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# The Role of Secondary Algorithmic Tacit Collusion in Achieving Market Alignment

Maurice E. Stucke

Ariel Ezrachi

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# The Role of *Secondary Algorithmic Tacit Collusion* in Achieving Market Alignment

Ariel Ezrachi* and Maurice E. Stucke**

*The antitrust risks associated with the use of the same hub's pricing algorithm by many sellers are now well-accepted. But what if many rivals use several different hubs for dynamic pricing? The common assumption is that in such instances, competition among the pricing hubs would support competition among the sellers. However, in this paper we argue differently and introduce the concept of secondary algorithmic tacit collusion, which leads to anticompetitive effects, independent of the conditions on the primary market. This phenomenon may lead to the evils of price-fixing but on far a wider scale. Contrary to traditional tacit collusion, this aggregated form of collusion, through the use of algorithmic hub-and-spoke structures, can occur in markets with many competitors and with seemingly competitive dynamics. We outline how the combination of hub-and-spoke frameworks on the primary market and conscious parallelism on the secondary market for algorithmic pricing services can lead to secondary tacit collusion. Addressing its anticompetitive effects requires competition agencies to consider the interaction between price setters in the secondary markets, while taking note of the hub-and-spoke structures on the primary market.*

* Slaughter and May Professor of Competition Law, The University of Oxford. Director, Oxford University Centre for Competition Law and Policy.
** Douglas A. Blaze Distinguished Professor, University of Tennessee College of Law.

## Introduction

Going to college is different today. One reason is the choice of housing. Rather than dreading the on-campus lottery (where one might end up in some basement cinder-block dorm room at the fringe of the campus), many students today can choose among the burgeoning off-campus options. And at one time, these real estate developers wooed students (and their parents paying for the housing) with rental concessions or giveaways. Competition was fierce because after the semester started, it would be harder to fill the room. Few, if any, faculty or other potential renters would want to live in a building catering to college students. And college students would unlikely move mid-semester. Thus, in fear of empty rooms, some properties sought to woo early on students with "rental concessions (offering the first month free if the customers signed a one-year lease) and giveaways (gift cards, raffles, Apple products, free parking, or sometimes even cruise tickets)."[1]

But as one recent antitrust complaint filed in the U.S. alleged, things changed with the advancement of AI pricing algorithms. Many off-campus housing developers started using RealPage's algorithm to set their rental terms.[2] It seemed like the competitive thing to do. Many college housing developers were chasing the same student pool. So, RealPage offered the developers software that collected real-time pricing and supply levels, and then provided each developer with "forward-looking, unit-specific pricing and supply recommendations."[3] As the college housing developers saw their rivals using RealPage's pricing service, that increased the pressure for them to follow suit. As one industry executive stated, "because the industry is so competitive, 'we absolutely have to have a software and technology provider that allow us to be above and beyond the rest of the market and specific to students.'"[4]

The use of such software and common dataset, on the surface, may seem benign. After all, collusion (whether fostered by algorithms or humans) typically occurs in markets with few competitors and fungible products (think gypsum board or cement). It should not occur in markets with many rivals with differentiated products (just consider the apartment hunting in any major city, and the myriad factors considered, such as view, layout, amenities, parking, etc.). However, in the digital reality, where algorithmic hub-and-spoke frameworks are used

[1] Complaint ¶ 35, filed in Navarro v. RealPage, Inc., Case 2:22-cv-01552 (W.D. Wash. filed 11/02/22).
[2] Complaint, filed in Navarro v. RealPage, Inc., Case 2:22-cv-01552 (W.D. Wash. filed 11/02/22).
[3] Navarro Compl. ¶ 3.
[4] Navarro Compl. ¶ 4.

to service many sellers, alignment of business terms and upward pressure on price may result in markets that appear to be robustly competitive.

The U.S. antitrust litigation, as of mid-2023, against RealPage continues. Over twenty lawsuits alleged that "the lessor defendants all employed revenue management software provided by RealPage called AI Revenue Management (formerly known as YieldStar), which gathered real-time pricing and vacancy data from the lessors and made unit-specific pricing and vacancy recommendations—which the lessors allegedly agreed to adhere to, on the understanding that competing lessors would do the same—with the intent and effect of raising lease prices above competitive levels."[5]

Not surprisingly, the issue of algorithmic induced alignment affects more than college housing. RealPage has been sued for fostering collusion in residential apartments.[6] In Seattle, for example, the company's algorithm was allegedly used to price over 60% of multifamily properties. The property managers' reliance on one company for unit-specific rent recommendations seems to have resulted in higher rents (and profitability), despite a decrease in occupancy rate.[7] The joint reliance on one company's software appears to have made a once competitive market far less competitive.[8]

The outcome of the litigation is, as of mid-2023, unknown. What is clear is that these pricing algorithms are being increasingly adopted, and with an increasing range of offerings.[9] The ability to align many rivals' strategy and pricing decisions, through the use of a single algorithmic hub-and-spoke structure, is here to stay. As more competitors outsource their pricing decisions to the same software provider or dynamic pricing service, uncertainty on the market and competitive pressure will likely diminish. And while the companies may have joined the service without intending to collude, the anticompetitive outcome is hard to ignore.

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[5] In re RealPage, Inc., Rental Software Antitrust Litig., No. MDL 3071, 2023 WL 2875737, at *1 (U.S. Jud. Pan. Mult. Lit. Apr. 10, 2023). All of these plaintiffs alleged in their complaints that this conduct violated federal antitrust law, as well as various state antitrust and consumer protection statutes. All of these cases were transferred in 2023 to the Middle District of Tennessee for coordinated or consolidated pretrial proceedings.

[6] Navarro v. RealPage, Inc. et al.; Cherry et al. v. RealPage, Inc. et al.

[7] Gabriele Bortolotti, 'Algorithmic Collusion in the Housing Market' ProMarket (2023) https://www.promarket.org/2023/05/30/algorithmic-collusion-in-the-housing-market/#:~:text=RealPage%20marketed%20YieldStar%20as%20a,revenues%20by%203%2D4%25; The Verge; Bloomberg; The Real Deal (Real Estate Portal); Gizmodo; ProPublica.

[8] Heather Vogell, 'Rent Going Up? One Company's Algorithm Could Be Why' ProPublica https://www.propublica.org/article/yieldstar-rent-increase-realpage-rent

[9] Mark Lewis 'Market Guide for B2B Price Optimization and Management Software' (Gartner, 2022). Available online: https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/deloitte-analytics/deloitte-nl-amc-market-guide-for-b2b.pdf

The antitrust risks are apparent when many rivals, as in *RealPage*, all use the same hub. But are there any risks of tacit collusion when different rivals use the services of different AI pricing services (hubs)? For example, should antitrust enforcers and courts be concerned if a third of real estate developers use RealPage, while another third use *Rival A* to RealPage, and the balance use *Rival B*? Indeed, in many markets, this may be the more likely scenario. Nonetheless, this issue has not yet been explored.

This paper examines the potential anticompetitive effects that can emerge in seemingly competitive markets when sellers outsource pricing decisions to multiple independent hubs. The conventional wisdom would suggest no need to worry: The competing pricing hubs would promote competition on the primary market as they try to improve the position of their clients. But as we explain, the combination of algorithmic hub-and-spoke on the primary market and tacit collusion on the secondary market can lead to anticompetitive results in the primary market – *even though* both markets look robustly competitive (for example, if hundreds of property managers outsourced pricing to several different dynamic pricing services). We explain how this aggregation could dampen competition even in markets characterized by many sellers that use a range of independent third-party services to determine their price or strategy. We refer to this phenomenon as "Secondary Algorithmic Tacit Collusion."

