See* Frode Steen & Lars Sørgard, *Coordinated Rebate Reductions in Semi-collusion in the Swedish Gasoline Market*, *in* Cartels Diagnosed: New Insights on Collusion (Cambridge Univ. Press) (Joseph E. Harrington & Maarten P. Schinkel eds., forthcoming 2023) (noting an agreement to eliminate rebates to large customers in the Swedish retail petrol market).

29 *See generally* Rosa M. Abrantes & D. Daniel Sokol, *The Lessons from Libor for Detection and Deterrence of Cartel Wrongdoing*, 3 Harv. Bus. L. Rev. Online 10 (2012) (examining an agreement surrounding LIBOR) https://journals.law.harvard.edu/hblr//?p=2451.

30 *See generally* Trucks, 2016 Eur. Comm'n AT.39824 (Commission Decision, Sept. 27, 2017) (regarding an agreement on internal list prices that were not observed by consumers, much less paid by them).

31 Chaim Fershtman and Ariel Pakes, *A Dynamic Oligopoly with Collusion and Price Wars*, 31 RAND J. Econ. 207 (2000) (showing that it is possible for price collusion to incentivize firms to invest more in product quality, and this can raise both consumer welfare and industry profit).

32 The same conclusion applies if the objective is avoiding harm to competition rather than harm to consumers. As just noted, constraining competition in one dimension—such as price—may promote it in another dimension—such as product quality—in which case competition is both harmed and enhanced. Still, the latter is not thought to be a sufficient basis for departing from the per se or by object prohibition, though there is an exception discussed later.

Point #2: An agreement among firms may be necessary for them to adopt a third party's pricing algorithm and thereby realize those efficiencies.

Beginning with point #1, a reason for the existence of a third party offering a pricing algorithm is that it is better at supplying that input to a firm. More specifically, a third party's pricing algorithm can raise a firm's profit without harming consumers (i.e., there is no anticompetitive effect) and thus provides a legitimate basis for its adoption.

At a high level, efficiencies stem from three sources. First, holding fixed the flow of information and the frequency with which price is adjusted, a third party's pricing algorithm could be better at identifying a price closer to the full information profit-maximizing price, and that results in higher realized profit. As this could mean either a higher or lower price, there is no reason to presume that consumers are harmed. This efficiency could come from the third party having a better optimization routine, a better demand estimation procedure, or faster learning about how price affects profit.[33] Second, holding fixed the flow of information, a third party's pricing algorithm could more frequently adjust price and thereby have price better calibrated to demand and cost conditions at that time. Again, the price is closer to the full information profit-maximizing price, and that results in higher realized profit. This efficiency could be due to automating pricing decisions or being able to recalculate the best price more quickly.[34] Third, a third party could have a greater flow of information, which increases maximal profit and, given any level of maximal profit, realized profit. More information could be due to aggregating subscribers' data or might reflect a third party's greater willingness to incur the cost of collecting data. This additional data could enhance profit through better training of the pricing algorithm or more precise demand estimation. In sum, a third party's pricing algorithm can raise the maximal profit (i.e., the profit achieved when the theoretically best price is identified) and reduce the gap between realized profit and maximal profit (i.e., identify a price closer to the theoretically best price).

Some of these efficiencies are more likely to be achieved by a third party rather than an individual firm for at least two reasons. First, there is a fixed cost associated with developing a pricing algorithm and a third party will have a stronger incentive to incur those costs because multiple firms—not just a single firm—can use the pricing algorithm. That is, the third party can license the pricing algorithm to many firms, while a firm can only use the pricing algorithm itself.[35] Second, the third party can have access to information from all adopting firms, while firms could run into

33 *When algorithms set prices: winners and losers*, Oxera 1, 15 (June 19, 2017) (discussion paper) ("Algorithms can be faster and better at correctly identifying changing market conditions such as demand shocks and cost changes. This enables companies to adjust prices more quickly to the efficient price level. This, in turn, reduces instances of excess supply and excess demand … thereby increasing market efficiency"), https://www.oxera.com/insights/agenda/articles/when-algorithms-set-prices-winners-and-losers/.

