The Role of Secondary Algorithmic Tacit Collusion in Achieving Market Alignment

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ABSTRACT

Antitrust enforcers now recognize the risks associated with many sellers' use of a singular hub's pricing algorithm. 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. This Article, however, argues differently and instead introduces the concept of secondary algorithmic tacit collusion, which leads to anticompetitive effects independent of primary market conditions. This phenomenon may lead to the evils of price fixing but on a far wider scale. Contrary to traditional tacit collusion, this aggregated form of collusion—via algorithmic hub-and-spoke structures—can occur in markets with many competitors and with seemingly competitive dynamics. This Article outlines 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, and what the agencies and courts can do to prevent this harm.

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I. INTRODUCTION

Many students at large research universities have far more off-campus housing options than earlier graduates who dreaded the on-campus lottery where one might find themselves assigned to some basement cinder-block dorm room at the fringe of the campus.[1] Real estate developers and property managers who oversee these off-campus units woo students and parents alike with "rental concessions (offering the first month free if the customers signed a one-year lease) or giveaways (gift cards, raffles, Apple products, free parking, or sometimes even cruise tickets)."[2] Competition is fierce because after the semester starts, it becomes harder to fill the rooms.[3]

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1. *See* Maggie Eastland, *Commercial Real Estate Finds a Rare Bright Spot by Campuses*, WALL ST. J. (July 4, 2023), https://www.wsj.com/articles/commercial-real-estate-finds-a-rare-bright-spot-by-campuses-ed90cbe1 [https://perma.cc/7NSC-Y3JL].

2. Complaint ¶ 35, filed in Navarro v. RealPage, Inc., Case 2:22-cv-01552 (W.D. Wash. filed 11/02/22). at 12; Julia Bunch, *A Breakdown of Student Housing Giveaways*, REALPAGE (June 7, 2021), https://www.realpage.com/analytics/breakdown-student-housing-giveaways/ [perma.cc/V5YD-C73X].

3. *Id.* at 12, 13.

But as one recent antitrust complaint, *Navarro v. RealPage, Inc.*, filed in the US District Court for the Western District of Washington alleged, the off-campus, private housing market shifted with the advancement of artificial intelligence (AI) pricing algorithms.[4] Many off-campus housing developers have begun using RealPage's algorithm to set their rental terms.[5] Since many college housing developers chase the same student pool, RealPage offers the developers software that collects real-time pricing and supply levels.[6] RealPage then provides each developer with "forward-looking, unit-specific pricing and supply recommendations."[7] As the college housing developers saw their rivals using RealPage's pricing service, pressure increased for them to follow suit.[8] As one industry executive stated, "we absolutely have to have a software and technology provider that allow[s] us to be above and beyond the rest of the market and specific to students."[9]

And here lies the crux of the matter. The use of such software may seem benign or even procompetitive, but instead, it yields anticompetitive results. In this case, these anticompetitive effects of higher prices are made possible through an algorithmic hub-and-spoke structure when competitors use the same algorithm or software to determine their pricing strategy.[10] The hub (the software provider) collects nonpublic commercially sensitive market information from each spoke (the building owners or property managers) for its algorithm to calculate the optimal pricing strategy to maximize profits.[11] So, the students might think there is plenty of competition, and the student housing lessors are not colluding in the traditional sense (for example, by secretly meeting to agree on pricing). But the result is the same—namely, higher prices—anywhere from 2 to 7 percent higher than competitive markets.[12]

Economic theory suggests that collusion (whether fostered by algorithms or humans) typically occurs in markets with few competitors and fungible commodities (like gasoline).[13] It should not occur in

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4.   *Id.* at 18.

5.   *Id.* at 1–2.

6.   *Id.* at 2.

7.   *Id.*

8.   *Id.*

9.   *Id.*

10.   *Id.* at 13–14.

11.   *Id.* at 14–15.

12.   *Id.* at 5.

13.   *See In re* RealPage, Inc., No. 3:23-MD-03071, 2023 WL 9004806, at *15 (M.D. Tenn. Dec. 28, 2023) (characteristics that make a market susceptible to collusion include that the market "(i) is highly concentrated; (ii) has high barriers to entry for would-be competitors; (iii) has high switching costs for renters; (iv) has inelastic demand; and (v) offers a fungible product"); *see*

markets with many rivals and differentiated products, like the housing market.[14] However, even in markets with many rivals and differentiated products and services, the use of algorithmic hub-and-spoke frameworks may lead to anticompetitive outcomes, namely higher prices and reduced rivalry.

Unsurprisingly, the issue of algorithmic collusion affects more than just college housing. In 2023, RealPage faced lawsuits for fostering collusion in residential apartments in at least forty-five geographic markets throughout the United States.[15] In Seattle, for example, the company allegedly used its algorithm to price over 60 percent of multifamily properties.[16] The property managers' reliance on one company for unit-specific rent recommendations appears to have resulted in higher rents and profitability despite a decrease in occupancy rate.[17] The joint reliance on one company's software appears

generally OECD, Roundtable on Hub-and-Spoke Arrangements: Background Note by the Secretariat (Nov. 25, 2019), https://one.oecd.org/document/DAF/COMP(2019)14/en/pdf [https://perma.cc/CM94-GTDT].

14.   *See In re RealPage Inc.*, 2023 WL 9004806, at *15. The apartment hunt in any major city involves consideration of myriad factors, including view, layout, amenities, and parking. Ruth Tam & Andee Tagle, *Looking for a New Apartment? Here's a Checklist to Help With the Housing Hunt*, NPR (Aug. 31, 2021, 12:03 AM), https://www.npr.org/2021/08/24/1030659258/looking-for-a-new-apartment-heres-a-checklist-to-help-with-the-housing-hunt [perma.cc/5GX8-GWM6]; *What Is the View That My Apartment Will Have?*, HAUZD, https://hauzd.com/blog/what-is-the-view-that-my-apartment-will-have/ [perma.cc/JF5Z-A8T8] (last visited Feb. 23, 2024).

15.   *In re RealPage, Inc.*, 2023 WL 9004806, at *26 n.18 (alleging harm in the following Metropolitan Statistical Areas: Nashville, Tennessee; Atlanta, Georgia; Austin, Texas; Baltimore, Maryland; Boston, Massachusetts; Charlotte, North Carolina; Chicago, Illinois; Dallas, Texas; Denver, Colorado; Detroit, Michigan; Houston, Texas; Jacksonville, Florida; Las Vegas, Nevada; Los Angeles, California; Memphis, Tennessee; Miami, Florida; Milwaukee, Wisconsin; Minneapolis, Minnesota; New York, New York; Orlando, Florida; Philadelphia, Pennsylvania; Phoenix, Arizona; Pittsburgh, Pennsylvania; Portland, Oregon; San Diego, California; San Francisco, California; San Jose, California; Seattle, Washington; St. Louis, Missouri; Tampa, Florida; Tucson, Arizona; Washington, D.C.; Wilmington, North Carolina; Birmingham-Hoover, Alabama; Buffalo, New York; Cincinnati, Ohio; Cleveland, Ohio; Columbus, Ohio; Hartford, Connecticut; Riverside, California; Sacramento, California; Salt Lake City, Utah; San Antonio, Texas; San Juan, Puerto Rico; and Virginia Beach, Virginia).

16.   Heather Vogell, Haru Coryne & Ryan Little, *Rent Going Up? One Company's Algorithm Could Be Why*, PROPUBLICA (Oct. 15, 2022, 5:00 AM), https://www.propublica.org/article/yieldstar-rent-increase-realpage-rent [perma.cc/7BKC-FH8S].