Why is this important? Because without understanding this risk, the competition agencies and courts may assume that the presence of multiple hubs would undermine possible market wide alignment and refrain from intervention. To a similar extent, they may underestimate the potential harmful effects that flow from mergers between competing hubs (such as when the U.S. Department of Justice did not challenge RealPage's acquisition of rival Lease Rent Options). Moreover, because the traditional antitrust tools (besides merger review) are generally insufficient to deter STC, new tools are required. Otherwise, as more companies outsource their pricing to hubs, expect more STC and higher than competitive prices.

The paper is organized as follows: Part I reviews the two building blocks that enable secondary algorithmic tacit collusion. Part II then explores the aggregated effect in markets that are seemingly competitive and serviced by several hub-and-spoke frameworks. We explain how secondary algorithmic tacit collusion may emerge among the competing hubs (i.e., those providing price optimization software), and how that collusion may occur even when the primary market is not susceptible to tacit collusion. Finally, Part III addresses the enforcement implications.

## I. ALGORITHMIC ALIGNMENT

Before delving into *secondary algorithmic tacit collusion*, let us briefly consider its components, that is the conditions for tacit algorithmic collusion and hub-and-spoke.

### A. TACIT ALGORITHMIC COLLUSION

As we explored extensively, pricing algorithms can help foster collusion.[10] One way is when rivals agree to collude and use pricing algorithms to perfect their conspiracy. That is an easier case to prosecute – whether in the U.S. or E.U.

The tougher case is when there is no agreement among rivals. Each competitor decides to employ pricing algorithms, which unilaterally learn that it is more profitable to raise prices than compete. Although there is no agreement among rivals to use similar algorithms or increase prices, the rivals know that the industry-wide use of pricing algorithms will help foster tacit collusion. Important, for our purposes, is the fact that tacit collusion is legal under the U.S. and E.U. antitrust laws. As the U.S. Supreme Court noted,

> *[T]acit collusion, sometimes called oligopolistic price coordination or conscious parallelism, describes the process, not in itself unlawful, by which firms in a concentrated market might in effect share monopoly power, setting their prices at a profit-maximizing, supracompetitive level by recognizing their shared economic interests and their interdependence with respect to price and output decisions and subsequently unilaterally set their prices above the competitive level.*[11]

As we discussed, this legal form of collusion is likely in concentrated markets with homogenous products, where the transparency of the key market terms enables pricing algorithms to monitor competitors' pricing and other keys terms of sale, detect and react to changes on the market in a way that reflects and facilitates a common understanding. In markets susceptible to such "conscious parallelism," prices could increase above competitive levels without any agreement (or even direct communications) among rivals.

The phenomenon of tacit collusion, of course, can happen without algorithms. Just consider the high price for gasoline on the summer resort Martha's Vineyard, which the court found was attributable to tacit collusion.[12] This market had all the conditions: a homogeneous

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[10] ARIEL EZRACHI & MAURICE E. STUCKE, VIRTUAL COMPETITION: THE PROMISE AND PERILS OF THE ALGORITHM-DRIVEN ECONOMY (2016); Ariel Ezrachi & Maurice E. Stucke, *Sustainable and unchallenged algorithmic tacit collusion*, 17 NW. J. TECH. & INTELL. PROP. 217 (2020); Ariel Ezrachi & Maurice E. Stucke, *Artificial Intelligence & Collusion: When Computers Inhibit Competition*, 2017 U. ILL. L. REV. 1775, 1782-84 (2017); Ariel Ezrachi & Maurice E. Stucke, *Emerging Antitrust Threats and Enforcement Actions in the Online World*, 13 COMPETITION L. INT'L 125, 129 (2017).

[11] Brooke Group Ltd. v. Brown & Williamson Tobacco Corp., 509 U.S. 209 (1993).

[12] White v. R.M. Packer Co., 635 F.3d 571 (1st Cir. 2011).

product, a highly concentrated market, transparent prices, swift competitive responses, aligned incentives, and little alternatives for consumers (who would have to reserve and pay for a ferry to get gas on the mainland).[13]

But the use of algorithms can enhance and stabilize the conscious parallelism. So, when the gas stations start to use pricing algorithms to optimize their price decisions, alignment of price may increase, while the possibility of getting a gas discount significantly decreases. Rather than each gas station owner driving around the island to check rivals' pricing, the pricing algorithm, using the data from a gas app, can quickly detect any rival cheating (by offering lower prices), and punish that cheater, by lowering its price. When interdependence between sellers' actions is established, and they learn that none of them can profit from price reductions, their behavior changes: they start raising prices above competitive levels.

Pricing algorithms do more than facilitate conscious parallelism in markets already susceptible to this type of alignment. Rather, they can expand the market conditions in which tacit collusion may be possible. The stability of algorithmic decision-making and the swift reaction to deviations from the tacit agreement have the potential to expand tacit collusion to markets with additional sellers. For example, if the number of independent gas stations increased on Martha's Vineyard, tacit collusion would still be possible if they all used pricing algorithms designed and trained to maximize profits.

As a result, in concentrated markets, algorithmic tacit collusion may form a business strategy, rather than merely reflect a market outcome. And still, to the extent that the practice does not involve signaling, communications, or collusion, it is regarded as a rational reaction to market characteristics. Without evidence of an agreement, it is difficult, if not impossible, to challenge algorithmic tacit collusion under U.S. and E.U. antitrust laws.[14] This is true, even if the wide-spread use of algorithms leads to higher prices.[15]

Earlier doubts about the feasibility of sustaining algorithmic tacit collusion have been addressed extensively in the economic literature and policy papers. It has been shown that --

[13] See DOJ & FTC Draft Merger Guidelines § 3 (2023), https://www.justice.gov/d9/2023-07/2023-draft-merger-guidelines_0.pdf.
[14] OECD 'Algorithms and Collusion: Competition Policy in the Digital Age' (2017) https://www.oecd.org/competition/algorithmscollusion-competition-policy-in-the-digital-age.htm; OECD 'Algorithmic Competition' (2023) www.oecd.org/daf/competition/algorithmic-competition-2023.pdf.
[15] *Id*.

- relatively simple algorithms can raise prices above competitive levels without entering into illegal collusion,
- more advanced reinforced learning algorithms can independently learn to play collusive strategies (and do so in relatively complex environments),[16]
- algorithms can effectively optimize market interactions in a manner that leads to upward pressure on price,[17]
- wide-scale adoption of algorithmic pricing software could have a significant upward effect on profitability,[18]
- such strategy may prevail even under imperfect conditions and limited monitoring,[19] and
- algorithms could be used unilaterally to decode the operation of competing pricing algorithms and manipulate them to increase price.[20]

The bottom line – subject to prevailing market conditions – when many rivals switch to algorithmic pricing, tacit collusion may occur in markets previously not susceptible to it. Algorithms can also foster a level of stability unachievable by humans.

No doubt, concerns about the phenomenon increased with the improvement in computing power, ability to better monitor market activities, and improvement in the collection, sifting, cleaning, and generation of market data. Still, recall that the practice does not affect every market and is conditioned on certain market and product characteristics. In markets characterized by heterogeneous products, complex sale terms, secret deals, or many competitors, algorithmic tacit collusion is unlikely to be sustained.