34 *Id.*, at 16 ("Algorithms can monitor the market and adjust prices at a very low marginal cost. Limited human involvement reduces staff costs and may reduce the scope for behavioural biases …").

35 In principle, a firm could sell its pricing algorithm to competitors but that would certainly run afoul of competition law.

legal trouble by directly exchanging commercially sensitive information such as prices, sales, and inventories.[36]

At this point, it is relevant to point out a U.S. exception to the per se prohibition of price-fixing agreements. Since *Leegin* (2007),[37] resale price maintenance (RPM) is evaluated under the rule of reason in the U.S. (though it is illegal by object in many jurisdictions, including the EU and UK). The rationale is that there are well-established efficiencies when a manufacturer restrains price competition among retailers selling its products. By requiring retail prices to exceed those under unrestrained price competition, retailers are incentivized to compete more aggressively on non-price dimensions, such as providing personnel at stores to inform and guide consumers in their purchases. In the absence of RPM, such service is underprovided from a social welfare perspective and, consequently, RPM can benefit both firms and consumers. The U.S. Supreme Court has ruled that this efficiency is sufficiently likely and substantial to warrant the rule of reason.[38]

Given that a hardcore price-fixing agreement like RPM is evaluated using the rule of reason, should an agreement to adopt pricing algorithms also be so? Though the efficiency is certainly not de minimis, the answer depends on whether an agreement is necessary to realize the efficiency. It is in the case of RPM, as firms lack an adequate incentive to enhance service unless they are able to sell at a higher price, and that requires that competitors be prevented from undercutting them. In the case of pricing algorithms, it is possible to construct scenarios whereby it will not be in the individual interest of a firm to adopt an efficiency-enhancing pricing algorithm, but it would be in their interest when all (or enough) firms do so.

This discussion has thus brought us to point #2. As shown in Harrington's 2022 paper, firms' adoption decisions can be strategic complements; that is, it is more profitable to adopt a pricing algorithm when other firms do so.[39] The pricing algorithm raises firms' profits by supporting more price discrimination, and price discrimination can be more profitable for a firm when other firms also engage in it. For suppose the pricing algorithm adjusts price up (or down) when demand is strong (or weak)—thereby engaging in price discrimination—which increases a firm's profit. This profit gain is larger when competitors also adjust their prices in that manner because a firm, in response to strong demand, will optimally price even

36 *See* Joseph E. Harrington, Jr. & Christopher R. Leslie, *Horizontal Price Exchanges*, 44 Cardozo L. Rev. 101, 104-105 (2023) (explaining that a per se prohibition is justified, while observing that a private exchange of prices is illegal by object in the EU and by the rule of reason in the U.S.).

37 *Leegin Creative Leather Products, Inc. v. PSKS*, Inc., 551 U.S. 877 (2007).

38 "Under the rule of reason, the legality of a business practice is evaluated based on a thorough analysis of its purpose, its potential effects on competition, and any justifications or pro-competitive benefits it may have. The court considers the overall context and circumstances surrounding the conduct. The rule of reason is based on the understanding that not all business practices that restrict competition are necessarily harmful. Some may have legitimate justifications or even pro-competitive effects that outweigh their anticompetitive impact. Therefore, a detailed examination is necessary to determine whether the practice promotes or harms competition in the relevant market." ChatGPT-4o, downloaded 27 August 2024.

39 Harrington, *supra* note 13, at 6889.

higher when rival firms are also pricing higher.[40] With that in mind, let X denote the incremental profit to a firm from adopting the pricing algorithm when all other firms adopt it, and Y the incremental profit when all other firms do not adopt it. It has just been explained that X > Y. Now suppose the third party sets the fee F for the pricing algorithm so that X > F > Y. In that case, a firm is not willing to pay F if it expects other firms not to adopt; hence, independent adoptions could result in no adoptions. However, it would be willing to pay F if there were an agreement whereby all firms will adopt. An agreement may then be required for firms to adopt the pricing algorithm and realize the efficiencies.