17.   Gabriele Bortolotti, *Algorithmic Collusion in the Housing Market*, PROMARKET, (May 30, 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 [perma.cc/P7UG-5585]; Emma Roth, *The DOJ is Reportedly Investigating Rent-Setting Software Company RealPage,* THE VERGE (Nov. 26, 2022, 11:58 AM), https://www.theverge.com/2022/11/26/23479034/doj-investigating-rent-setting-software-company-realpage [perma.cc/CPQ9-DHHW]; Lean Nylen, *Warren Urges DOJ Review of Thoma Bravo Rental Software Unit,* BLOOMBERG (Mar. 3, 2023, 9:42 AM), https://www.bloomberg.com/news/articles/2023-03-03/warren-urges-doj-review-of-thoma-bravo-rental-software-unit [https://perma.cc/48HS-K7LJ]; Maddy Sperling, *RealPage Could Face Real Trouble with Antitrust Suits,*

to have made a once competitive market far less competitive.[18] Over twenty lawsuits have alleged:

> 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.[19]

All these plaintiffs alleged in their complaints that this conduct violated federal antitrust law, as well as various state antitrust and consumer protection statutes.[20]

Add to the mix a separate lawsuit in the District of Columbia (D.C.) Attorney General filed in Washington, D.C. against RealPage and multi-family apartment building owners.[21] Other states, and perhaps the United States, might also file lawsuits against RealPage.[22] Thus, as this Article discusses later, multiple lawsuits will emerge alleging similar anticompetitive conduct, but which courts may evaluate under different legal standards (antitrust's rule of reason versus per se illegal standard) with potentially different outcomes.[23]

What is also clear is that apartment complexes and property developers are increasingly adopting these pricing algorithms, and for a growing range of offerings.[24] The ability to align many rivals' strategies and pricing decisions using a single algorithmic hub-and-spoke structure appears 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

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THEREALDEAL (Nov. 22, 2022, 11:02 AM), https://therealdeal.com/texas/2022/11/22/realpage-could-face-real-trouble-with-antitrust-suits/ [perma.cc/32WX-5GYX**]**; Lucas Ropek, *Is an Algorithm Raising Your Rent? A New Class Action Lawsuit Says Yes*, GIZMODO (Oct. 21, 2022), https://gizmodo.com/realpage-yieldstar-high-rent-housing-class-action-suit-1849683731 [perma.cc/VK25-A4LA]; Vogell et al., *supra* note 16.

18.   *See* Vogell et al., *supra* note 16.

19.   *In re* RealPage, Inc., Rental Software Antitrust Litig., 2023 WL 2875737, at *1 (J.P.M.L. Apr. 10, 2023).

20.   *Id.*

21.   *Attorney General Schwalb Sues RealPage & Residential Landlords for Rental Price-Fixing, Illegally Raising Thousands of District Residents' Rents*, OFFICE OF THE ATT'Y GEN. FOR D.C. (Nov. 1, 2023), https://oag.dc.gov/release/attorney-general-schwalb-sues-realpage-residential [perma.cc/48CN-HCM9].

22.   *See* Kenadee Mangus, *NY Rep Accuses Landlord App RealPage of 'Price-Fixing Scheme'*, NOWTHIS NEWS (Dec. 4, 2023, 4:09 PM), https://nowthisnews.com/news/ny-rep-accuses-landlord-app-realpage-of-price-fixing-scheme [https://perma.cc/LK9N-EWVW].

23.   *See* discussion *infra* Section IV.A.

24.   Mark Lewis, *Market Guide for B2B Price Optimization and Management Software*, DELOITTE (Jan. 25, 2022), https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/deloitte-analytics/deloitte-nl-amc-market-guide-for-b2b.pdf [perma.cc/53GC-8BHH].

diminish. Moreover, while the companies may have joined the service without intending to collude, the anticompetitive outcome is hard to ignore.

Now consider an even more complex scenario from an antitrust law perspective. Instead of the rivals relying on one hub to dictate prices and business terms, several competing pricing hubs offer their services. One might hope that competitive dynamics between the rival hubs would prevail. Yet, this is not necessarily the case.

This Article examines the potential anticompetitive effects that can emerge in seemingly competitive markets when sellers outsource pricing decisions to multiple independent hubs. Conventional wisdom suggests that competition on both levels of the market should yield a competitive outcome. On the secondary market, where the pricing hubs operate, each hub should be competing for more clients. On the primary market, the clients would be seeking to earn more business through better pricing, services, quality, and innovations. So, with several pricing hubs competing on the secondary market, and many businesses who use these pricing hubs competing in the primary market, one would expect lower prices, better quality and services, and greater innovation. But, as this Article explains, the combination of algorithmic hub and spoke on the primary market and tacit collusion (also known as conscious parallelism) on the secondary market (the market where the pricing hubs operate) can lead to anticompetitive results in the primary market, even though both markets look robustly competitive.

This Article refers to this phenomenon as "secondary algorithmic tacit collusion" (STC). In what follows, this Article shows how this aggregation can dampen competition even in markets characterized by many sellers who use a range of independent third-party services to determine their price or strategy.

The practical implications of STC are that price alignment can persist even when different rivals use different artificial intelligence pricing services (hubs). Returning to the real estate example, multifamily apartments do not all rely on RealPage's algorithm.[25] Instead, RealPage's leading competitor is Yardi.[26] According to one 2023 antitrust complaint, Yardi sets prices for at least twice the number of multifamily units as RealPage and fostered a price-fixing conspiracy among its customers.[27] And yet, despite the perceived competition

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    25.   Complaint at 18, Duffy v. Yardi Sys., Inc., Civ. Act. No. 2:23-cv-01391 (W.D. Wash. Sept. 8, 2023).

    26.   *Id.* It was unclear what is RealPage's market share, relative to Yardi, but as the court noted, "Discovery will reveal RealPage's true market power in each of its alleged markets." *In re* RealPage, Inc., 2023 WL 9004806, at *28 (M.D. Tenn. Dec. 28, 2023).

    27.   Complaint at 18, 36, *Duffy*, Civ. Act. No. 2:23-cv-01391.

between independent service providers such as RealPage and Yardi, price alignment may prevail when the conditions for tacit collusion are present on the secondary market.[28]

Why does this matter? As advanced algorithmic pricing providers service more markets, STC will likely become a key dynamic capable of dampening competition. Without understanding this risk, antitrust enforcers, like the Department of Justice (DOJ) and Federal Trade Commission (FTC), and courts may assume that alignment of price and strategy is unlikely, if not impossible, when multiple hubs compete for the business of many sellers in the primary market. Moreover, STC will be even harder to prosecute under current antitrust law than the claims brought against Yardi and RealPage.[29] If the hubs are tacitly colluding (without ever agreeing), then it is legal under the Sherman Act (as well as European antitrust law).[30] The primary way to prevent such tacit collusion is through merger review. But here the antitrust agencies and courts may likely underestimate the potential harmful effects of STC, including its increased risk when rival pricing hubs merge.[31] Consequently, enforcement under the Sherman and Clayton Acts, as courts currently construe them, will be generally insufficient to deter STC.[32] The antitrust laws must be updated for the AI-driven digital economy. Otherwise, as more companies outsource their pricing to hubs, consumers can expect more STC and higher prices.

This Article proceeds by examining the phenomenon of STC and proposing avenues by which to combat its ill effects. Part II of this Article reviews the two building blocks that enable secondary algorithmic tacit collusion. Part III explores the aggregated effect in markets that are seemingly competitive and serviced by several hub-and-spoke frameworks. It explains 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,

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28.   *See* U.S. DEP'T OF JUST. & FED. TRADE COMM'N: MERGER GUIDELINES 9 (Dec. 18, 2023), https://www.justice.gov/d9/2023-12/2023%20Merger%20Guidelines.pdf   [perma.cc/A2FV-F78J] [hereinafter MERGER GUIDELINES].

29.   *See* discussion *infra* Section IV.A.

30.   *See* discussion *infra* Section IV.A.

31.   *See, e.g.*, Vogell et al., *supra* note 16 (when the US Department of Justice did not challenge RealPage's acquisition of rival Lease Rent Options).

32.   ARIEL EZRACHI & MAURICE E. STUCKE, HOW BIG-TECH BARONS SMASH INNOVATION—AND HOW TO STRIKE BACK 143–51 (2022). On the limitations of traditional antitrust tools, *see id.*

Part IV addresses the legal challenges in prosecuting STC directly but offers several avenues for antitrust enforcers to deter it.

II. ALGORITHMIC ALIGNMENT

Before delving into secondary algorithmic tacit collusion, this Part first considers its two components—the conditions for tacit algorithmic collusion and hub and spoke—and how they differ.

A. Tacit Algorithmic Collusion

Pricing algorithms can help foster collusion under several scenarios.[33] One scenario is when rivals agree to collude and use pricing algorithms to perfect their conspiracy. That is an easier case to prosecute, whether in the United States[34] or abroad.[35]

A tougher scenario is when there is no agreement among rivals, yet they achieve market alignment through tacit collusion. Each competitor decides to employ pricing algorithms that unilaterally learn that it is more profitable to raise prices than to compete. Although no agreement exists among rivals to use similar algorithms or increase prices, the rivals know that the industry-wide use of pricing algorithms could help foster alignment through tacit collusion. Such tacit collusion is legal under US antitrust laws, as well as under the competition laws of other jurisdictions.[36] The US Supreme Court noted:

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33. *See* ARIEL EZRACHI & MAURICE E. STUCKE, VIRTUAL COMPETITION: THE PROMISE AND PERILS OF THE ALGORITHM-DRIVEN ECONOMY 36–37 (2016); Ariel Ezrachi & Maurice E. Stucke, *Sustainable and Unchallenged Algorithmic Tacit Collusion*, 17 NW. J. TECH. & INTELL. PROP. 217, 221 (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).