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[16] Emilio Calvano, Giacomo Calzolari, Vincenzo Denicolò, and Sergio Pastorello 'Artificial Intelligence, Algorithmic Pricing, and Collusion' American Economic Review 2020, 110(10): 3267–3297; Asker and others, "The Impact of AI Design on Pricing" (2023) Journal of Economics & Management Strategy; Michael Schlechtinger, Damaris Kosack, Heiko Paulheim, Thomas Fetzer, Franz Krause, 'The Price of Algorithmic Pricing: Investigating Collusion in a Market Simulation with AI Agents' AAMAS 2023, May 29–June 2, 2023; Lerer, A. & Peysakhovich, A. Maintaining cooperation in complex social dilemmas using deep reinforcement learning. http://arxiv.org/abs/1707.01068 (2017); John Asker, Chaim Fershtman, Ariel Pakes 'The impact of artificial intelligence design on pricing' (15 February 2023) Journal of Economics and Management Strategy 12516; Jeanine Miklós-Thal, Catherine Tucker 'Collusion by Algorithm: Does Better Demand Prediction Facilitate Coordination Between Sellers?' (2019) Management Science 65/4.

[17] Competition in Pricing Algorithms, Zach Y. Brown Alexander MacKay Working Paper 20-067 https://www.hbs.edu/ris/Publication%20Files/20-067_71a112ae-f461-45da-8157-42763d61c015.pdf

[18] Assad, Stephanie; Clark, Robert; Ershov, Daniel; Xu, Lei (2020) : Algorithmic Pricing and Competition: Empirical Evidence from the German Retail Gasoline Market, CESifo Working Paper, No. 8521, Center for Economic Studies and Ifo Institute (CESifo), Munich

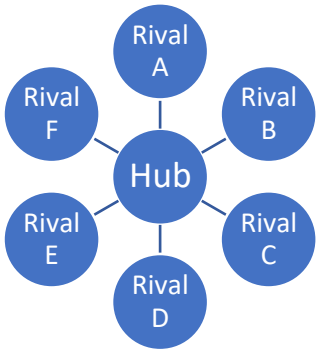
[19] Emilio Calvano, Giacomo Calzolari, Vincenzo Denicoló and Sergio Pastorello, 'Algorithmic collusion with imperfect monitoring' International Journal of Industrial Organization, 2021, vol. 79, issue C

[20] Luc Rocher, Arnaud J. Tournier, & Yves-Alexandre de Montjoye, 'Adversarial competition and collusion in algorithmic markets' Nature Machine Intelligence, Volume 5,May 2023, 497–504 497

## B. ALGORITHMIC HUB-AND-SPOKE

At its simplest manifestation, algorithmic hub-and-spoke emerges when competitors all use the same algorithm or software to determine their pricing strategy. This may be an intentional strategy (such as when drivers and riders rely on the dominant ride sharing app to determine the fare) or incidental strategy (such as when competitors migrate to the same pricing algorithm provider). Either way, as Figure I reflects, it results in a single hub's pricing algorithm now affecting several rivals' pricing strategies.[21]

***Figure 1***




The use of the same algorithm would result in increased alignment when the service provider also relies on the same data pool and data points to determine the price recommendations to each seller. In such instances, the rivals (spokes) not only use the same algorithm (provided by the hub), but also rely on the same input of data to determine their pricing strategies.

Further alignment among the rivals will emerge when the hub recommends and implements business strategies and sets business terms. In such instances, the hub-and-spoke frameworks may affect more than price and lead to worsening business terms, commissions, or discounts, degrading quality, or marginalizing some groups of customers (which the algorithm predicts is of low value). Alignment would become complete when the hub optimizes the joint interests of all the spokes (rather than each rival individually), thus treating them as a collective. In such instance, rather than determining how much incremental profits Rival A could get through discounting (and stealing share from rivals), the algorithm would calculate the increase in profits if all the rivals raised their prices.

Hub-and-spoke frameworks need not be sophisticated and could be implemented through relatively simple means. In the *Eturas* case, for example, the Court of Justice of the

[21] N 1 above; OECD 'Roundtable on Hub-and-Spoke Arrangements – Background Note by the Secretariat' (December 2019) https://one.oecd.org/document/DAF/COMP(2019)14/en/pdf

European Union reviewed a coordination scheme facilitated by an administrator of the online travel booking system. The administrator posted a newly implemented technical restriction that affected discount rates offered by travel agents using the system.[22]

Another case of simple implementation involves real estate agents and MLS listings. The Spanish National Markets and Competition Commission (CNMC) investigated a hub-and-spoke framework where the MLS and customer relationship management software "were designed in a such a way that a property could only be shared in the MLS if the member shared the information on the fee (when uploading the property) and the actual fee was above the established minimum of 4%." If real estate agents sought to gain a competitive advantage by discounting their fee, the software prevented the agents from uploading their properties onto the MLS pool and "the system would send a pop-up warning specifying the reason (the fact that the broker was not respecting the minimum fee)."[23] So, the software, in helping to monitor and punish any discounting, reduced the real estate agents' incentives and ability to compete and set commissions independently. Besides the two real estate franchisers, which had launched the system and drafted and enforced the rules, the Spanish competition authority also fined "several IT companies, which were running the MLS and which had adapted the CRM software in order to make sure that properties were uploaded only when complying with the rules."

More sophisticated hub-and-spoke services may include the setting of dynamic prices in reaction to live market data. In such instances, the hub will engage in data collection and advanced analysis, aimed at optimizing pricing strategies for each rival seller. For example, the Danish company a2i Systems offered pricing services to the majority of gas stations in Rotterdam.[24] The company's algorithm sets and adjusts the prices of gas sold by competing gas stations. At the time, on its website, the company provided a case study to illustrate how its pricing technology changed the market's pricing dynamics – transforming a market characterized by "fierce competition and high volatility" and reduced the likelihood of price wars.[25] The use of a single decision-making algorithm softened competition on the market and

[22] Case C-74/14, [2016] 4 CMLR 19.
[23] OECD 'Algorithmic competition – Note by Spain' (14 June 2023) https://one.oecd.org/document/DAF/COMP/WD(2023)16/en/pdf
[24] Sam Schechner, Why Do Gas Station Prices Constantly Change? Blame the Algorithm, WALL ST. J. (May 8, 2017), https://www.wsj.com/articles/why-do-gas-station-prices-constantly-changeblame-the-algorithm-1494A262674 [https://perma.cc/UR8H-KX8E]; Samantha Oller 'Artificial Intelligence Could Bring a Byte to Fuel Pricing' CSP MAGAZINE CSPDaily.
[25] PriceCast Fuel Case Story, cited in Ariel Ezrachi and Maurice E Stucke 'Algorithmic Collusion: Problems and Counter-Measures' (OECD) DAF/COMP/WD(2017)25, page 15

resulted in across the board upward pressure on price. Nonetheless, it did not trigger antitrust intervention.[26]

At present, besides the RealPage cases discussed in the introduction, only a few other hub-and-spoke arrangements are drawing antitrust scrutiny. One ongoing case in the U.S. concerns alleged overcharge by leading hotels on the Las Vegas Strip, which was facilitated through an algorithmic hub-and-spoke framework.[27] According to the lawsuit, a third-party revenue management service was used by an estimated 90% of Vegas Strip hotels.[28] The single point management that oversaw the collective pricing decisions of the competitors, allegedly enabled hotel to boost room prices despite lower occupancy, thus maximizing overall profitability.