Of course, the third party's fee is endogenous. If agreements were prohibited, then presumably it would set the fee F < Y so as to induce adoptions. However, suppose the cost of developing and selling the pricing algorithm is high enough that only a fee exceeding Y will make it profitable. In that case, an agreement may be needed for the pricing algorithm to be developed and thus for efficiencies to be realized.

Though there are then conditions whereby an agreement among firms to adopt a third party's pricing algorithm could be necessary to realize efficiencies, my tentative conclusion is that the conditions seem too special to justify departing from a per se prohibition. While further analysis is required, there is not yet a compelling case for the rule of reason to be used to evaluate agreements to adopt a third party's pricing algorithm.

> *Existing law*: A third party supplying a pricing algorithm to competitors is lawful if there is no agreement among the adopting firms.

In the context of hub-and-spoke collusion, a necessary condition for a third party's conduct to be unlawful is that the third party (hub) facilitates an agreement (referred to as the "rim") among the firms (spokes). Following up on our earlier discussion, here I discuss the possibility that a third party will result in supracompetitive prices even when there is no agreement between the third party and the adopting firms.

Suppose a data analytics company tells each firm to try out its pricing algorithm and then assess whether, as the third party claims, it results in higher profits. Having convinced enough firms to adopt, the third party designs the pricing algorithm so that it sets monopoly prices and thus raises all adopting firms' profits. Firms are sufficiently uncertain of the source of the higher profits that they continue to use the pricing algorithm rather than mess with the goose that laid the golden egg. As long as firms have independently decided whether to contract with the third party and to charge the recommended prices, there is no agreement and only the third party has intent. Nevertheless, supracompetitive prices are being charged and the harm

40 While it is also true that a firm, in response to weak demand, will optimally price even lower when rival firms price lower, the profit gain when demand is strong exceeds the profit low when demand is weak.

created could far exceed any efficiencies. This "liability gap" has been previously noted,[41] but to my knowledge a solution is yet to be identified.[42]

Let me summarize. Under current competition law, an agreement among competitors to adopt a third party's pricing algorithms is per se or by object unlawful. The potential problem with this rule is that such an agreement could be necessary to realize efficiencies. However, possibility is not plausibility, and I do not think there is sufficient justification to veer from a per se or by object prohibition. Under current competition law, a third party supplying a pricing algorithm to competitors is lawful if there is no agreement among the firms to adopt the pricing algorithm or the prices that the pricing algorithm recommends. Nevertheless, the possibility remains that the third party could cause harm without an agreement between or with the adopting firms. This creates a liability gap, and we consider some proposed remedies in the next Part.

IV. Some Proposed Remedies for Filling the Liability Gap

The goal is to restrict the conduct of third parties so their pricing algorithms do not result in supracompetitive prices while not unduly limiting the efficiencies that firms might realize in outsourcing their pricing decisions. This problem will be considered in the absence of an agreement (as there are already remedies to deal with that case), so the concern is that a third party may design its pricing algorithm to have an anticompetitive effect without the consent or even knowledge of the firms who are adopting the pricing algorithm.

In general terms, a remedy could involve limiting to whom a third party can supply a pricing algorithm or restricting the properties of the pricing algorithm that a third party supplies. Both features are present in two bills proposed in the U.S. Senate in January 2024. These bills target third parties who are designing and supplying pricing algorithms along with competitors in a market who are using a third party's pricing algorithm. At their core, they prohibit a software or data analytics company from providing a service to two or more firms in a market that involves: a) collecting nonpublic data from those firms; b) using that data to train

41 German Monopolies Commission's Report on "Algorithms and Collusion", *supra* note 3, at ¶ 266 ("[L]iability gaps can open up if the IT service provider brings about a collusive market outcome without the approval of the parties involved. It is possible that several users use pricing algorithms whose use leads to collusive pricing. However, users may not be able to recognize this collusive market outcome themselves – e.g., due to the complexity of the product or the market conditions – and therefore may not form a joint intention necessary to create a cartel. At the same time, however, the IT service provider that provided the pricing algorithms may be well aware of the possibility of collusive pricing and may also approve of it. In such a case, the situation … cannot or only with difficulty be addressed pursuant to Article 101 TFEU.").

