A DATA ANALYTICS COMPANY AS THE HUB IN A HUB-AND-SPOKE CARTEL

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In an increasing number of markets, data analytics companies are assisting firms in their pricing by training a pricing algorithm based on firms' data and using it to recommend prices. While data analytics delivers a legitimate efficiency, there is a concern that this business relationship could be the basis for a hub-and-spoke cartel where the data analytics company is the hub and subscribing firms operating in the same market are the spokes. Indeed, that is the claim made in private litigation involving apartment rentals, equipment rentals, and other markets. This article considers the unique economic features and legal implications associated with hub-and-spoke collusion when the hub is a data analytics company. Compared to more traditional hub-and-spoke cartels, collusion is likely to be more effective but proving a Section 1 violation may be more difficult.

I. INTRODUCTION

Firms are increasingly turning to the services of a date analytics company to assist them in pricing whether it is a hotel chain in the setting of room rates, gasoline stations and their pump prices, or insurance companies when negotiating prices with out-of-network health providers. At a high level, the process is the same. A firm contracts with a third party to whom it pays a fee and shares its data relevant for pricing. Using subscribing firms' data along with other data it has collected, the third party trains a pricing algorithm with methods such as machine learning, optimization programs, and AI. The third party inputs current data into that pricing algorithm to generate prices which are then recommended to a subscribing firm. Finally, a subscribing firm decides whether to implement the recommended prices.

While a firm could choose to engage in algorithmic pricing on its own, the pricing algorithm designed by a data analytics company is likely to be superior and developed at lower cost. A data analytics company has more data from serving many clients and markets. It has more expertise due to more experience and scale; e.g. it can hire a staff of data scientists and economists. And it has stronger incentives to invest in developing a better pricing algorithm as it can license it to many companies and thus reap a higher return to that investment.

The antitrust problem is that these data analytics companies often have competitors as clients. That is, they are making price recommendations to firms who operate in the same market. The risk for anticompetitive harm is acute because a basic condition for competition – firms independently setting their prices – is at jeopardy when a common agent advises competitors on their prices.

Anticompetitive harm can arise through three avenues. First, the third party and subscribing firms have a price-fixing agreement. Second, the third party and subscribing firms have an information exchange agreement which proves to be anticompetitive.[2] Third, the third party unilaterally causes harm without the request, approval, or knowledge of subscribing firms.[3]

This article focuses on the first source of harm. There is a hub-and-spoke cartel where the data analytics company is the hub coordinating the prices of subscribing firms who are the spokes. The unlawful agreement takes the form of firms agreeing to contract with that third party and/or agreeing to implement the third party's recommended prices. This is a standard hub-and-spoke cartel with an upstream supplier acting as a hub but where its input is a pricing algorithm rather than a physical input for a production process or a manufacturer supplying its product to retailers.

There has been considerable litigation activity in recent years with plaintiffs claiming there is a hub-and-spoke conspiracy in the markets for apartment rentals, equipment rentals, hotel rooms, and out-of-network health services.[4] Illustrative are these complaints made in the markets for apartment rentals and hotel rooms, respectively.

> RealPage provides software and data analytics to Lessors [and] serves as the mechanism by which Lessors collude and avoid competition, increasing lease prices to Plaintiffs ... RealPage has [been] facilitating an agreement among participating Lessors not to compete on price ...[5]

> ... Operator Defendants have agreed and conspired to outsource their independent pricing decision-making to a single, common pricing manager - IDeaS, which has willingly facilitated and enforced the conspiracy.[6]

2 In the U.S. Department of Justice's case against RealPage and subscribing apartment owners and management companies, it claims there is an unlawful information sharing agreement in violation of Section 1 of the Sherman Act. See *United State of America et al v. RealPage, Inc. et al*, No. 1:24-cv-00710-LCB-JLW, U.S. District Court for the Middle District of North Carolina, Amended Complaint, January 7, 2025, ¶ 259-269.

3 For a description of and a proposed remedy for this source of harm, see Joseph E. Harrington, Jr. and Samuel N. Weinstein, "A Remedy for Third-Party Pricing Algorithms," working paper, December 2025.

4 Though there are not yet any cases in gasoline markets, competition agencies in Brazil and Canada are currently conducting investigations and an empirical study has shown the use of a third party's pricing algorithm caused higher gasoline prices in Germany; see Stephanie Assad, Robert Clark, Daniel Ershov, and Lei Xu, "Algorithmic Pricing and Competition: Empirical Evidence from the German Retail Gasoline Market," *Journal of Political Economy*, 132 (2024), 723-771.

5 *Bason, et al. v. RealPage, Inc., et al.*, No. 3:22-cv-01611-WQH-MDD, U.S. District Court, Southern District of California, October 18, 2022, ¶ 5.