Note that the harmful effect generated by the hub, is directly related to its market power. Hub frameworks that can behave independently of competitors and consumers could more easily set higher prices. By contrast, in a competitive setting, they cannot ignore the pressures from other operators and hubs. To some extent, this explains why not many are concerned about Uber's hub-and-spoke network. Some are.[29] But the belief is that Uber faces competition from other hubs, such as Lyft, and from other service providers. Thus, the common belief is that we should not be concerned about hub-and-spokes when multiple hubs offer competing pricing services.

### C. Difference Between Hub-and-Spoke and Tacit Algorithmic Collusion

So how does the hub-and-spoke scenario differ from tacit algorithmic collusion? After all, does it matter if the rivals use their own pricing algorithm or a hub's algorithm, if the

[26] To that extent also note Uber and other ride sharing services that use a centralised pricing system that could be seen to facilitate coordination, yet so far have not been subjected to significant scrutiny. Note an earlier case in the US in which the issue was explored: *Meyer v. Kalanick*, No. 1:2015cv09796 - Document 37 (S.D.N.Y. 2016)
[27] JOE SCHNEIDER AND MICHAEL LEONARD 'Vegas visitors sue the Strip's biggest hotels, alleging price collusion' BLOOMBERG (JAN. 26, 2023)
[28] Hagens Berman: Las Vegas Hotel Operators Sued for Allege d Scheme to Illegally Inflate Hotel Room Rates to Record Highs (January 25, 2023) Business Wire https://www.businesswire.com/news/home/20230125005898/en/Hagens-Berman-Las-Vegas-Hotel-Operators-Sued-for-Alleged-Scheme-to-Illegally-Inflate-Hotel-Room-Rates-to-Record-Highs ; CBS News 'Vegas hotel giants MGM, Caesars, Wynn and Treasure Island sued for "algorithmic-driven price-fixing"' (27 January 2023) https://www.cbsnews.com/news/vegas-strip-resorts-price-fixing-lawsuit-mgm-caesars-wynn-treasure-island/
[29] See, e.g., The Yellow Cab Co. v. Uber Techs., Inc., No. CIV. RDB-14-2764, 2015 WL 4987653, at *5 (D. Md. Aug. 19, 2015) (plaintiffs alleging "that Uber, with the participation of its drivers, including the Driver Defendants, conspired to set a minimum price threshold below which the drivers may not charge," which "facilitated Defendants' attempted monopolization of the transportation service industry in Baltimore and Montgomery County;" the district court remanded the complaint back to state court).

pricing algorithms can eventually learn that it is more profitable to raise prices rather than discount?

In a simple setting when the hub merely supplies the algorithms to the spokes, the resulting alignment may indeed be similar to the tacit algorithmic collusion scenario (where each competitor independently gravitates toward using similar algorithms or use different reinforcement learning algorithms that converge to charging higher prices). Advancements in technology and convergence of learning algorithms toward a common policy could increase stability and widen the number of competitors who could achieve alignment through tacit collusion, similar to that offered by a hub. That anticompetitive outcome, however, depends on the market conditions being conducive to such conscious parallelism, as elaborated in Part 1.A. above.

But once we change the base conditions, the difference between the two becomes apparent. To begin with, as noted above, the hub-and-spoke framework could foster alignment even if all the conditions outlined in Part 1.A are not present. Thus, alignment induced through hub-and-spoke framework can occur with heterogeneous products in moderately concentrated markets where prices are not perfectly transparent.

The differences between the two further increases when services offered by the hub move beyond the mere supply of software. For example, when in addition to software, the hub offers data harvesting and analysis and uses the same (or similar) data input in setting the price for each rival. In such instances one would expect a closer alignment in the recommended prices for each rival. Further alignment is likely when the hub also offers comprehensive strategy services and rivals rely upon it for the full management of pricing, strategy, and integrated services.

When the hub engages in optimization of the collective position of all of the spokes, rather than independently optimizing the position of each competitor (albeit using the same datapoints and software), alignment further increases.

To illustrate the impact a centralized framework may have on alignment, let us look briefly at enforcement against cartel activities. Consider one empirical analysis of successfully prosecuted cartels between 1910 and 1972. The study showed that cartels on average had many participants. But where a trade association facilitated collusion, 33.6 firms was the mean of firms involved, and fourteen firms was the median, which was much higher than price-fixing cartels without a trade association involved (where 8.3 firms was the mean and six was

the median).[30] One possible explanation for this disparity is the role of the trade association as a joint hub in facilitating collusion.

Like a trade association, the hub-and-spoke framework can help facilitate alignment in an otherwise complex market, where the sellers, even if they had all adopted AI pricing technology, could not tacitly collude. This would likely be the case when --

- ✓ the market includes many sellers,
- ✓ the market lacks transparency on pricing and key terms of sale,
- ✓ where the algorithms cannot readily respond to price moves by sellers (who may be at different levels of adoption of algorithmic pricing),
- ✓ the products or services are heterogeneous or command complex pricing.

Once a leading hub establishes itself, a feedback loop can emerge that enables increased profitability. For instance, as more landlords use RealPage, the company acquires even more data for its price optimization software, customers increasingly rely on the algorithm for pricing (or why else pay for the services) and the hub's pricing algorithm incrementally affects more of the downstream rental market. As its pricing accounts for a larger part of the downstream market, its pricing can increasingly behave independently of the remaining competitors. Its success and data reach attract more clients, making it harder for another AI pricing optimization company to enter and compete (without such market data); and it would become harder for landlords to forego the increase in profits from the higher rents suggested by the algorithm. So, one can envision many rivals coalescing around one AI revenue management provider. Here the rivals in this hub-and-spoke framework may benefit as the hub's market power increases and its pricing strategy impacts the de facto market price.

## **II.** SECONDARY ALGORITHMIC TACIT COLLUSION

Let us now turn to "secondary algorithmic tacit collusion" (STC) to illustrate how it may overcome some of the limitations presented by algorithmic tacit collusion and hub-and-spoke.

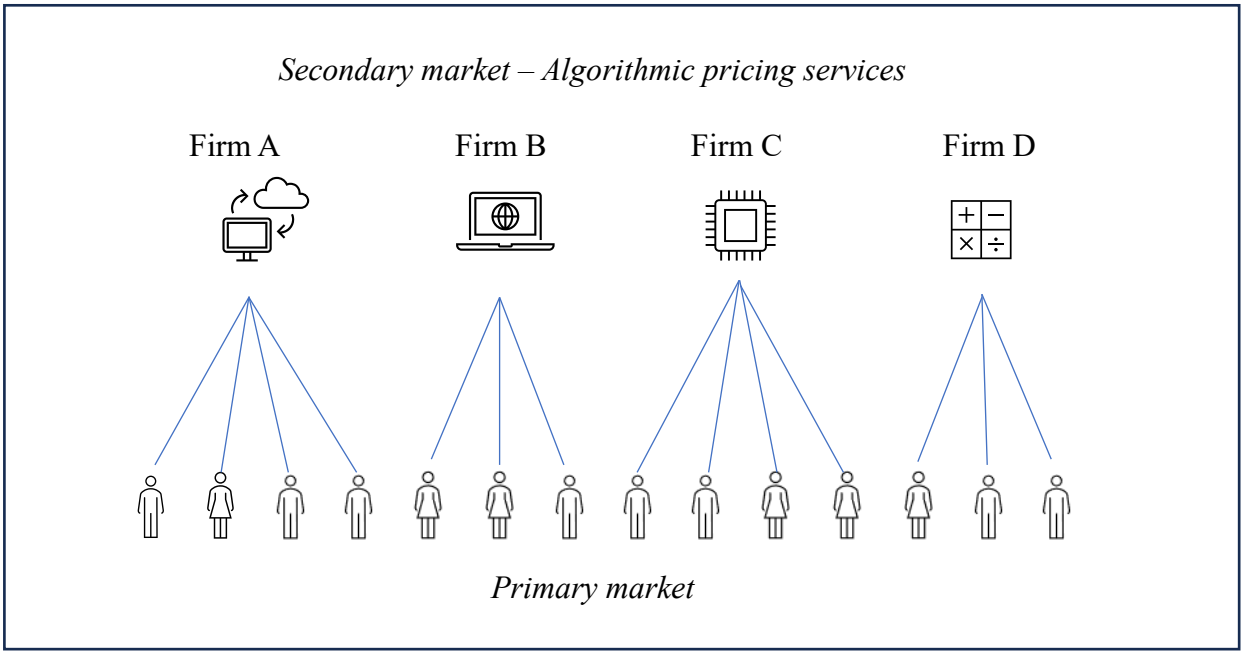
Imagine a market in which sellers on the primary market are serviced by several different hubs. On the one hand, the alignment that each hub may foster among its spokes is