42 *See generally* Michal S. Gal, *Algorithms as Illegal Agreements*, 34 Berkeley Tech. L. J. 67, (2019) (considering the liability for adopting firms but not that of a third party, and thus does not address when intent exclusively resides with the third party).

an algorithm; and c) recommending prices to those firms. These bills will serve as a useful device to discuss some issues related to the design of remedies.

The "Preventing Algorithmic Collusion Act Bill"[43] has three key features. First and foremost, it prohibits the use of a pricing algorithm using nonpublic competitor data, the details of which are described below. Second, and for the purpose of enforcing that prohibition, it gives the U.S. Department of Justice's Antitrust Division and U. S. Federal Trade Commission the authority to audit a firm's pricing algorithm. Third, it requires a firm to share certain information with customers and other market participants towards providing transparency regarding its pricing algorithm.

Section 4 of the "Preventing Algorithmic Collusion Act Bill" states: "It shall be unlawful for a person to use or distribute any pricing algorithm that uses, incorporates, or was trained with nonpublic competitor data."[44] Nonpublic data is "information that is not widely available or easily accessible to the public … regardless of whether the data is attributable to a specific competitor or anonymized,"[45] and a competitor is someone who "competes in the same market … or a related market."[46] Nonpublic competitor data excludes "information distributed, reported, or otherwise communicated in a way that does not reveal any underlying data from a competitor, such as narrative industry reports, news reports, business commentaries, or generalized industry survey results."[47]

When they engage in the unlawful conduct described in Section 4, the bill presumes that the defendants have an agreement in violation of Section 1 of the Sherman Act and have engaged in an unfair method of competition in violation of Section 5 of the FTC Act when it is established that:

> (1) the defendant distributed the pricing algorithm to 2 or more persons: (A) with the intent that the pricing algorithm be used to set or recommend a price or commercial term of a product or service in the same market or a related market; or (B) and 2 or more persons used the pricing algorithm to set or recommend a price or commercial term of a product or service in the same market or a related market;[48]
>
> or
>
> (2) (A) the defendant used the pricing algorithm to set or recommend a price or commercial term of a product or service; and (B) the pricing algorithm was used by another person to set or recommend a price or commercial term of a product or service in the same market or a related market.[49]

Part (1) applies to a third party and part (2) applies to firms subscribing to the third party's service.

---

43 Preventing Algorithmic Collusion Act of 2024, S.3686, 118th Cong. (2024).
44 *Id.* § 4(a).
45 *Id.* § 2(6).
46 *Id.* § 2(5)(A).
47 *Id.* § 2(5)(B).
48 *Id.* § 5(a).
49 *Id.*

Motivated by the plaintiffs' complaints against RealPage and apartment property owners, the "Preventing the Algorithmic Facilitation of Rental Housing Cartels Act of 2024"[50] bill is targeted specifically to the rental housing market. The bill's stated objective is "[t]o prohibit the use of algorithmic systems to artificially inflate the price or reduce the supply of leased or rented residential dwelling units in the United States."[51] The bill proposes to make it a per se violation of Section 1 of the Sherman Act for a rental property owner to contract with "any person that operates a software or data analytics service that performs a coordinating function,"[52] where a coordinating function means: "(A) collecting historical or contemporaneous prices, supply levels, or lease or rental contract termination and renewal dates of residential dwelling units from 2 or more rental property owners; (B) analyzing or processing of the information described in (A) using a system, software, or process that uses computation, including by using that information to train an algorithm; and (C) recommending rental prices, lease renewal terms, or ideal occupancy levels to a rental property owner."[53]

An analysis of this proposed remedy requires assessing how well it does in preventing an anticompetitive effect while not interfering with the provision of efficiencies. Towards that end, I will discuss various forms of conduct that are compliant with the proposed laws.