34. *See* Plea Agreement at 1, 4, United States v. Topkins, No. CR 15-00201 (N.D. Cal. 2015) (pleading guilty to agreeing with his co-conspirators to fix the prices of certain posters sold in the United States through Amazon Marketplace, where the conspirators used specific pricing algorithms to implement their illegal oral agreement).

35. *See Online Sales of Posters and Frames*, GOV.UK (Dec. 4, 2015), https://www.gov.uk/cma-cases/online-sales-of-discretionary-consumer-products [perma.cc/7DYH-LCQ7]. The UK antitrust authority, for example, found in 2016 that Trod Ltd. and GB eye Ltd. infringed competition law by agreeing that they would not, in certain specified circumstances, undercut each other's prices for posters and frames sold on Amazon's UK website, and using pricing algorithms to facilitate their illegal agreement. An illegal cartel between humans was facilitated using algorithms. *Id.*

36. Bell Atl. Corp. v. Twombly, 550 U.S. 544, 553–54 (2007); Brooke Grp. Ltd. v. Brown & Williamson Tobacco Corp., 509 U.S. 209, 227 (1993); OECD, Algorithmic Competition: OECD Competition Policy Roundtable Background Note 37 (2023), www.oecd.org/daf/competition/algo-rithmic-competition-2023.pdf [perma.cc/UD76-7RNT] [hereinafter OECD Background Note];

> [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].[37]

As the Court noted, this legal form of collusion is likely in concentrated markets with homogenous products.[38] The US Court of Appeals for the Ninth Circuit observed:

> [E]ach firm in an interdependent market expects that a widely unfollowed price increase will be rescinded. But so long as prices can be easily readjusted without persistent negative consequences, one firm can risk being the first to raise prices, confident that if its price is followed, all firms will benefit. By that process ("follow the leader"), supracompetitive prices and other anticompetitive practices, once initiated, can spread through a market without any prior agreement.[39]

In these concentrated markets, transparency of the key market terms enables each rival to monitor its competitors' pricing and other key terms of sale as well as detect and react to changes in the market.[40] In markets susceptible to such "conscious parallelism," prices can increase above competitive levels without any agreement, or even direct communications, among rivals.[41]

The phenomenon of tacit collusion, of course, can happen without algorithms. For instance, in *White v. R.M. Packer Co.*, the US Court of Appeals for the First Circuit attributed the high price of gasoline in Martha's Vineyard to tacit collusion.[42] This market had all the requisite conditions for tacit collusion: a homogeneous product (gasoline), a highly concentrated market, transparent prices, swift competitive responses, aligned incentives, and few alternatives for consumers, who would have needed to reserve and pay for a ferry to get gas on the mainland.[43]

Ezrachi & Stucke, *Artificial Intelligence & Collusion: When Computers Inhibit Competition*, *supra* note 33, at 1790.

37.   *Brooke Group Ltd.*, 509 U.S. at 227.

38.   MERGER GUIDELINES, *supra* note 28. On the necessary economic and market conditions, *see* OECD: Algorithms and Collusion - Background Note by the Secretariat 17 (June 9, 2017), https://one.oecd.org/document/DAF/COMP(2017)4/en/pdf [https://perma.cc/GVK8-NGYK] [hereinafter OECD Secretariat].

39.   *In re* Musical Instruments & Equip. Antitrust Litig., 798 F.3d 1186, 1195 (9th Cir. 2015).

40.   MERGER GUIDELINES, *supra* note 28.

41.   White v. R.M. Packer Co., 635 F.3d 571, 581 (1st Cir. 2011); *see* MERGER GUIDELINES, *supra* note 28, at 8.

42.   *White*, 635 F.3d at 581.

43.   *Id.* at 578–79; *see* MERGER GUIDELINES, *supra* note 28.

The use of algorithms can enhance and stabilize conscious parallelism because the pricing algorithm can respond in milliseconds to rivals' behavior, thus preventing any rival from benefitting from discounting.[44] In *White*, each gas station owner likely had an employee drive around the island periodically to check their rivals' prices.[45] Depending on how often this employee checked prices, and how quickly the other gas stations responded to any discounts or price hikes, it is conceivable that a gas station might benefit (at least temporarily) from discounting. If the gas stations used pricing algorithms to optimize their price decisions, and the prices were quickly updated on a gas price app, like GasBuddy,[46] the pricing algorithm could instantaneously detect any lower-priced rivals and punish them by lowering its own price. Thus, the discounter will not necessarily pick up any additional gas sales when all the rivals immediately match the lower price. The incentive to discount significantly decreases.[47] Once sellers establish interdependence among their actions and learn that none of them can unilaterally profit from price reductions, their behavior changes; they can start raising prices above competitive levels without ever agreeing.[48]

Pricing algorithms do more than facilitate conscious parallelism in markets already susceptible to this type of alignment. They can expand the market conditions in which tacit collusion is possible. The stability of algorithmic decision-making and the swift reaction to deviations from the tacit agreement have the potential to expand tacit

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44.   Ezrachi & Stucke, *Sustainable and Unchallenged Algorithmic Tacit Collusion*, *supra* note 33, at 246, 227.

45.   *See White*, 635 F.3d at 579.

46.   Andrew Kunesh, *How to Use GasBuddy to Get Ahead of Summer's Fuel Price* Surge, THE POINTS GUY (May 7, 2022), https://thepointsguy.com/guide/gasbuddy-guide/ [perma.cc/4WMH-RL6A].

47.   Stephanie Assad, Robert Clark, Daniel Ershov & Lei Xu, *Algorithmic Pricing and Competition: Empirical Evidence from the German Retail Gasoline Market* 6 (CESifo, Working Paper No. 8521, 2021).

48.   *See* MERGER GUIDELINES, *supra* note 28, at 9.

> A market is more susceptible to coordination if a firm's behavior can be promptly and easily observed by its rivals. Rivals' behavior is more easily observed when the terms offered to customers are readily discernible and relatively observable (that is, known to rivals). Observability can refer to the ability to observe prices, terms, the identities of the firms serving particular customers, or any other competitive actions of other firms. Information exchange arrangements among market participants, such as public exchange of information through announcements or private exchanges through trade associations or publications, increase market observability. Regular monitoring of one another's prices or customers can indicate that the terms offered to customers are relatively observable. Pricing algorithms, programmatic pricing software or services, and other analytical or surveillance tools that track or predict competitor prices or actions likewise can increase the observability of the market.

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 all gas stations used pricing algorithms designed and trained to maximize profits.

Importantly, to violate Section One of the Sherman Act, there must be proof of an agreement.[49] The antitrust plaintiff must provide sufficient "evidence that tends to exclude the possibility of independent action . . . . That is, there must be direct or circumstantial evidence that reasonably tends to prove that the [defendant] and others had a conscious commitment to a common scheme designed to achieve an unlawful objective."[50] Otherwise without this proof, as the courts observe, "in an interdependent oligopoly it may be in a company's interest to raise prices in the hope that its competitors play 'follow the leader.'"[51] If the algorithms simply follow each other's pricing moves, that parallel pricing behavior is legal under the Sherman Act, even if it leads to higher prices.[52] This is true even if the rivals know that their use of algorithms will likely lead to higher prices.[53] So long as the rivals do not agree among themselves (for example, agreeing to tamper with pricing by all using pricing algorithms), their algorithms can tacitly collude without violating the Sherman Act.[54]

When we originally raised these concerns, some expressed doubts about the feasibility of algorithms sustaining tacit collusion. But the subsequent economic literature and policy papers have shown that: (1) relatively simple algorithms can raise prices above competitive levels without entering into illegal collusion; (2) more advanced reinforced learning algorithms can independently learn to play collusive strategies (and do so in relatively complex environments);[55] (3)

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49.   *See In re* Travel Agent Comm'n Antitrust Litig., 583 F.3d 896, 907 (6th Cir. 2009) (quoting Monsanto Co. v. Spray-Rite Service Corp., 465 U.S. 752, 768 (1984)).

50.   *Id.*

51.   Prosterman v. Am. Airlines, Inc., 747 F. App'x 458, 461 (9th Cir. 2018).

52.   *See* Bell Atl. Corp. v. Twombly, 550 U.S. 544, 553–54 (2007); Brooke Grp. Ltd. v. Brown & Williamson Tobacco Corp., 509 U.S. 209, 227 (1993); OECD: Algorithms and Collusion: Competition Policy in the Digital Age 28–29 (2017), https://web-archive.oecd.org/2019-02-17/449397-Algorithms-and-colllusion-competition-policy-in-the-digital-age.pdf [perma.cc/Q2V8-2RJ3]; OECD Secretariat, *supra* note 38, at 15.