[30] Arthur G. Frass & Douglas F. Greer, Market Structure & Price Collusion: An Empirical Analysis, 26 J. INDUS. ECON. 21, 25, 36–41 (1977).

detached from the requisite conditions for tacit collusion. Limited transparency, large number of sellers, inability to detect and react to other's pricing decisions are all irrelevant when the decision making is outsourced to the hub-and-spoke framework. On the other hand, the presence of multiple hubs, in theory, should sustain competition. As we noted above, absent market power, competition on the market is expected to prevail since the competing hubs are assumed to be price takers.

Yet, as we explain below, the secondary market in which the algorithmic service providers operate, is where STC kicks in. What makes STC unique is that it takes place on the secondary market for pricing services rather than on the primary market for products and services. As a result, STC is detached from the limitations imposed by the primary market characteristics.

***Figure 2***




Suppose Firms A, B, C, and D provide price and strategy optimization services for sellers who operate on a primary market. Both levels appear seemingly competitive. Let us assume that the primary market comprises of many sellers, heterogeneous offering and limited transparency, so as saw in Part I.C, even if the sellers all use similar pricing algorithms on this market, tacit algorithmic collusion is unlikely.

The secondary market comprises of four competing providers of algorithmic pricing and strategy services. Each of them operates independently and services a portion of the primary market.

Ideally, one would expect competition in the secondary market, whereby Firms A, B, C, and D's pricing algorithms undercut each other in order for their customers to gain additional sales. Firm A would not recommend to its clients higher prices for their products, when doing so risks their losing sales to rival sellers, who are using Firms B's, C's or D's pricing algorithms. Indeed, if Firm A suggests higher prices, or unaffordable sale terms, the rival algorithms will likely use the opportunity to increase sales and capture market share by offering more competitive prices and terms. Undercutting Firm A would benefit their clients (with higher profits) and the hubs themselves (as garnering greater profits for their clients might attract other sellers to use its pricing algorithm). As a result, Firms A, B, C and D's price optimization algorithms will compete against each other, and both the primary and secondary markets will remain competitive.

But when the secondary market satisfies the conditions for tacit algorithmic collusion (such as transparency of the prices that the rival algorithms recommend to its clients and the speed to respond to any discounts that the rival sellers' offer, based on the rival hub's suggestion), we may witness the emergence of conscious parallelism. Basically, under these conditions, the hubs' algorithms learn to collude, by suggesting higher prices to their clients, in the recognition that suggesting lower prices will erode the clients' profits and willingness to use the hub's services.

While each hub does not have full data over market conditions, it has far more data than any downstream seller would individually have. In addition, in observing downstream pricing in real-time, knowing for which sellers it sets, and for which sellers its rivals set the prices, the algorithms can learn to tacitly collude. Thus, the fate of the competitiveness of the primary market rests on the conditions of competition in the secondary market where the hubs operate. If the conditions for tacit collusion are present, each pricing hub could effectively learn its competitor's strategy by observing its decision-making and react accordingly.

What makes secondary tacit collusion distinctive is that it may be achievable irrespective of the conditions on the primary market, and likely due to the conditions on the secondary market. To put it differently, it can deliver outcomes that cannot be attained on the primary market, even if all sellers were using the same algorithms, or utilizing different learning algorithms that could assimilate.

### A. STC AMONG GASOLINE STATIONS

Returning to our example, suppose Firms A, B, C, and D supply pricing decisions to over 100,000 gas stations across the New England and Mid-Atlantic states. Let us suppose each hub services 25,000 gas stations scattered throughout these states. While tacit collusion is likely in Martha's Vineyard and other concentrated geographic markets, it is unlikely in cities and suburbs with many independent gas stations. These markets are not concentrated. Moreover, the gas station owners, on their own, might have divergent incentives. Smaller independent stations might be bent on stealing share from larger chains. So even if the gas stations in Boston, New York City, Philadelphia, and other major cities adopted pricing algorithms, tacit collusion will be difficult to sustain. Also contributing to the instability of tacit collusion will be the range of algorithms used by the different gas stations, the different proficiency in their deployment, and the use of different data input and data points. But now suppose all of these gas stations ceded pricing to one of four hubs, the risk of STC increases. The hub can help align the rival owners' incentives and increase their profits. Moreover, the hub has a broader view of the market (as it now has data for 25,000 gas stations), and it knows that the pricing decision of the remaining gas stations are controlled by three rival hubs. The rival hubs, in learning to tacitly collude, also have a broader geography to signal and retaliate. If one hub cheats, the other three hubs can target and undercut that discounting hub's client stations, while charging higher prices in other local gas markets.[31] So, an otherwise complex and unstable market of 100,000 sellers can be simplified by four sophisticated players who

[31] For example, in the Airline Tariff Publishing case, the United States alleged that the defendant airlines used their computerized fare dissemination services to freely negotiate among themselves supracompetitive fares in multiple markets. No one questioned that the defendants' computerized fare dissemination system had a pro-competitive purpose in supplying travel agents with basic information about the airline fares for specific routes. But the antitrust risks arose when the defendant airlines also used this system as a forum to exchange information that was of limited or no use to consumers but was important to the other airlines in communicating and agreeing upon supracompetitive fares. The Antitrust Division asserted that the defendant airlines essentially signalled their concurrence or disagreement to entreaties to raise fares and/or eliminate discounted fares through the First and Last Ticket Dates. Essentially, the defendant airlines communicated among themselves relatively costless proposals to change fares through these footnote designators with First and Last Ticket Dates. They employed sophisticated computer programs to process all this fare information, which enabled them to monitor and analyze their competitors' responses to current and future fares on certain routes. These negotiations at times would link fare changes among different routes, and continue for several weeks until all the airlines had indicated their commitment to the fare increases by filing the same fares in the same markets with the same First Ticket Date. Likewise, the airlines used the Last Ticket Dates in connection with the footnote designators to communicate proposals to eliminate discounted fares currently being offered to consumers. Not only did this computerized fare dissemination system enable the defendants to negotiate supracompetitive fares, it importantly enabled them to verify that such fares would stick, and signal retaliatory measures against any airline that did not go along targeting discounting rivals with specific fares for specific routes. United States v. Airline Tariff Publ'g Co., 836 F. Supp. 9, 12 (D.D.C. 1993). United States v. Airline Tariff Publ'g Co., Civ. Action No. 92-2854 (SSH) (D.D.C. 1992), Competitive Impact Statement, filed Dec. 21, 1992 & Competitive Impact Statement, filed March 17, 1994.

specialize in pricing strategies and use similar data points. With STC the alignment of strategies could emerge naturally as the hubs learn about each other strategies.