A third party could comply by only providing its service to one firm in a market. On the positive side, any chance of an anticompetitive effect disappears, as we are back to a firm's price being set independently of rival firms' prices. However, that avoidance of consumer harm comes at a potentially large welfare loss in terms of foregone efficiencies. To begin with, all but one firm in a market are deprived of having a pricing algorithm that would allow them to price more effectively. Furthermore, the efficacy of the pricing algorithm itself may be harmed. By limiting the potential customer base, a third party may invest less in collecting data and training the pricing algorithm since there will be a lower return from the investment.[54] It could even discourage a third party from entering the market at all. There is another concern, which is that the firm who is the exclusive user of a third party's pricing algorithm will have an advantage over its competitors. While its implications are unclear, this could contribute to market dominance, which would then be subject to abuse.[55] In sum, a remedy that causes a third party to supply only one firm in a market could cause a serious loss of efficiencies.

Alternatively, a third party could supply its services to multiple firms and comply with the law by restricting its pricing algorithm from using nonpublic competitor data.

---

50 Preventing Algorithmic Facilitation of Rental Housing Cartels Act, 118th Cong. (as proposed Jan. 30, 2024).

51 *Id.*

52 *Id.* § 2(5).

53 *Id.* § 2(4).

54 This source of harm is reduced when there are more geographic markets for a product or service, as a third party could supply one firm in each of those markets.

55 The more software and data analytics companies there are to supply pricing algorithms, the more this effect will be mitigated.

This means that nonpublic competitor data is not used to train the pricing algorithm or to determine the pricing algorithm's recommended price. Interestingly, such a restriction was purportedly agreed to between third party RealPage and apartment property owner AvalonBay, where the latter "insisted on a contractual provision …. that prohibited [RealPage] from: (1) utilizing any data [used in determining the rent recommended to AvalonBay] other than AvalonBay's own data and publicly available data; and (2) utilizing AvalonBay's data or disclosing the … recommendations made by AvalonBay to any other [RealPage] client."[56]

Compliance by not using nonpublic competitor data avoids the negative effects mentioned above, as a third party's customer base comprises all firms in a market and therefore all firms could contract with the third party. An inefficiency remains, however (which is also present when a third party supplies only one firm in a market), which is that the third party will not be able to develop as effective a pricing algorithm when it does not use rival firms' data. For example, a third party can produce a more precise and less biased estimate of a firm's demand function when it is able to measure how responsive a firm's demand is to rival firms' prices, and that can only be done with data on rival firms' prices. In addition, data on rival firms' quantities can be critical for distinguishing between firm-specific and market-wide changes in demand. If a firm's sales decline is experienced by other firms, then it is likely to reflect overall weaker market demand, and that calls for a larger price response than if lower sales are idiosyncratic to the firm. This distinction is not only relevant to a firm's profit, but also to an efficient allocation of resources. For firms to appropriately respond by increasing or decreasing supply, they need to know whether there has been a market-wide increase or decrease in demand. Prohibiting a third party from using all market data—including rival firms' prices and sales—can mean foregoing efficiencies in the form of a pricing algorithm that recommends prices less attuned to market conditions.[57]

As should be clear from the preceding discussion, it is crucial to take account of how restricting a data analytic company's conduct affects the efficiencies that it is able to deliver with better pricing algorithms. What is striking is the absence of efficiencies in the public debate. Recent Congressional testimony by Bill Baer (who is a former head of the U.S. Department of Justice's Antitrust Division) rightfully pointed out the anticompetitive risks from competitors contracting with the same data analytics company, but drew an incomplete parallel with hub-and-spoke collusion.

---

56 *In re* RealPage, Inc., Rental Software Antitrust Litig., 2023 U.S. Dist. LEXIS 230199, at *27 (M.D. Tenn. Dec. 28, 2023).