53.   *See Twombly*, 550 U.S. at 553–54; *Brooke Grp. Ltd.*, 509 U.S. at 227; Algorithmic Competition, OECD Background Note, *supra* note 36, at 14, 26.

54.   *See Twombly*, 550 U.S. at 553–54.

55.   Emilio Calvano, Giacomo Calzolari, Vincenzo Denicolò & Sergio Pastorello, *Artificial Intelligence, Algorithmic Pricing, and Collusion*, 110 AM. ECON. REV. 3267, 3268 (2020); 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 2748, 2748 (2023); *see* John Asker, Chaim Fershtman & Ariel Pakes, *The Impact of AI Design on Pricing*, JOHNASKER.COM 1, 27–28 (Feb. 11, 2023), http://www.johnasker.com/AI2.pdf

algorithms can effectively optimize market interactions in a manner that leads to upward pressure on price;[56] (4) wide-scale adoption of algorithmic pricing software could have a significant upward effect on profitability;[57] (5) such strategy may prevail even under imperfect conditions and limited monitoring;[58] and (6) algorithms could decode the operation of competing pricing algorithms and manipulate them to increase price.[59] 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 may also foster a level of stability that humans cannot.

Undoubtedly, concerns within the legal and economic communities about the phenomenon increased with the improvement in computing power that enabled more robust market data collection.[60] Such improvements include the ability to better monitor data as well as improve the collection, sifting, cleaning, and generation of said data.[61] In concentrated markets, algorithmic tacit collusion may form a business strategy rather than merely reflect a market outcome. Still, the practice does not affect every market and is conditioned on certain market and product characteristics.[62] The belief is that in markets characterized by heterogeneous products, complex sale terms, secret

[https://perma.cc/8J4X-PXP7]; Jeanine Miklós-Thal & Catherine Tucker, Collusion by Algorithm: Does Better Demand Prediction Facilitate Coordination Between Sellers?, INST. FOR OPERATIONS RSCH. & THE MGMT. OF SCI. 1–2 (Oct. 5, 2018). *Cf.* Adam Lerer & Alexander Peysakhovich, *Maintaining Cooperation in Complex Social Dilemmas Using Deep Reinforcement Learning*, ARXIV 1, 14 (Mar. 5, 2018), http://arxiv.org/abs/1707.01068 [perma.cc/24D5-N4E4].

56. Zach Y. Brown & Alexander MacKay, *Competition in Pricing Algorithms* 1 (Harv. Bus. Sch., Working Paper, No. 20-067, 2020), https://www.hbs.edu/ris/Publication%20Files/20-067_71a112ae-f461-45da-8157-42763d61c015.pdf [perma.cc/2DT2-AGSU].

57. *See* Assad et al., *supra* note 47, at 2, 4.

58. Emilio Calvano, Giacomo Calzolari, Vincenzo Denicoló & Sergio Pastorello, *Algorithmic Collusion with Imperfect Monitoring*, 79 INT'L J. of INDUS. ORG. 1, 2 (2021).

59. Luc Rocher, Arnaud J. Tournier & Yves-Alexandre de Montjoye, *Adversarial Competition and Collusion in Algorithmic Markets*, 5 NATURE MACH. INTEL. 497, 497 (2023).

60. GOV.UK COMPETITION & MKTS. AUTH., ALGORITHMS: HOW THEY CAN REDUCE COMPETITION AND HARM CONSUMERS 4–5 (Jan. 19, 2021), https://www.gov.uk/government/publications/algorithms-how-they-can-reduce-competition-and-harm-consumers/algorithms-how-they-can-reduce-competition-and-harm-consumers#techniques-to-investigate-these-harms [perma.cc/472S-NTHM]; *see* Algorithmic Competition, OECD Background Note, *supra* note 36, at 6–7.

61. *See* GOV.UK COMPETITION AND MKTS. AUTH., *supra* note 60, at 4.

62. *See* MERGER GUIDELINES, *supra* note 28. Absent the market conditions and product characteristics necessary to sustain alignment, tacit collusion will not be possible. Similarly, the presence of a disruptor or maverick will destabilize conscious parallelism. *Id.*

deals, many competitors, or mavericks,[63] algorithmic tacit collusion is likely unsustainable.[64]

B. Algorithmic Hub-and-Spoke

At its simplest manifestation, algorithmic hub-and-spoke structures emerge when competitors all use the same algorithm or software to determine their pricing strategy.[65] This may be an intentional strategy, such as when drivers and riders rely on the dominant ridesharing app to determine the fare, or an incidental strategy, like when competitors migrate to the same pricing algorithm provider. Either way, as Figure 1 reflects, this reliance results in a single hub's pricing algorithm now affecting several rivals' pricing strategies.[66]
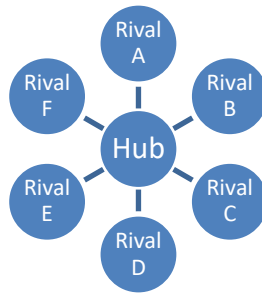

Figure 1

The level of alignment the hub fosters depends on the commonality of analytics, data, and strategy.[67] Consider the allegations in the *RealPage* apartment renting case, where each rival shared with the hub not only its publicly available data, but also nonpublic, commercially sensitive data, such as the actual rent charged versus the published rents, and each building's inventory, occupancy rate, and

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63.   *Id.* ("A maverick is a firm with a disruptive presence in a market. The presence of a maverick, however, only reduces the risk of coordination so long as the maverick retains the disruptive incentives that drive its behavior. A merger that eliminates a maverick or significantly changes its incentives increases the susceptibility to coordination.").

64.   OECD Secretariat, *supra* note 38, at 34.

65.   Algorithms and Collusion: Competition Policy in the Digital Age, *supra* note 52, at 27.

66.   OECD, Roundtable on Hub-and-Spoke Arrangements, *supra* note 13, at 5.

67.   *Id.* at 8.

units and unit types that either were available or would soon become available.[68] As the plaintiffs alleged,

> RealPage's vast client base provides it with real-time data on every aspect of the rental housing market, including actual rent prices as opposed to advertised rents – data which was previously unavailable to landlords. With this data, Defendant RealPage is able to calculate and disseminate supracompetitive unit-by-unit pricing on a daily basis for use by the Lessor Defendants, touting that its algorithm "crunches millions of transactions each night, pinpointing price shifts for every single unit on the platform at any point in time."[69]

The data exchange helps foster the rivals' assimilation, whereby the defendant property managers adopted RealPage's pricing for their units up to 80 to 90 percent of the time.[70] In such instances, the rivals (i.e., the spokes) not only use the same pricing services that the hub's algorithms provide but also rely on the same data to determine their pricing strategies.[71]

Further alignment among the rivals will emerge when the hub recommends and implements business strategies and sets business terms.[72] In such instances, the hub-and-spoke frameworks may affect more than price and lead to worsening business terms, commissions, discounts, or quality. This framework also risks marginalizing some groups of customers, whom the algorithm predicts are of low value. Alignment becomes complete when the hub optimizes the joint interests of all the spokes, thus treating them as a collective. In such an instance, rather than determining how much incremental profits a rival could achieve through discounting (thus encroaching upon rivals' market share), the algorithm would calculate the increase in profits if all the subscribing rivals raised their prices.

Hub-and-spoke frameworks need not be sophisticated, and sellers could implement horizontal alignment through relatively simple vertical signaling and coordination. A few examples from around the world illustrate various means through which parties have leveraged such frameworks to foster alignment.

In the *Eturas* case, for example, the Court of Justice of the European Union reviewed a coordination scheme facilitated by an administrator of an online travel booking system.[73] The online travel

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    68.   Consol. Class Action Complaint at ¶¶ 5, 111, Goldman v. RealPage, No. 3:23-md-03071 (M.D. Tenn. June 16, 2023).

    69.   *Id.* at ¶ 109.

    70.   *Id.* at ¶ 5.

    71.   *Id.* ¶¶ 16, 17, 21.