Awareness as to the strategy deployed by each hub could also be facilitated by communications between the hubs and their respective clients. Marketing of pricing services to the primary market, unilateral signaling via the press, and the use of technology, can all be harnessed to facilitate industry awareness at the secondary market. In similar vein, statements from price optimization software vendors as to their ability to "reduce the likelihood of price wars and to sustain above competitive prices" serve a dual purpose of marketing and signaling.[32]

We see some of this marketing currently in the gas sector. For example, a2i markets promotes how its PriceCast Fuel algorithm "can improve volumes and margins and ultimately generate more profit, even in the most volatile market conditions."[33] Its rival Kalibrate similarly helps gas station clients "[c]alibrate pricing strategies and tactics to meet volume and margin targets and market demands."[34] It notes how a "more efficient software system allows fuel pricing teams to price entire networks from central locations, and use their experience and expertise in the areas that can have the most impact — to drive profitability increases."[35] PriceAdvantage's tagline is "Faster Pricing, Better Profits."[36] Now imagine when a handful of these operators offer services to many sellers in a territory. To deliver on their promise for greater profitability, these hubs need to foster an increase in price. Their dominant strategy is public and rational. Tacit collusion, for them, is a strategy, and they will deploy means to ensure it is sustained. And as long as they achieve it without illicit agreement or communications, it may escape antitrust scrutiny.

Consider one economic study of the German gas station markets. When gas stations operating in Germany adopted algorithmic-pricing software, their margins increased by 9% on average over pre-adoption levels.[37] As the algorithms learned to tacitly collude, margins gradually increased on average by nearly 30% and "the entire distribution of margins shifts to the right."[38] The study did not focus on which stations relied on which particular pricing hubs.

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[32] n 24 above
[33] https://www.a2isystems.com/fuel-pricing-software/.
[34] https://www.businesswire.com/news/home/20131025005087/en/KSS-Fuels-to-Change-Name-to-Kalibrate-Technologies
[35] https://kalibrate.com/solutions/price/fuel-pricing-management/
[36] https://www.priceadvantage.com/fuel-pricing-software/why-priceadvantage/.
[37] Assad, Stephanie; Clark, Robert; Ershov, Daniel; Xu, Lei (2020): Algorithmic Pricing and Competition: Empirical Evidence from the German Retail Gasoline Market, CESifo Working Paper, No. 8521, Center for Economic Studies and Ifo Institute (CESifo), Munich
[38] *Id.*

But the gas stations did not rely on a single hub. Instead, there were multiple hubs, including a2i and Kalibrate that had contracts with German brands Orlen and Tamoil/HEM.[39] Other rivals included PDI[40] and PriceAdvantage.[41] The characteristics of the market in this case may have led to a similar outcome regardless of whether the AI adoption was facilitated through one or several software providers.

Since STC takes place on the secondary market, it is somewhat detached from the product characteristics on the primary market. Accordingly, STC will not be limited to primary markets with homogeneous products, such as gasoline. If the conditions for STC are present on the secondary market, it could be sustain irrespective of many of the conditions in the primary market. Returning to our example of apartments, in many markets served by RealPage the primary market was characterized by heterogeneous offering of apartment listings. Now would it matter if RealPage faced several rivals. Arguably, with STC, the same strategies that enable RealPage to overcome the heterogeneity through the hub-and-spoke structure and increased profitability for its clientele, would apply even when other competitors operate on the secondary market. Each of the competitors will overcome the heterogeneity of its clientele to ensure overall profitability, and all hubs would find it rational to avoid price wars or align on business terms and commission levels that favor their clients.

In the end, in a market controlled by several pricing algorithms each of which is seeking to boost profits for its clients, the algorithms will learn that raising (rather than depressing) price will yield greater profits. The result? Through their optimization strategy on that secondary market, they will dampen competition on the primary market.

As is the case with any scenario involving tacit collusion, STC is, of course, not immune from disruption. Many markets may have peculiarities that would prevent STC, such as a significant time lag in the upstream hub detecting the price offered by sellers using rival hubs or where key terms of dale (including discounts) are hidden. In addition, a maverick with a different pricing strategy and sufficient market power and capacity to service the market, could destabilize the STC.

However, to the extent that STC is the most profitable outcome, one would expect the other hubs' pricing algorithms to react in line with the dynamics of tacit collusion. In doing so, they may eliminate the advantage for the maverick, who may (in a repeated game) learn

[39] Moreover, fuel retailers in over 40 countries use Kalibrate's Fuel Pricing to "maximize fuel profits." - https://kalibrate.com/products/software/kalibrate-pricing/
[40] https://pditechnologies.com/convenience-retail/increase-profits/#
[41] https://www.priceadvantage.com/fuel-pricing-software/why-priceadvantage/

that its strategy is unprofitable. A sophisticated maverick will learn that it cannot profitably deviate from the STC. Afterall, the prevailing policy advanced by the STC is sustained exactly because of its profitability. In a transparent secondary market populated by a handful of sophisticated pricing experts, STC has a high chance to prevail.

## III. LEGAL IMPLICATIONS

Secondary algorithmic tacit collusion presents an interesting antitrust enforcement challenge. While the outcome of STC may well be anticompetitive, each of its components may seem benign.

To begin with, the conscious parallelism at the secondary market often reflects a rational reaction to market characteristics. As such, to the extent that it is not facilitated by signaling or express collusion, it ordinarily will not violate the U.S. or E.U. antitrust laws (one exception is discussed below). As for the hub-and-spoke frameworks, absent market power these too would likely escape scrutiny. The prevailing assumption is that if the hub faces multiple rivals, it will unlikely be able to affect the market dynamics. Indeed, the outsourcing of pricing services has become a common feature in many markets. And yet, despite each component of STC rarely triggering antitrust liability, STC achieves the same outcome as if the rival hubs and sellers colluded with one another.

While it is difficult to challenge STC under Section 1 of the Sherman Act and Article 101 of TFEU, antitrust law in both jurisdictions offers a few narrow avenues to deter STC.

### A. THE USE OF ALGORITHMS AS A FACILITATING PRACTICE AMONG THE HUBS

In the secondary market, STC is made possible through conscious parallelism between the hubs. The phenomenon, on its own, is not challengeable under Section 1 of the Sherman Act or its equivalent European provision – Article 101 TFEU. Afterall, it reflects a rational reaction to market characteristics. However, when the conscious parallelism was enabled through facilitating elements that amount to direct signaling or communications between the hubs, a court might infer an agreement under Section 1 of the Sherman Act or concerted practice under Article 101 TFEU.