57 *See generally* William L. Cooper, Tito Homen-de-Mello & Anton J. Kleywegt, *Learning and Pricing with Models That Do Not Explicitly Incorporate Competition,* 63 Operations Research 86 (2015) (showing that prices are higher when a pricing algorithm trains only on a firm's own prices and sales and excludes rival firms' prices, because failing to control for rival firms' prices can cause a firm's estimated demand to be more price-inelastic than it actually is, which then results in the algorithm recommending higher prices); *see also* Karsten Hansen, Kanishka Misra, & Mallesh Pai, *Algorithmic Collusion: Supra-Competitive Prices via Independent Algorithms*, 40 Marketing Science 1 (2021) (the same).

> The second area of concern with the use of pricing algorithms [is] companies avoiding price competition by using the same third-party vendor to collect data on supply and demand and "recommend" pricing or output behaviors that facilitate price coordination. Antitrust jurisprudence describes this behavior as a hub and spoke conspiracy …[58]

While the law prohibits an upstream supplier from acting as a hub to facilitate collusion among its downstream customers, it still allows it to supply its input to those customers. Analogously, we must not forget that a software or data analytics company is also an upstream supplier of an input—in the form of an algorithm—and interfering with that legitimate business relationship comes with welfare costs. For example, better pricing can mean better matching of demand and supply, which results in more transactions that benefit both sellers and buyers. However, there is no mention in his written or oral testimony of the antitrust challenge associated with balancing a reduced chance of anticompetitive harm against the possibility of foregone efficiencies.

Similarly, consider the testimony of Professor Maurice Stucke:

> There may be another avenue for liability, namely, if the competitors continuously share competitively sensitive, non-public data with the hub. … A company ordinarily would not share competitively sensitive and nonpublic data with the hub, if it knew that the hub's algorithm could use that data to help rivals undercut the company. Thus, the rivals will continuously share this non-public information with the knowledge that the hub will use it to their mutual advantage. Consequently, this information sharing could be used as a plus factor to establish a conspiracy or challenged by itself …[59]

While Professor Stucke notes elsewhere in his testimony that the third party can provide efficiencies, this statement does not recognize that the sharing of nonpublic data such as rival firms' prices and sales may be a critical input to delivering those efficiencies. Firms' mutual interest can reside in having better demand estimates and not just charging supracompetitive prices.[60] And there is no basis for the claim that, absent an agreement, the third party would use a firm's information to aid a rival firm in undercutting the firm's price. The third party could simply be recommending competitive prices but based on better demand information. The broader point is that sharing nonpublic competitor data is relevant to producing efficiencies and not just anticompetitive harm.[61]

---

58 *The New Invisible Hand? The Impact of Algorithms on Competition and Consumer Rights: Hearing Before the Subcomm. on Competition Pol'y, Antitrust, and Consumer Rights,* 118th Cong. 2 (2023) (written testimony of Bill Baer, Visiting Fellow in Governance Studies, The Brookings Institution), https://www.judiciary.senate.gov/imo/media/doc/2023-12-13_pm_-_testimony_-_baer.pdf.

59 *Examining Competition and Consumer Rights: Hearing Before the Subcomm. on Competition Pol'y, Antitrust, and Consumer Rights*, 118th Cong. 7 (2023) (written testimony of Maurice E. Stucke, Professor of Law, Univ. of Tennessee College of Law), https://www.judiciary.senate.gov/imo/media/doc/2023-10-24_-_testimony_-_stucke.pdf.

60 *See* Kai-Uwe Kühn & Xavier Vives, Information Exchanges Among Firms and their Impact on Competition (Dec. 1994) (unpublished manuscript) (IESE).

61 However, it is clearly appropriate to prohibit the sharing of recommended prices because such an information exchange could facilitate coordinated pricing and does not offer an obvious efficiency gain.