6 *Hanson Dai, et al v. SAS Institute, Inc.*, et al, No. 3:24-cv-02537, U.S. District Court, Northern District of California, April 26, 2024, ¶ 9.

Of course, these are claims which may ultimately prove to be unfounded.[7] Nevertheless, the risk of a hub-and-spoke conspiracy is real whenever a common agent is recommending prices to competitors.

In the typical hub-and-spoke cartel, an upstream firm's supply of an input is orthogonal to its role in coordinating downstream firms' prices. That is not the case when the hub is a data analytics company as its supply of a pricing algorithm is intrinsically connected to the implementation of price coordination. Consequently, there are unique economic features and legal implications associated with hub-and-spoke collusion when the hub is a data analytics company.

II. HOW IS HUB-AND-SPOKE COLLUSION DIFFERENT WHEN THE HUB SUPPLIES A PRICING ALGORITHM?

Effective collusion requires firms to coordinate on a collusive outcome, monitor for compliance with that outcome, and punish when there is evidence of noncompliance. A cartel does a better job performing these tasks when it has the assistance of an upstream supplier.[8] That is especially so when the upstream hub is a data analytics company providing price recommendations.

Many hub-and-spoke cartels involve a manufacturer acting as a hub and retailers - to whom it is supplying its product - as the spokes. Coordinating on a collusive outcome often takes the form of promoting adherence to a manufacturer's suggested retail price (MSRP). A data analytics company is also recommending a price but doing so in a much more profitable manner. It can adjust prices to changing demand conditions, which is not so easily done with an MSRP. It can tailor prices to narrow market segments to extract more surplus from customers, which again is not easily done with an MSRP. Consequently, collusion is more profitable when the upstream hub is supplying a pricing algorithm than when it is supplying a physical product.

Turning to monitoring, it has been noted that an upstream supplier may, through its normal interactions with downstream firms, be able to monitor their prices for compliance.[9] A data analytics company is far superior in this task for it is regularly receiving a subscribing firm's price data. Unless the firm were to supply false data, which while possible is unlikely (as it would harm the value of the third party's services to the firm), the hub will be able to accurately determine whether the actual prices are in line with the recommended (collusive) prices. With a data analytics company as the hub, monitoring is likely to be near perfect.

Finally, it has been noted that the use of an upstream supplier as a hub expands the set of punishments because it can restrict supply to a noncompliant cartel member.[10] Similarly, a data analytics company can threaten denying its services to a subscribing firm who fails to implement the recommended prices. Stronger punishments discourage cheating and make for more durable collusion.

In sum, a data analytics company is more effective as a hub than the typical input supplier. This means collusion is more profitable and more stable and, therefore, a cartel is more likely to form and to be of longer duration.

Adding to this understanding, recent analyses have theoretically investigated hub-and-spoke collusion with a data analytics company.[11] In these models, a third party is assumed to design the pricing algorithm to maximize the joint profits of subscribing firms subject to inducing them to adopt the pricing algorithm and implement the recommended prices. The setting is one in which there is demand variation; it could be due to demand varying over time or that demand varies across market segments. The efficiency delivered by the data analytics company is that it can design a pricing algorithm that is better at conditioning price on the demand state than can be developed by a firm. The use of its pricing algorithm means a firm's prices respond quicker and more effectively to high-frequency demand variation or price discrimination is more precise in that prices are better tailored to market segments.

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7 While the hotels cases are not faring well – some being dismissed at pleading – the apartment rental cases have survived motions to dismiss and there is empirical evidence supporting supracompetitive prices; see Sophie Calder-Wang and Gi Heung Kim, "Algorithmic Pricing in Multifamily Rentals: Efficiency Gains or Price Coordination?," working paper, July 2024.

8 Luke Garrod, Joseph E. Harrington, Jr., and Matthew Olczak, *Hub-and-Spoke Cartels: Why They Form, How They Operate, and How to Prosecute Them*, The MIT Press, 2021. Chapter 2 summarizes the mechanisms through which a hub facilitates collusion and Chapter 6 offers a summary of cartel episodes that illustrates those mechanisms.

9 "Those interactions provide opportunities to collect information useful for monitoring. For example, when visiting stores, it would be easy for an upstream supplier to observe the prices that a retailer is charging and thus whether it is setting collusive prices." *Ibid*, p. 21.

10 "If the hub is an upstream supplier, it could threaten to limit, delay, or deny supply to a downstream [firm] that is undercutting the collusive price." *Ibid*, p. 21.

11 Joseph E. Harrington, Jr., "Hub-and-Spoke Collusion with a Third-Party Pricing Algorithm," working paper, November 2025 (*Journal of Industrial Economics*, forthcoming) and Takuo Sugaya and Alexander Wolitzky, "Collusion with Optimal Information Disclosure," working paper, November 2025.