Of particular interest is the handling of seemingly unilateral public statements directed from each hub to its prospective clients. These are often made as part of marketing efforts and as indicated above, may include promises to increase prices and margins or eliminate price wars. As the Italian competition authority observed, “a number of specialized software developers offer solutions that allow even small companies to implement ‘strategic’ dynamic

pricing strategies, offering tools to 'auto-detect pricing wars' as well as to 'help drive prices back up across all competition.'"[42]

Such statements may well act as a signaling mechanism between the hubs, to facilitate industry awareness as to the desired common strategy. Enforcement action against such statements that treats them as part of concerted practice between the hubs, could help increase uncertainty as to the desired common strategy, and destabilize the alignment. Against these claims, hubs will likely argue that statements merely form a unilateral action that the hubs did not agreed among themselves to tamper with prices, and that any alignment forms a rational reaction to market characteristics. Thus, signaling, by itself, may not suffice for antitrust liability.[43]

### B. JOINING THE HUB-AND-SPOKE FRAMEWORK TO ACHIEVE ALIGNMENT BETWEEN THE SPOKES.

A different approach to tackle STC focuses on the sellers in the primary market joining the services of the hub. Recall that our focus is not on a typical hub-and-spoke conspiracy that supports a cartel activity. Rather, in the case of pricing services we are confronted with businesses that use third party providers to enable them to benefit from better technology and analysis. In our earlier writing, we referred to this as an "incidental hub and spoke" to reflect the way it emerges. One difficulty we noted is identifying the point in which one objects to when sellers use the same hub. Is such objection warranted when the second seller joins the hub, the third, tenth, hundred? Does the objection depend on market characteristics? The scale of analytical services?

Despite these challenges, one could consider applying Section 5 of the FTC Act to these circumstances. Under this statute, the Federal Trade Commission can bring claims without evidence of any agreement, only a showing of an "unfair practice" or "unfair method of competition." To date, the FTC has been unsuccessful in bringing these "facilitating practices" claims, as is evident in *Boise Cascade*[44] and *Ethyl*.[45] If the court adopts the standard

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[42] Note from Italy, Algorithms and Collusion, OECD Doc. DAF/COMP/WD(2017)18, at 3 (2 June 2017), https://one. oecd.org/document/DAF/COMP/WD(2017)18/en/pdf [https://perma.cc/66GU-ZUKV]; Also see past promotions by Boomerang, stating that its price optimization software can "put an end to price wars before they even begin." Abhijeet Sathe, How Retailers and Brands Can Avoid the Race to the Bottom in Online Pricing, INTERNET RETAILER (July 9, 2018), https://www.digitalcommerce360.com/2018/07/09/how-retailers- and-brands-can-avoid-the-race-to-the-bottom-in-online-pricing/ [https://perma.cc/3YDF-EZXY]

[43] See, e.g., Holiday Wholesale Grocery Co. v. Philip Morris Inc., 231 F. Supp. 2d 1253, 1277 (N.D. Ga. 2002) ("setting aside whether the companies understood how to 'signal' one another," the court noted "that it is difficult for such allegations to support an inference of conspiracy"), aff'd sub nom. Williamson Oil Co. v. Philip Morris USA, 346 F.3d 1287 (11th Cir. 2003).

[44] 637 F.2d 573 (9th Cir. 1980).

[45] 729 F.2d 128 (2d Cir. 1984).

in *Ethyl*, the FTC would need to show either (1) evidence that defendants tacitly or expressly agreed to use pricing algorithms to avoid competition, or (2) oppressiveness, such as (a) evidence of defendants' anticompetitive intent or purpose or (b) the absence of an independent legitimate business reason for the defendants' conduct.[46]

Accordingly, sellers in the primary market may be liable if, when outsourcing their pricing to the hubs' algorithms or in seeing the effects, they were (1) motivated to achieve an anticompetitive outcome, or (2) aware of their actions' natural and probable anticompetitive consequences.[47] Of course, since we are dealing with an incidental hub-and-spoke, proving motivation and awareness may be challenging, especially when the sellers will likely argue that its hub-and-spoke framework, by itself, lacks sufficient market power. Indeed, the seller might legitimately claim that when it used the services of a hub it was unaware of the hubs' tacitly colluding. Moreover, the presence of several hubs on the secondary market may be used to counter claims that the sellers agreed among themselves to fix price or could anticipate the alignment among the hubs operating on the secondary market.

But, at other times, the sellers' and hubs' intentions may be anticompetitive. So, the FTC can analogize this scenario to minimum resale price maintenance ("RPM"), whereby a manufacturer agrees with retailers to fix the minimum price of its products. For decades, RPM was per se illegal under the Sherman Act. That changed in 2007, when the Supreme Court subjected RPM to the laxer rule of reason standard.[48] Putting aside the merits of that choice, the Court did recognize that RPM could be anti-competitive at times. One such case is when manufacturers use RPM to facilitate their express collusion. RPM, for example, could assist a cartel in identifying any manufacturer that cheats from the cartel price. By observing retail prices, the manufacturers can identify when a competitor has begun to cut wholesale prices. (A producer who cuts wholesale prices without lowering the minimum resale price will stand to gain little, if anything, in increased profits, because the dealer will be unable to stimulate increased consumer demand by passing along the producer's price cut to consumers.) But RPM could also facilitate tacit collusion. In concentrated industries, manufacturers may use RPM to observe each other's pricing behavior, each understanding that price cutting by one firm is likely to trigger price competition by all. Like STC, an antitrust defendant could

[46] Id. at 128 & 139.
[47] FTC, Policy Statement Regarding the Scope of Unfair Methods of Competition Under Section 5 of the Federal Trade Commission Act, Commission File No. P221202 (Nov. 10, 2022), https://www.ftc.gov/system/files/ftc_gov/pdf/p221202sec5enforcementpolicystatement_002.pdf (discussing facilitating practices).
[48] Leegin Creative Leather Prod., Inc. v. PSKS, Inc., 551 U.S. 877, 899 (2007).

compartmentalize RPM by showing that neither the manufacturer nor any individual retailer has market power. Nonetheless, the Court recognized that RPM, in helping facilitate tacit collusion, would be illegal.

This approach would be suitable to the operation of a hub that actively fosters alignment between the spokes. One can identify a threshold of services offered by the hub, above which "incidental hub and spoke" would be treated as a collusive agreement and be subjected to the Sherman Act and the TFEU. Such approach could be suitable when the hub engages in optimization of the collective position of all spokes, rather than independent optimization for each one of its clients. Liability for the hub could then be established when it is shown to have intended to facilitate the alignment among the spokes.[49] Liability for the spokes may be established, when they were aware that joining the hub serves to promote common pricing strategies on the market.[50] Their adherence could be seen as part of a horizontal conspiracy manifested through vertical links.[51]

Absent joint optimization, or other facilitating practices, it may be more challenging to identify a point from which enforcement is merited. Would the use of the same algorithm and data points justify intervention? With evolving technology and analytical capabilities, the limiting principles that will govern intervention in such case are likely to be difficult to ascertain. Uncertainty as to the point in which intervention may be triggered risks chilling valuable innovation on the market. Difficulties ascertaining the nature of services provided by each hub, further compound the problem.

One possibility to address these challenges is to design an auditing algorithm that could engage in ongoing monitoring of the analytical means and services offered by hubs.[52] But the principal question remains: at what level of analysis should one intervene? Is intervention merited when alignment emerged organically through the use of similar data points and advance analytics? Would intervention be justifiable when the hub occupies a small portion of the market, just because of the risk of STC?

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[49] Case T-99/04 AC-Treuhand AG v Commission (AC-Treuhand I) General Court, [2008] ECR II-1501; Case C-194/14 AC-Treuhand AG v Commission (AC-Treuhand II) Court of Justice, [2015] CMLR 26

[50] Case C-74/14 Eturas and others, Court of Justice of the European Union, [2016] 4 CMLR 19

[51] Interstate Circuit v. United States, 306 US 208, 227 (1939); Toys" R" Us, Inc. v. FTC, 221 F. 3d 928, 936 (7th Cir. 2000).