This tradeoff between efficiency and the harm associated with information sharing has a long history in connection with trade associations, which has led to certain guidelines for the information that a trade association should share with individual firms:

> Although articulated in the different vocabulary of Article 101, the guidelines present a similar set of criteria to those identified in U.S. law. …. [E]xchanges of individualized data are more concerning than those of aggregated data, exchanges of historic data are more benign than those of present or future data, [and] highly frequent exchanges are more suspect …[62]

With trade associations, the concern is that one firm's data will be shared with a rival firm and that will facilitate coordinated pricing. With data analytics companies supplying pricing algorithms, the concern is that they will use one firm's data in determining another firm's price, and that will facilitate coordinated pricing. As with trade associations, the age of data may help alleviate this concern. One could require a third party to train a pricing algorithm on "old" competitor data. That could still prove useful in deriving a pricing algorithm that is responsive to market conditions. By also requiring that only a firm's own data be inputted into the pricing algorithm to generate a recommended price, a pathway may be neutralized to produce supracompetitive prices. This proposed policy warrants examination and serves to underscore the task before us: How to restrict third parties so as to reduce anticompetitive harm without having an undue deleterious effect on efficiencies.

While restricting a third party from using competitors' nonpublic data could well harm the efficacy of the pricing algorithm that it delivers, a greater concern is that such a restriction may not even have the desired effect of avoiding an anticompetitive effect. To examine the matter, suppose that, as is feared, a third party will try to design its pricing algorithm to maximize some collective objective of its subscribers and thereby result in supracompetitive prices. Will prohibiting the third party from using nonpublic competitor data prevent it from achieving that end? I will offer a setting where that is not the case and, more generally, I see no reason why supracompetitive prices will be avoided by preventing the use of competitor data.

Suppose the third party is using an estimation-optimization algorithm where an estimation module uses data to estimate a firm's demand and profit function, and those estimated profit functions are then put into an optimization module to determine prices. Given the prohibition on using nonpublic competitor data, the third party will estimate a firm's profit function using that firm's data (such as prices, quantities, costs, and inventories) and public data or data that it collects (such as consumer income and other demand shifters and perhaps rival firms' prices when

---

For example, if a firm feels that the third party's recommended price is high, it may be disinclined to implement it out of concern that it may be pricing above its competitors. However, if a firm learns that other subscribers have been recommended high prices, the firm may then have the reassurance it needs to implement it.

62 Daniel A. Crane, *Cartels and the Exchange of Information*, *in* Research Handbook on Cartels 221, 230 (Peter Whelan ed., Edward Elgar, 2023).

they are publicly available). The data prohibition will affect the estimation module by resulting in less precise and possibly biased estimates. What about the optimization module? If there are no restrictions on the optimization module, then a third party could choose firms' prices to maximize the joint profit of its subscribers or some other collective objective, which will result in supracompetitive prices. But suppose the law requires and is able to enforce that each firm's optimization module is run independently so that it produces competitive prices based on the estimated profit functions. Even in that case, we are not assured that supracompetitive prices will be prevented. For example, the third party could use an inflated cost in each optimization module. Even if the pricing algorithm is the competitive pricing rule, prices are supracompetitive because they are based on a cost that exceeds the true cost. By suitably choosing this artificial cost, the third party could even have the pricing algorithm recommend monopoly prices.[63]

The general takeaway is that before we start imposing a remedy for third-party pricing algorithms, we need to rigorously investigate to what extent the remedy will actually prevent a third party from producing supracompetitive prices, and to what extent it will reduce efficiencies. Recognizing that a clever third party may find workarounds to recommend supracompetitive prices, there should also be a focus on better understanding the incentives of a third party to want to have its pricing algorithms be supracompetitive and, should such incentives be identified, designing remedies that change those incentives. It may prove more effective for policy to induce third parties to want to design competitive pricing algorithms rather than to try to regulate them to prevent them from designing supracompetitive pricing algorithms.[64]