    72.   *See generally id.*

    73.   Case C-74/14, Eturas UAB v. Lietuvos Respublikos Konkurencijos Taryba, ECLI:EU:C:2016:42 ¶ 5, 4 (Jan. 21, 2016).

booking system agreed with certain travel agents to reduce the level of discounts from 4 percent to 1–3 percent.[74] If any travel agent offered a greater discount, the hub's booking algorithm automatically reduced the discount to 3 percent.[75] As a result, many participating travel agencies decreased their discounts to 3 percent or less.[76]

Another illustrative case involves real estate agents and their multiple listing service (MLS).[77] The Spanish National Markets and Competition Commission (CNMC) investigated a hub-and-spoke framework in which the competing realtors, along with the software developer, designed the MLS to prevent secretive discounting.[78] A realtor could only upload a property on the MLS if it revealed its commission and this commission was at least 4 percent.[79] If real estate agents sought to gain a competitive advantage by discounting their fee, the software would prevent the agents from uploading their properties onto the MLS.[80] To eliminate any ambiguity, the software also gave "a pop-up warning" specifying why it rejected the listing.[81] So, in helping to monitor and punish any discounting, the software reduced the real estate agents' incentives and ability to compete by setting commissions independently.[82] Interestingly, the Spanish competition authority fined not only the offending real estate franchisers, who drafted and enforced the anticompetitive rules, but also the IT companies who created the software to police the cartel.[83]

More sophisticated hub-and-spoke services may include the setting of dynamic prices in reaction to live market data.[84] In such instances, the hub will collect and analyze data, with the aim of optimizing the pricing strategies for all the rivals.[85] For example, the

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74.   *Id. at* ¶¶ 9–10. The director of Eturas sent to several travel agencies emails to encourage reduction of the online discount rate from 4 percent to 1–3 percent.

75.   *Id.* at ¶ 10.

76.   *Id.* at ¶¶ 11–13.

77.   Mia Taylor, *What is the MLS, and How Does it Work?*, BANKRATE (Dec. 11, 2023), https://www.bankrate.com/real-estate/mls-multiple-listing-service [https://perma.cc/5LZJ-LWN3] (defining MLS as "a platform used by real estate agents and brokers to share information about properties for sale and find available listings for prospective buyers").

78.   OECD: Algorithmic Competition - Note by Spain 3 (June 14, 2023), https://one.oecd.org/document/DAF/COMP/WD(2023)16/en/pdf [https://perma.cc/3T9U-DECF].

79.   *Id.*

80.   *Id.*

81.   *Id.*

82.   *See id.*

83.   *Id.* at 4.

84.   Sam Schechner, *Why Do Gas Station Prices Constantly Change? Blame the Algorithm*, WALL ST. J. (May 8, 2017, 6:41 PM), https://www.wsj.com/articles/why-do-gas-station-prices-con-stantly-changeblame-the-algorithm-1494A262674 [perma.cc/UR8H-KX8E].

85.   *Id.*

Danish company a2i Systems offers pricing services to many gas stations in Rotterdam.[86] The company's algorithm sets and adjusts the prices of competing gas stations.[87] At the time, on its website, the company had provided a case study to illustrate how its pricing technology changed the market's pricing dynamics—transforming a market previously characterized by "fierce competition and high volatility" and thereby reducing the likelihood of price wars.[88] The use of a single decision-making algorithm softened competition in the market and resulted in across-the-board upward pressure on price. Nevertheless, despite the press coverage, no European competition authority has prosecuted it as of early 2024.[89]

The harmful effect the hub generates directly relates to the market power of its clients. As many more rivals start using the same hub, the hub's pricing algorithm can behave more independently of the remaining competitors and set higher prices more easily. By contrast, in a competitive setting, the hub cannot ignore the pressures from the many firms competing against their customers.

At present, besides the *RealPage* and *Yardi* cases discussed above, only a few other hub-and-spoke arrangements have drawn antitrust scrutiny. One 2023 case in the United States concerned the leading hotels on the Las Vegas Strip overcharging their rooms. The conspiracy, plaintiffs alleged, was that all of the hotels "agreed to use a shared set of pricing algorithms offered by the Rainmaker subsidiary of Cendyn that recommend supracompetitive prices to the hotel operators."[90] According to the lawsuit, an estimated 90 percent of Vegas

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86.   *Id.*; Samantha Oller, *Artificial Intelligence Could Bring a Byte to Fuel Pricing*, CSP MAG. (Nov. 13, 2017), https://www.cspdailynews.com/csp-magazine/artificial-intelligence-could-bring-byte-fuel-pricing [perma.cc/944D-XPX2].

87.   Schechner, *supra* note 84.

88.   OECD: Algorithmic Collusion: Problems and Counter-Measures - Note by A. Ezrachi & M. E. Stucke, Roundtable on Algorithms and Collusion 15 (June 21–23, 2017), https://one.oecd.org/document/DAF/COMP/WD%282017%2925/En/pdf [https://perma.cc/Y8YX-B2P5].

89.   To that extent, Uber and other ride-sharing services have used for years a centralized pricing system that could be seen as facilitating coordination. *See* Doc. 37 at 3–4, Meyer v. Kalanick, No. 1:2015cv09796 (S.D.N.Y. 2016). Thus far, it has attracted limited antitrust scrutiny. *Cf.*, Nick Passaro, *Uber Has an Antitrust Litigation Problem, Not an Antitrust Problem*, CPI ANTITRUST CHRON. 38, 42 (2018).

90.   Gibson v. MGM Resorts Int'l, No. 223CV00140MMDDJA, 2023 WL 7025996 at *1 (D. Nev. Oct. 24, 2023); *see also* Joe Achneider & Michael Leonard, *Vegas Visitors Sue the Strip's Biggest Hotels, Alleging Price Collusion*, BLOOMBERG L. (Jan. 26, 2023, 3:58 PM), https://news.bloomberglaw.com/antitrust/vegas-visitors-sue-big-names-on-the-strip-over-hotel-room-prices [perma.cc/624X-47SD].

Strip hotels used a third-party revenue management service.[91] Although the complaint alleged anticompetitive effects from this hub-and-spoke arrangement, the district court dismissed the complaint.[92] One significant issue the court identified with the complaint was "that it fail[ed] to plausibly allege Defendants entered into an agreement," let alone tacitly colluded.[93] Part of the problem in the Las Vegas case was that the plaintiffs failed to plead what specific algorithms the defendant hotels were using, whether the rivals were sharing commercially sensitive, nonpublic information with the hub, and the extent to which the defendant hotels even adopted the pricing the hub's algorithms recommended.[94] But the district court allowed the plaintiffs to file an amended complaint curing these and several other deficiencies that the court noted.[95] The difficulties in challenging these algorithmic hub and spokes under the Sherman Act are further explored in Part IV.

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

As noted in Section II.A above, tacit algorithmic collusion may yield anticompetitive outcomes when the underlying market conditions are conducive to such conscious parallelism. In contrast, the hub-and-spoke framework could foster alignment even if many of the conditions outlined in Section II.A are not present. For instance, the alignment a hub-and-spoke framework induces can occur with heterogeneous products in moderately concentrated markets where prices are not perfectly transparent.

In a simple setting when a hub merely supplies the algorithms to the spokes, the resulting alignment may resemble the tacit algorithmic collusion scenario in which each competitor independently gravitates toward using similar algorithms or uses different reinforcement learning algorithms that converge to charging higher prices. The difference between the two scenarios arises when the hub

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91.   Hagens Berman, *Las Vegas Hotel Operators Sued for Alleged Scheme to Illegally Inflate Hotel Room Rates to Record Highs,* BUS. WIRE (Jan. 25, 2023, 8:54 PM), https://www.busi-nesswire.com/news/home/20230125005898/en/Hagens-Berman-Las-Vegas-Hotel-Operators-Sued-for-Alleged-Scheme-to-Illegally-Inflate-Hotel-Room-Rates-to-Record-Highs   [perma.cc/TVA8-ULYZ]; *Vegas Hotel Giants MGM, Caesars, Wynn and Treasure Island Sued for "Algorithmic-Driven Price-Fixing*", CBS NEWS (Jan. 27, 2023, 9:54 AM), https://www.cbsnews.com/news/vegas-strip-resorts-price-fixing-lawsuit-mgm-caesars-wynn-treasure-island/ [perma.cc/7Y9V-DV8A].

92.   *Gibson,* 2023 WL 7025996 at *4.

93.   *Id.* at *2. The court also dismissed the complaint as to defendant MGM as the plaintiffs did not sufficiently allege that any MGM hotels within the plaintiffs' defined market area of the Las Vegas Strip used the Rainmaker software. *Id.* at *3.

94.   *Id.* at *3.

95.   *Id.* at *1.

does more than merely supply software. The *RealPage* case is illustrative.[96] Suppose the landlords simply purchased their own pricing algorithms or created them in-house, rather than outsourcing their pricing to a common hub. Under that scenario, prices would not have necessarily increased above competitive levels while occupancy rates declined.