One of the findings is that the efficiency delivered by the third party is a facilitating factor in collusion. First note that the third party's services are more valuable to firms when demand variation is greater as then it is more important to properly adjust price to that changing demand state. Thus, the more variation in market demand, the greater is the efficiency delivered by a data analytics company. Analysis shows the pricing algorithm's supracompetitive markup is higher when market demand variation is greater and, therefore, a third party's efficiency makes collusion more attractive. The intuition is as follows. In building a supracompetitive markup into its pricing algorithm, the third party makes it tempting for a firm not to adopt the pricing algorithm and instead undercut the high prices of rival firms who are adopting the pricing algorithm. This is the usual incentive to deviate from a collusive price. However, nonadoption also means foregoing the efficiency of being able to condition price on the demand state. Hence, as the efficiency is greater, the third party can set a higher markup and still induce firms to adopt the pricing algorithm and implement the recommended prices.

That a third party's efficiency is a facilitating factor for collusion has implications for enforcement. To begin, consider a third party who does not have an efficiency but nevertheless is being paid to recommend prices. Such a situation is inherently suspicious because the only plausible deliverable is that the third party is assisting in the coordination of subscribing firms' prices. If the third party now has an efficiency, there is a rationale for firms contracting with a third party which is not tied to anticompetitive conduct. However, as explained above, more efficiency makes collusion more profitable and thus more enticing to all parties. This creates an enforcement challenge because a third party who has a significant efficiency may just be delivering a legitimate service but, at the same time, there is an enhanced risk of the third party and subscribing firms forming a hub-and-spoke cartel.

III. HOW IS PROVING LIABILITY DIFFERENT WHEN THE HUB SUPPLIES A PRICING ALGORITHM?

Just as with any hub-and-spoke cartel, a data analytics company supplying a pricing algorithm is as liable as the subscribing firms it is helping to coordinate. Proving liability requires establishing that there is an agreement among subscribing firms – commonly referred to as the "rim" - which is facilitated by the data analytics company. Competitors could agree to contract with the third party to receive recommended prices or agree to implement those recommended prices or both. Here, we discuss two impediments to proving liability when the hub is advising a firm on its pricing but also a source of economic evidence that can be used as circumstantial evidence.

With most hub-and-spoke cartels, a challenge to prove liability is that competitors do not directly communicate so there is no evidence of one firm inviting another to collude and the other accepting that invitation. Instead, communications are generally bilateral involving the hub and a spoke. Proving liability requires showing these bilateral communications resulted in an agreement among the spokes. Applying that approach to a setting where the hub is supplying a pricing algorithm, evidence supporting the existence of an agreement could be, for example, that the hub communicated to each firm that its pricing algorithm will generate supracompetitive prices, encouraged the implementation of those prices, and made clear that the same was being said to other subscribing firms.

What can make identifying such evidence more difficult than with the usual hub-and-spoke cartel is distinguishing between the third party's delivery of a legitimate service and the facilitation of an unlawful agreement. The typical hub supplies an input which does not require that it intimately engage itself with its customers' pricing. Consequently, the involvement of an upstream supplier in downstream firms' pricing is suspect. But that is not the case when the hub is a data analytics company. That a data analytics company discusses prices with its subscribing firms is what it is paid to do. As a result, it could be difficult to distinguish legitimate pricing advice from that which is intended to coordinate firms' prices.

A plus factor commonly used to assist in proving liability in Section 1 cases is that firms took actions against their independent self-interest and that those actions only make sense when they expect other firms to act in the same manner. Plaintiffs in some cases involving third party pricing algorithms have drawn on this plus factor when arguing that it would not be in subscribing firms' independent self-interest to share their confidential information with a data analytics company. Here are examples from cases in the markets for equipment rentals and apartment rentals, respectively.

> [I]t is against the unilateral economic interest of any individual rental company to share its [commercially sensitive information] with other rental companies through a common third party unless each Rental Company Defendant knew that all competitors had agreed to do the same.[12]

12 *Mack's Junk Removal, Inc. et al v. Rouse Services LLC et al*, No. 2:25-cv-03565, U.S. District Court – Central District of California, Class Action Complaint, April 22, 2025, ¶ 145.