[52] OECD Background Note 'Algorithmic Competition' (2023) available online: https://www.oecd.org/daf/competition/algorithmic-competition-2023.pdf; On techniques to investigate harms, also see: CMA 'Algorithms: How they can reduce competition and harm consumers (19 January 2021), available online: https://www.gov.uk/government/publications/algorithms-how-they-can-reduce-competition-and-harm-consumers/algorithms-how-they-can-reduce-competition-and-harm-consumers

## C. MERGER CONTROL

While ex-post intervention would not easily capture STC (absent anticompetitive intent, additional signaling and communications, or conspiracy), the phenomenon could be more effectively addressed ex-ante through merger control.[53]

As part of the appraisal of merger transactions between hubs, the competition agency could inquire whether the market, post transaction, could more easily tilt into STC. Merger control could be used to block or modify transactions that would create or enhance tacit collusion between operators.

To date, however, agencies have not taken STC into account in their merger review. In fact, they have been relatively permissive even when confronted with possible increase in market power that could foster a change in market dynamics. A 2022 *ProPublica* article examined how RealPage has sold rent pricing software to property managers, thereby boosting the landlords' profits.[54] As the article notes, "RealPage became the nation's dominant provider of such rent-setting software after federal regulators approved a controversial merger in 2017 with Lease Rent Options, a ProPublica investigation found, greatly expanding the company's influence over apartment prices. The move helped the Texas-based company push the client base for its array of real estate tech services past 31,700 customers."[55] The agencies typically do not disclose why they closed their merger investigations. But under traditional merger review the agency would have likely considered the merger's impact on the buyers of the AI pricing software, namely the property managers. Would prices for the software increase? The agencies would not likely consider the merger's impact on tenants.

In a step forward, the U.S. agencies in their recent draft merger guidelines, consider the risks of tacit algorithmic collusion.[56] The antitrust agencies should also assess whether the merger may facilitate STC and thereby harm customers of the primary market. In secondary markets where pricing and algorithms services are widespread, the agency should prevent

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[53] On the possible use of merger review to limit algorithmic coordination, see: Michal S. Gal and Daniel L. Rubinfeld 'Algorithms, AI and Mergers' Antitrust Law Journal (forthcoming)

[54] Heather Vogell, *Rent Going Up? One Company's Algorithm Could Be Why*, PROPUBLICA (Oct. 15, 2022), https://www.propublica.org/article/yieldstar-rent-increase-realpage-rent.

[55] *Id*.

[56] https://www.justice.gov/atr/d9/2023-draft-merger-guidelines (noting that "use of algorithms or artificial intelligence to track or predict competitor prices or actions likewise increases the transparency of the market" making it more susceptible to collusion and that a market "is more susceptible to coordination if a firm's prospective competitive reward from attracting customers away from its rivals will be significantly diminished by likely responses of those rivals," which is more likely "the stronger and faster the responses from its rivals;" such a risk is greater when "suppliers use algorithmic pricing").

further concentration if this could facilitate STC, unless the parties can demonstrate with compelling evidence that the merger would be pro-competitive. Furthermore, agencies should take note of a history of STC, which would indicate that this kind of market "has not always been protected by competitive market forces."[57]

In assessing whether the secondary market is susceptible to algorithmic tacit collusion, the agency should consider the following factors:

- ✓ Whether many competitors in the primary market outsource their pricing to a third-party vendor.
- ✓ Whether the pricing algorithms can monitor at present (or could evolve to do so in the future), to a sufficient degree, the pricing and other key terms of sale of pricing in the primary market, and any deviations from the current equilibrium.
- ✓ The level of analytical and data services offered by the operators.
- ✓ Whether conscious parallelism would also be facilitated and stabilized to the extent (i) the rival algorithms' pricing reactions are predictable, or (ii) through repeated interactions, the pricing algorithms "could come to 'decode' each other, thus allowing each one to better anticipate the other's reaction."[58]
- ✓ Whether once deviation (e.g., discounting) is detected, a credible deterrent mechanism exists. Unique to an algorithmic environment is the speed of retaliation. Computers can rapidly detect deviations and calculate the profit implications of a myriad of moves and countermoves to punish deviations. The speed of calculated responses effectively deprives discounting rivals of any significant sales. The speed also means that the tacit collusion can be signaled in seconds. The greater the improbability that the first mover will benefit from its discounting, the greater the likelihood of either STC or tacit algorithmic collusion. Thus, if each algorithm can swiftly match a rival algorithm's discount incentive to discount in the first place, the threat of future retaliation keeps the coordination sustainable.
- ✓ Whether the pricing algorithms will likely improve, post-merger, as the algorithms will have more data and more opportunities to experiment with prices and refine their pricing strategies for each client, and

[57] In the Matter of Chicago Bridge & Iron Company N.V., 2003 WL 27387332, at *9 (quoting In the Matter of the Coca-Cola Co., 117 F.T.C. 795, 960 (1994)).
[58] Note from the European Union, *Algorithms and Collusion*, OECD Doc. DAF/COMP/WD(2017)12, at 8 (June 14, 2017).

- ✓ Whether the algorithms, programmed to increase the profits of the vendors' clients, will likely tamper with market prices (basically the digital hand displacing the market's invisible hand).
- ✓ Whether disruptor or maverick operators operate on the secondary market, and how the transaction may affect their incentives and interdependence.

Accordingly, when providers of price optimization services indicate their desire to merge, agencies should not solely assess the potential increase in prices to the companies using the vendors' services on the primary market (for example, the apartment building owners), but also the risk of tacit collusion in the secondary market, which in turn would result in upward pressure on price for the ultimate consumers of the primary market (the apartment tenants).

## CONCLUSION

Antitrust enforcers cannot simply accept secondary algorithmic tacit collusion as a natural market outcome. It may be no more natural than earlier facilitating practices – such as basing-point pricing.[59] Although their current antitrust tools are limited, they should be employed, especially when the hub-and-spoke framework is "contaminated" by illicit actions, anticompetitive intent, or collective efforts to facilitate tacit collusion.

But other tools will need to be created. While regulation may offer valuable ex-ante framework in some instances,[60] it does not resolve the principal problem of identifying a clear threshold for intervention in the case of STC. Thus, rather than regulate algorithms directly, an alternative is devising countermeasures that destabilize or prevent the tacit collusion.

Otherwise, don't expect market forces to fix the problem of secondary algorithmic tacit collusion. For the hubs, it is rational to avoid price wars – a strategy that will prevail at both human and algorithmic levels. Being experts in their field, the pricing hubs understand the cost of price wars to their clients (and their own business), and the benefits in avoiding them. Now AI can enable them to advance this strategy with limited exposure to antitrust sanctions.

[59] Fed. Trade Comm'n v. Cement Inst., 333 U.S. 683, 697 (1948).
[60] In Europe, for example, the competition provisions have been supplemented by two regulatory frameworks with significant reach and scope – the Digital markets Act and the Digital Services Act; Regulation (EU) 2022/1925 of the European Parliament and of the Council of 14 September 2022 on contestable and fair markets in the digital sector and amending Directives (EU) 2019/1937 and (EU) 2020/1828 (Digital Markets Act) (Text with EEA relevance)

For the sellers on the primary market, advanced algorithmic pricing and real time data are attractive. They too prefer greater profits over “ruinous” competition. While they may be unaware of the STC in the secondary market, they welcome the choice of hubs, each of whom supports their goal for increased profitability.

While good for the hubs and sellers, we will pay the price – whether at the gas pump, looking for an apartment, or booking a hotel. As the hubs’ AI learn, expect a greater sophistication of price optimization software, its increased adoption in many more markets, and more instances of STC. And expect to pay slightly more, even in markets that are seemingly competitive with many sellers ostensibly chasing for your business.