In addition to offering pricing software, a hub, as in *RealPage*, can collect and analyze the rivals' commercially sensitive data when setting the price for each rival. For the district court in the *RealPage* case, this data exchange was the "most persuasive evidence" of an illegal horizontal agreement: it was "the simple undisputed fact" that each landlord provided RealPage "its proprietary commercial data, knowing that RealPage would require the same from its horizontal competitors and use all of that data to recommend rental prices to its competitors."[97] In sharing that confidential data with RealPage, each defendant knew that its rivals were doing the same.[98] Each defendant was also aware that its rivals were delegating their pricing decisions to the algorithm.[99] This enabled the algorithm to do what it promised: namely to "'outperform the market,' primarily by increasing rent prices."[100] No competitor would divulge to RealPage its commercially sensitive information unless it knew that its rivals were doing the same.[101] Moreover, a landlord would not likely turn over this data if RealPage used it to help rival landlords better compete.[102] The landlords turned over the data, the court noted, because they knew they were "receiving in return the benefit of their competitors' data in pricing their own units."[103] When the hub optimizes the collective position of all spokes, rather than independently optimizing the position of each competitor, alignment increases further.

To illustrate the impact a centralized framework may have on alignment, enforcement against cartel activities proves instructive. An empirical analysis of successfully prosecuted cartels between 1910 and 1972 showed that cartels on average had many participants.[104] But

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96.   *See In re* RealPage, Inc., No. 3:23-MD-03071, 2023 WL 9004806, at *15 (M.D. Tenn. Dec. 28, 2023).

97.   *Id.*

98.   *Id.*

99.   *Id.*

100.   *Id.*

101.   *Id.*

102.   *Id.*

103.   *Id.*

104.   Arthur G. Frass & Douglas F. Greer, *Market Structure & Price Collusion: An Empirical Analysis*, 26 J. INDUS. ECON. 21, 35 (1977).

where a trade association facilitated collusion, a larger number of competitors were involved, and able to sustain collusion.[105] 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 could not tacitly collude, even if they had all adopted AI pricing technology. This would likely be the case when: (1) the market includes many sellers; (2) the market lacks transparency on pricing and key terms of sale (such as the actual rents charged); (3) the algorithms cannot readily respond to price moves by sellers (who may be at different levels of adoption of algorithmic pricing); (4) the rivals are unaware of the changes in supply (such as how many of their rivals' apartment units will be soon available); and (5) the products or services are heterogeneous or command complex pricing.

Once a leading hub establishes itself, a feedback loop enabling increased profitability may emerge. For instance, as more apartment buildings in a city use RealPage, the hub's algorithm acquires even more commercially sensitive, nonpublic data from each subscriber for its price optimization software; the hub's pricing algorithm incrementally affects more of the local apartment market; and RealPage's pricing can increasingly behave independently of the remaining apartments not using its pricing algorithm.

As a result, the leading algorithm's success for its clients attracts more of the remaining apartment buildings, making it harder for other AI pricing optimization companies to enter and compete without such market data. Further, it would become more difficult for the remaining apartment buildings to forego these profits, so they too switch to RealPage until many rivals coalesce 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 becomes the de facto market price. We see this tipping and "winner takes most" effects in other digital markets.[106] But one might assume that as long as several competing hubs operate, then there is little, if any, risk of algorithmic collusion. That assumption is wrong, as the next Part explores.

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    105.   Where a trade association facilitated collusion, an average of 33.6 and a median of fourteen firms were involved, 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. *See id.* at 34, 35.

    106.   *See* Maurice E. Stucke, Breaking Away: How to Regain Control Over Our Data, Privacy, and Autonomy 22 (2022); Ariel Ezrachi & Maurice E. Stucke, How Big-Tech Barons Smash Innovation — And How to Strike Back 82 (2022).

III. SECONDARY ALGORITHMIC TACIT COLLUSION

To illustrate secondary algorithmic tacit collusion, consider a market in which several different hubs offer pricing and other strategic services to many sellers on the primary market.
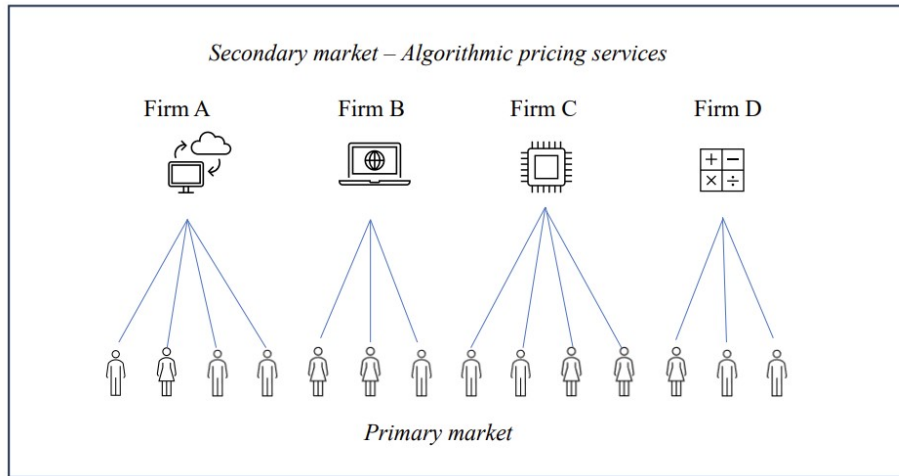

Figure 2

Suppose the hypothetical Firms A, B, C, and D provide price and strategy optimization services for the many sellers who operate on a primary market. Moreover, suppose both markets appear seemingly competitive.

Let us start with the primary market. Unlike highly concentrated markets, where the products are relatively homogeneous (think commodities like oil, corn, or sugar), in our example, the primary market is unconcentrated and involves differentiated goods or services (think of consumer markets where brand and product differentiation play a key role, such as shampoo and cars).[107] In this hypothetical, even if the sellers in the primary market all use similar pricing algorithms, tacit algorithmic collusion is unlikely, as seen in Section II.C.

Now let's turn to the secondary market. Unlike the hub-and-spoke scenario discussed in Part II (where one dominant hub determined the pricing for most of the rivals), the secondary market here has four competing providers of algorithmic pricing and strategy services. Suppose each hub has a 25 percent market share. On the one

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107.   MERGER GUIDELINES, *supra* note 28, at 8.

hand, the secondary market is highly concentrated.[108] On the other hand, each hub operates independently and services a portion of the primary (and highly competitive) market. Thus, even though the secondary market is highly concentrated, one would expect the competition in the primary market to spill over to the secondary market, whereby the four firms' pricing algorithms undercut each other for their customers to gain additional sales in the primary market. Firm A would not raise its clients' prices when doing so risks them 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 and the hubs themselves by securing higher profits, which might in turn attract other sellers to use the pricing algorithm. As a result, Firms A, B, C, and D's price optimization algorithms, in theory, should compete against each other, and both the primary and secondary markets should remain competitive.

But when the secondary market satisfies the other conditions for tacit algorithmic collusion, such as transparency of the prices that the rival algorithms recommend to its clients, each pricing hub could effectively learn its competitor's strategy by observing its decision-making and reacting accordingly. Under these conditions, alignment is achieved via the suggestion of 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 of its clients would have individually. In addition, in observing downstream pricing in real-time and appreciating which hub controls different groups of sellers, the hubs' 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.

What makes secondary tacit collusion distinctive is two-fold: first, STC may be achievable despite the competitive conditions in the primary market; second, the tacit collusion takes place on the *secondary* market for pricing services (the hub market) rather than on the primary market for products and services. As a result, STC is detached from the

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108.   *See id.* at 5. Using the common measurement of concentration, the Herfindahl-Hirschman Index (HHI), which is calculated by summing the squares of each firm's market share (here $4 * 25^2$), the secondary market's HHI is 2500. The antitrust agencies consider markets with an HHI greater than 1,800 to be highly concentrated. *Id.*

limitations that the primary market characteristics impose. Put differently, STC can deliver outcomes that cannot be attained on the primary market, even if all the sellers were using the same algorithms or otherwise using different learning algorithms that could assimilate. This is not a theoretical concern as the below examples illustrate.

A. STC Among Gasoline Stations

Returning to the hypothetical in Figure 2, suppose Firms A, B, C, and D set gas prices for over one hundred thousand gas stations across the New England and Mid-Atlantic states, and each hub services twenty-five thousand gas stations scattered throughout these states. While tacit collusion could be sustained 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 aim to steal shares from larger chains. So, even if the gas stations in Boston, New York City, Philadelphia, and other major cities adopted their own pricing algorithms, tacit collusion would be difficult to sustain. Also contributing to the instability of tacit collusion would be the range of algorithms the different gas stations use, the different proficiency in their deployment, and the data each pricing algorithm has to determine the price.