Concluding Remarks

Competition law is based on two sources of harm: 1) firms reducing competition through coordinated conduct or merger; and 2) abuse of dominance by a single firm. The conundrum before us is that the anticompetitive outcome that would typically require an agreement among competitors could be achieved by a single third party's pricing algorithm. This represents a fundamental departure regarding conduct: the firms whose prices are causing the harm are not determining those prices. Those prices are partially or fully determined by another party, and it is not

63 Joseph E. Harrington, Jr., *Cost Coordination* (RAND J. of Econ., Working Paper, 2023) (exploring a related collusive strategy where firms coordinate on the cost that they use in their internal pricing processes). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4156746

64 Another legal approach for when the third party designs the pricing algorithm to be supracompetitive and it is the only one with intent is to view it as a monopolization practice (in violation of Section 2 of the Sherman Act) and an abuse of dominance (in violation of Article 102 of the TFEU). Such an approach warrants consideration.

clear that, when contracting with that party, firms understand the properties of the prices they will be charging. Consequently, there is harm without an agreement.[65]

Early analysis of this conundrum has produced some misconceptions.

> *Misconception #1*: A third party will have an incentive to design the pricing algorithm to raise all subscribing firms' profits, and this will result in supracompetitive prices.

This view is associated with concerns expressed by competition authorities and is prominent in plaintiffs' complaints but, to be clear, it is a misconception only if one believes it is necessarily the case that a third party is incentivized to act anticompetitively. To the contrary, when firms make independent adoption decisions, it has been shown that the average price induced by a third party's pricing algorithm is the same as the competitive price.[66] While it is quite possible that a third party could design its pricing algorithm to produce supracompetitive markups, it is yet to be shown to have an incentive to do so, at least in the absence of an agreement with adopting firms. Further research is needed to better understand a third party's incentives and under what conditions it will supply a supracompetitive pricing algorithm.

> *Misconception #2*: A third party's pricing algorithm that facilitates firms charging supracompetitive prices is akin to a hub-and-spoke cartel.

This misconception is present in the recent public debate surrounding some proposed remedies. In the canonical hub-and-spoke cartel, an upstream supplier only causes harm when it facilitates coordinated pricing among downstream firms. In contrast, a third party's pricing algorithm delivers efficiencies even when it is coordinating prices. Though the pricing algorithm may result in a supracompetitive markup, it may also make price more responsive to market conditions, and that can be welfare improving for both buyers and sellers. This efficiency means that any remedy that restricts the third party's conduct must take account of how it affects those procompetitive benefits and balance that against reducing the risk of anticompetitive harm.

> *Misconception #3*: Prohibiting the use of nonpublic competitor data will prevent a third party from supplying a pricing algorithm that results in supracompetitive prices.

This misconception is implicit in recently proposed remedies. A preliminary analysis suggests that a third party could find workarounds whereby it designs the pricing

---

65 The conundrum of supracompetitive prices without coordinated conduct is also present when each firm has a learning algorithm determine its price. Referred to as "algorithmic collusion," this phenomenon has been confined to the lab and is yet to be unleashed on actual markets. However, when it does arrive, it will pose an even greater challenge for competition law because intent can be entirely absent. *See generally* Salil K. Mehra, *Antitrust and the Robo-Seller: Competition in the Time of Algorithms*, 100 Minn. L. Rev. 1323 (2016) (for a lively competition policy debate on algorithmic collusion); *see also* Ezrachi and Stucke, *supra* note 23 (the same); *see also* Ai Deng, *What Do We Know About Algorithmic Tacit Collusion?*, 33 Antitrust 88 (the same); *see also* Aslihan Asil & Thomas G. Wollmann, *Can Machines Commit Crimes under U.S. Antitrust Laws?*, 3 The Univ. of Chi. Bus. L. Rev. 1 (2023) (arguing that learning algorithms have intent and thus can be prosecuted under current competition laws).

66 Supra note 13.

algorithm to be supracompetitive while ensuring that the recommended price for a firm is not influenced by competitor data. As part of a proper vetting of any proposed remedy, there should be a rigorous investigation into whether it will actually achieve the intended goal of preventing a third party's pricing algorithm from putting forth supracompetitive prices.