> Operator Defendants all agreed to submit their confidential business information to Yardi RENTmaximizer with the knowledge that the system would use that data to calculate rents for their competitors. Such an agreement of mutual sharing and receiving competitors' information makes sense for Operator Defendants only if they are assured that their competitors will not use the information provided to gain competitive advantage …[13]

These arguments have three parts. First, a firm is sharing its confidential data with a third party. That is factually true. Second, in doing so, it is sharing that data with competitors. If the third party is only returning recommended prices to each subscribing firm then it is almost certainly not true. While those prices were influenced by the confidential data shared by its competitors - as that data was used to train the pricing algorithm - the complexity of the training process makes it unrealistic for a firm to learn about competitors' data from the algorithm's generated prices.[14] Third, a firm would only share its data if it anticipated competitors doing so. That is unlikely to be true. Regardless of whether competitors subscribe, it could be in a firm's interest to share its data with a third party because it would benefit from improved pricing. A third party's value is not just that it has more data but that it is more skilled at using data. A data analytics company can result in higher profit through improved pricing regardless of whether competitors are also providing its data and using its services. Elaborating on this point in the context of a hotel chain using data analytics company Rainmaker, one commentator states:

> [T]here seems to be a number of procompetitive reasons why a Hotel Operator might independently enter into a vertical agreement with Rainmaker for the use of its RMS [revenue management software] products. For one, the pricing algorithms in the Rainmaker RMS products can constantly monitor numerous variables related to demand, costs, and competitors' rates, and quickly suggest adjustments to a Hotel Operator's own room rates based on changes to these variables. These sophisticated pricing algorithms can provide a competitive advantage to Hotel Operators that have access to the Rainmaker products, which is a rational reason that a Hotel Operator would enter into a vertical agreement with Rainmaker even though none of its competitors also enter such agreements.[15]

While this benefit may be diminished if competitors are also utilizing the third party's services, there is no reason to believe it would disappear. The point is that mutual sharing of confidential data by competitors with a data analytics company is not a plus factor because it is consistent with firms independently making the decision to do so.

When evidence of communications between the hub and spokes is insufficiently direct and express, economic evidence could be useful to help prove a Section 1 violation. A recent analysis has identified properties of a third party's pricing algorithm which can be used as evidence of an agreement.[16] Using data on prices and the adoption rate (i.e. the fraction of competitors who use the third party's pricing algorithm), if there is an agreement then subscribing firms' prices are predicted to be increasing in the adoption rate. In contrast, if there is no agreement then subscribing firms' average prices are predicted not to change with the adoption rate. A second approach involves conducting an audit of the pricing algorithm.[17] If a higher adoption rate causes price to rise for a large share of demand states then the pricing algorithm is likely to have been designed as part of an unlawful agreement.

An audit study would require access to the third party's pricing algorithm and thus could only occur after having gone through discovery. However, as exemplified by studies of the effect of a third party's pricing algorithm in the markets for apartment rentals and gasolines,[18] an empirical analysis of the relationship between the adoption rate and average prices may be able to be performed based on publicly available data. In that case, it could be part of a plaintiffs' complaint.

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13 *McKenna Duffy et al v. Yardi Systems, Inc. et al*, No. 23-cv-01391, U.S. District Court for the Western District of Washington at Seattle, Class Action Complaint, September 8, 2023, ¶ 87.

14 "[U]sing data across all your customers for research does not plausibly suggest that one customer has access to the confidential information of another customer - it instead plausibly suggests that [third party] Cendyn uses data from various customers to improve its products." Gibson et al v. MGM Resorts, International et al, No. 2:23-cv-00140-MMD-DJA , U.S. District Court – District of Nevada, Order, May 8, 2024, p. 10.

15 Bradley C. Weber, "Hub-and-Spoke Conspiracies: Can Big Data and Pricing Algorithms Form the Rim?," *SMU Science and Technology Law Review*, 26 (2023), 25-84; p. 78.

16 Joseph E. Harrington, Jr., "An Economic Test for an Unlawful Agreement to Adopt a Third-Party's Pricing Algorithm," *Economic Policy - Special Issue on Artificial Intelligence and the Economy*, 40 (2025), 263-295.

17 An audit involves "repeatedly and systematically querying an algorithm with inputs and observing the corresponding outputs in order to draw inferences about its opaque inner workings." Danaë Metaxa, Joon Sung Park, Ronald E. Robertson, Karrie Karahalios, Christo Wilson, Jeff Hancock, and Christian Sandvig, "Auditing Algorithms," *Foundations and Trends in Human-Computer Interaction*, 14 (2021), 272-344; p. 288.

18 See footnotes 3 and 6.

The combination of competitors using a common agent to assist them in pricing, which supports their prices not being set independently, and evidence of higher prices when more firms are using that common agent, which supports anticompetitive effect, would seem to make the presence of an unlawful agreement plausible and thus could be enough to survive a motion to dismiss.

IV. CONCLUDING REMARKS

If a data analytics company is conspiring with subscribing firms to coordinate prices, their conduct falls squarely under Section 1 of the Sherman Act just like any other hub-and-spoke cartel. That the hub is supplying a pricing algorithm does, however, alter how we understand collusion and what types of evidence may be available to prove liability. As this article has explained, when the hub is a data analytics company, collusion is more effective and proving a violation is more difficult. That is not an encouraging combination for enforcers.

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