But if all these gas stations ceded pricing to one of four hubs, the risk of STC becomes apparent. Each 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 twenty-five thousand gas stations, and it knows that three rival hubs control the pricing decisions of the remaining gas stations. 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 quickly target and undercut that discounting hub's client stations while simultaneously charging higher prices in other local gas markets.[109] So, four sophisticated players who

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109.   *See* U.S. v. Airline Tariff Publ'g Co., 836 F. Supp. 9 (D.D.C. 1992); Competitive Impact Statement at 1–4, U.S. v. Airline Tariff Publ'g Co., Civ. Action No. 92-2854 (D.D.C. Dec. 21, 1992); Competitive Impact Statement at 1–3, U.S. v. Airline Tariff Publ'g Co., Civ. Action No. 92-2854 (D.D.C. Mar. 17, 1994). 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 supra-competitive fares in multiple markets. No one questioned that the defendants' computerized fare dissemination system had a procompetitive 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

specialize in pricing strategies and use similar data points can simplify the otherwise complex and unstable local geographic markets running along the Northeast corridor. With STC, the alignment of strategies could emerge naturally as the hubs learn about each other's strategies.

Communications between the hubs and their respective clients can also facilitate mutual awareness of the pricing strategy each hub deploys. To facilitate collusion, the hubs can exchange information among themselves, which the D.C. Attorney General alleged Yardi and RealPage did.[110] Moreover, the hubs can signal their algorithms' pricing strategies to each other through the marketing materials of their pricing services to the primary market. Consider the statements from price optimization software vendors regarding their ability to reduce the likelihood of price wars and to sustain above-competitive prices, which serve the aforementioned dual purposes of marketing as well as signaling between sophisticated hubs.

We can see several examples of this marketing in the retail gas sector. A2i Systems promoted its PriceCast Fuel algorithm while indicating that it can improve volumes and margins and ultimately generate more profit, even in the most volatile market conditions.[111] Its rival Kalibrate similarly helps gas station clients "[c]alibrate pricing strategies and tactics to meet volume and margin targets and market demands."[112] It notes how a "more efficient software system allows fuel

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communicating and agreeing upon supracompetitive fares. The Antitrust Division asserted that the defendant airlines essentially signaled 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 supra-competitive fares, but it also importantly enabled them to verify that such fares would stick, and signal retaliatory measures against any airline that did not go along with targeting discounting rivals with specific fares for specific routes. *See id.*

110.   Complaint at ¶¶ 1, 76, 100, 106, D.C. v. RealPage, Inc. (D.C. Super. Ct. Nov. 1, 2023) (alleging that RealPage "ingests non-public data from competing property management systems, including from Yardi, which is OneSite's leading competitor in the market").

111.   *PriceCast   Fuel*,   A2I,   https://www.a2isystems.com/fuel-pricing-software [perma.cc/QY9W-DQF6] (last visited Feb. 1, 2024).

112.   *KKS Fuels to Change Name to Kalibrate Technologies*, BUS. WIRE (Oct. 25, 2013, 9:30 AM) https://www.businesswire.com/news/home/20131025005087/en/KSS-Fuels-to-Change-Name-to-Kalibrate-Technologies [perma.cc/Y8SB-XJB8].

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."[113] Another fuel pricing provider—PriceAdvantage—promises "Faster Pricing, Better Profits."[114] To deliver their promise of greater profits, these hubs will need to avoid a price war among the rival gas stations, and instead increase retail gas prices. The hubs' strategy is public and rational, and they will deploy means to ensure it is sustained.

Indeed, one economic study of German gas station markets found evidence of such STC.[115] In dividing the study's sample between monopoly and non-monopoly markets, when gas stations operating in Germany adopted algorithmic-pricing software, the margins in *non-monopoly* markets increased by 11 percent on average over pre-adoption levels.[116] In comparison, in monopoly markets, these gas stations experienced only a small, statistically insignificant change in their margins.[117] Likewise, average prices rose in *non-monopoly* markets, but not in monopoly markets.[118] This is consistent with tacit collusion rather than efficiencies.

The economic study also examined duopoly markets, in which two firms operate.[119] When one firm adopted the pricing algorithm and the other did not, margins and prices remained constant on average.[120] But when both gas stations adopted the algorithms, the algorithms enabled alignment, margins gradually increased on average by nearly 38 percent, and "the distribution of margins and prices generally shift[ed] right."[121]

The study did not focus on which stations relied on which particular third-party pricing hubs. Important for our purposes is that the gas stations did not rely on a single hub, but rather several, including a2i, Kalibrate (which had contracts with German brands Orlen and Tamoil/HEM), PDI, and PriceAdvantage.[122] Here STC takes

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113.   *Fuel Pricing Management: Consistent, Auditable Fuel Pricing Decisions That Generate More* Profit, KALIBRATE, https://kalibrate.com/solutions/price/fuel-pricing-management/ [perma.cc/VN49-ALCK] (last visited Feb 1., 2024).

114.   *Why Price Advantage*, PRICE ADVANTAGE, https://www.priceadvantage.com/fuel-pricing-software/why-priceadvantage/ [perma.cc/8THZ-NAMN] (last visited Feb. 1, 2024).

115.   Assad et al., 47, at 39.

116.   *Id.* at 29.

117.   *Id.*

118.   *Id.*

119.   *Id.* at 29–30.

120.   *Id.* at 30.

121.   *Id.* at 31, 39.

122.   *Id.* at 9–10. Moreover, fuel retailers in over forty countries use Kalibrate's Fuel Pricing to "maximize fuel profits." *Fast, Intelligent, Agile Fuel Pricing Across Your Entire Network*,

place in the secondary market, where the hubs learn to tacitly collude, and consumers buying gas from stations in the primary market feel the anticompetitive effects. But, as the next example shows, 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 sustained regardless of other conditions in the primary market that ordinarily prevent tacit collusion.

B. Online Shopping

Marcel Wieting and Geza Sapi found algorithmic collusion on Bol.com, the largest online marketplace in the Netherlands and Belgium, which may also be attributed to STC.[123] The two economists examined more than two months of pricing data for around 2,800 popular products on Bol.com.[124] Their 2021 paper was the first to find algorithmic collusion in an online marketplace.[125] Given that Bol.com is bigger than Amazon in those two European countries, and "very similar to Amazon in format, functions, products and the availability of third-party re-pricer software,"[126] their findings can have broader implications: namely, consumers may be paying higher prices when shopping online because of STC.

On Bol.com, sellers relied on at least six different pricing algorithm hubs.[127] Like Amazon, Bol.com has a Buy Box (which is the "most prominently displayed offer for a product").[128] Generally, for any product, when only one seller relied on these algorithmic pricing hubs, it did not significantly increase the average Buy Box price.[129] But if two sellers relied on these algorithmic pricing hubs, the Buy Box price increased. Take, for example, the typical products sold on Bol.com. They had between three to five sellers.[130] When only one of these sellers was using a pricing algorithm service, the Buy Box price rose on average by less than 0.5 percent. But if two of the three to five sellers were using a

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KALIBRATE, https://kalibrate.com/products/software/kalibrate-pricing/ [perma.cc/6TPW-M9QQ] (last visited Feb. 1, 2024).

123.   Marcel Wieting & Geza Sapi, *Algorithms in the Marketplace: An Empirical Analysis of Automated Pricing in E-Commerce* 1 (NET Inst., Working Paper No. 21-06, 2021).

124.   *Id.*

125.   *Id.*

126.   *Id.*

127.   *See id.* at 4 (relying on re-pricer services such as ChannelEngine, EffectConnect, Channable, Vleks, Price-search.io and RepricerXL which "integrate with the Bol.com retailer API and automate the pricing process").

128.   *Id.* at Abstract.

129.   *Id.* at 28–29.

130.   *Id.* at 33.

pricing algorithm service, then the Buy Box price increased on average by 4 percent.[131]

When six to eight sellers sold the same product, the study found a similar pattern: when only one of them used an outside algorithmic pricing service, the Buy Box price increased by only a nominal amount (again less than 0.5 percent).[132] But when *two* sellers in this larger group used outside pricing hubs, the Buy Box price increased on average 0.78 percent, which was not as much as the three to five group but still significant for higher priced goods.[133] Thus, their study found on average higher prices for products with as many as eight sellers, some of whom were using pricing algorithms, and algorithmic sellers won the Buy Box more often than traditional sellers.[134]

But pricing algorithms, as the study found, at times can benefit consumers. For products with nine or more sellers, the Buy Box price significantly declined when two sellers were using an outside pricing hub.[135] As the study's authors concluded, their results should not be shocking when these pricing hubs were explicitly advertising to the sellers on Bol.com "their ability to raise prices and avoid competition, even using economic textbook language of collusion."[136]

C. Residential Apartment Buildings

Returning to the apartment example, in many markets RealPage provides real-time pricing services for apartment listings, which are hardly homogeneous. Moreover, RealPage faced rivals, including Yardi. Arguably, with STC, the same strategies that enable RealPage and Yardi to overcome the heterogeneity through the hub-and-spoke structure and increase profitability for their clientele would apply even when other competitors operate on the secondary market. Each competitor would 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. According to the complaints, property managers using RealPage saw their occupancy rate decline (from 97 to 95 percent) while

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131.   *Id.*
132.   *Id.* at 28.
133.   *See id.* at 28–29.
134.   *Id.* at 33–34.
135.   *Id.* at 34.
136.   *Id.* at 5.

their revenues increased 3–4 percent.[137]

One economic study of the impact of algorithmic pricing on the US multifamily rental housing market, however, found mixed effects over two time periods: namely, during the economic recession (between 2008 and 2010), property developers using the hubs' algorithms charged on average lower prices and experienced higher occupancy. But during the economic recovery (between 2014 and 2019), the higher penetration of algorithm pricing software in particular geographic markets led to "higher rents and lower occupancy."[138] In geographic rental markets "that experienced a sudden sharp increase in software adoption" there were "considerably higher rents" (on average 3 percent higher) and "lower occupancy, compared with markets that do not experience such jumps in adoption rates."[139] Consequently, this study leaves it unclear whether the pricing algorithms helped property managers set more responsive prices or more collusive prices.

But in the end, in a market controlled by several pricing algorithms, each of which is seeking to boost profits for its clients, the algorithms may start off competitively, and eventually learn that raising prices will yield greater profits. Just like ordinary price-fixing cartels, the collusion can also break down, and periods of tacit collusion will mix with periods of competition. But that does not diminish the harm of collusion—whether tacit or express.

As is the case with tacit collusion, some markets may possess features that would prevent STC, such as a significant time lag in the upstream hub detecting changes in prices that the other hubs are setting for their clients in the primary market. In addition, a maverick with a different pricing strategy, 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 learn that its strategy is unprofitable. A sophisticated maverick will learn that it cannot profitably deviate from the STC. After all, the prevailing policy the STC advances is sustained exactly because of its profitability. When the hubs' marketing material counsel how their algorithms can help rivals

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137.   Sophie Calder-Wang & Gi Heung Kim, *Coordinated vs Efficient Prices: The Impact of Algorithmic Pricing on Multifamily Rental Markets* 9, 32 (July 24, 2023) (forthcoming), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4403058 [https://perma.cc/KXG7-CCET].

138.   *Id.* at 2.

139.   *Id.*

avoid price wars,[140] one should not expect otherwise. After all, higher profits are what these hubs are promising to their clients, which STC has a high chance of delivering.

IV. 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. The prevailing assumption under US antitrust law is that if a defendant's market share is low (i.e., below 30 percent), then the company individually has insufficient market power to harm competition.[141] Proving a Sherman Act violation based on the hub's unilateral conduct in cases of low market share would be an uphill battle. So too if the spokes' collective market share were below 30 percent. Thus, any antitrust action would depend on proof of the hubs colluding among themselves. One would run into the same problems present in tacit algorithmic collusion: Even if evidence suggests parallel conduct among the hubs, that conscious parallelism in the secondary hub market may reflect a rational reaction to market characteristics.[142] Thus, absent any "plus factors" (such as the hubs exchanging confidential information[143]) or express collusion among the hubs, conscious parallelism, by itself, will not violate US or EU antitrust laws (with one exception discussed below).

A. The Challenges in Alleging Algorithmic Hub-and-Spoke Collusion

To illustrate the challenges in prosecuting STC, let us return to the simpler algorithmic hub-and-spoke allegations in the *RealPage*

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140.   *See generally* Ronan White, *How to Avoid a Price War on Amazon: A Seller's Guide*, Repricer (Nov. 10, 2023, 5:05 PM), https://www.repricer.com/blog/avoid-price-war-on-amazon/ [perma.cc/C5E4-E9XV] (touting how using its algorithms help Amazon third-party sellers protect their "profits from a price war").

141.   In *RealPage*, for example, the defendants cited cases of the courts' reluctance "to find an adequate showing of market power when a defendant controls less than 30% of the market." *In re* RealPage, Inc., No. 3:23-MD-03071, 2023 WL 9004806, at *29 (M.D. Tenn. Dec. 28, 2023). In five of the alleged forty-five geographic markets, the defendants collectively had a market share of less than 30 percent. *Id.* The district court refused to dismiss the complaint before the renter plaintiffs had discovery: "Discovery will reveal the appropriate percentage of market share needed to presume market power and the actual percentage RealPage enjoys in each of Plaintiffs' alleged submarkets." *Id.*

142.   *See* Bell Atl. Corp. v. Twombly, 550 U.S. 544, 554 (2007); Brooke Grp. Ltd. v. Brown & Williamson Tobacco Corp., 509 U.S. 209, 237 (1993).

143.   *See* Lifewatch Services Inc. v. Highmark Inc., 902 F.3d 323, 333 (3d Cir. 2018) (discussing "plus factors").

cases. The off-campus, private student housing market lawsuits and multi-family apartment building lawsuits were consolidated and transferred in 2023 to the US District Court for the Middle District of Tennessee for coordinated or consolidated pretrial proceedings.[144] Defendants moved to dismiss both sets of claims.[145] At this early stage of litigation, the legal standard is deferential to plaintiffs: the court must "construe the complaint in the light most favorable to the plaintiff, accept all well-pleaded factual allegations in the complaint as true, and draw all reasonable inferences in favor of the plaintiff."[146] The district court dismissed the students' antitrust claims against RealPage and the defendant lessors.[147] But the court did not dismiss the apartment renters' claims.[148] Here the court's choice of whether to apply the antitrust standard of per se or rule of reason played a key role.[149] The United States recognized this and took the unusual step of submitting a Statement of Interest in this private litigation.[150] Citing its strong interest in the correct application of the federal antitrust laws, the United States argued that the district court should employ antitrust's stricter per se illegal standard in assessing whether the complaints alleged a violation of the Sherman Act:

> Although not every use of an algorithm to set price qualifies as a per se violation of Section 1 of the Sherman Act, it is per se unlawful when, as alleged here, competitors knowingly combine their sensitive, nonpublic pricing and supply information in an algorithm that they rely upon in making pricing decisions, with the knowledge and expectation that other competitors will do the same.[151]

Under antitrust's per se illegal standard, the plaintiffs would only have to plead (and ultimately prove) an agreement among the rivals.[152] That agreement could be tacit or express, and plaintiffs could prove it with direct or circumstantial evidence.[153] Under that standard, the plaintiff

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144. *In re* RealPage, Inc., Rental Software Antitrust Litig., 2023 WL 2875737, at *1 (J.P.M.L. Apr. 10, 2023).

145. *Id.* at *2 n.2.

146. *In re* RealPage, Inc., No. 3:23-MD-03071, 2023 WL 9004806, at *4 (M.D. Tenn. Dec. 28, 2023) (quoting Courtright v. City of Battle Creek, 839 F.3d 513, 518 (6th Cir. 2016)). "To avoid dismissal under Rule 12(b)(6), a complaint must contain either direct or inferential allegations with respect to all material elements of each claim." *Id.* (quoting Wittstock v. Mark A. Van Sile, Inc., 330 F.3d 899, 902 (6th Cir. 2003)).

147. *Id.* at *1.

148. *Id.*

149. *Id.* at *24.

150. Mem. of Law in Supp. of the Statement of Interest of the United States at 1, *In re* RealPage, Inc., No. 3:23-MD-03071 (M.D. Tenn. Nov. 15, 2023).

151. *Id.* at 15.

152. *In re RealPage, Inc.*, 2023 WL 9004806, at *23.

153. Mem. of Law in Supp. of the Statement of Interest of the United States at 6, 8, *In re* RealPage, Inc., No. 3:23-MD-03071 (M.D. Tenn. Nov. 15, 2023).

does not have to prove that the defendants' agreement had anticompetitive effects, nor can the defendants offer any procompetitive justifications for their conduct.[154] As the courts observe, "[t]he per se rule is the trump card of antitrust law. When an antitrust plaintiff successfully plays it, he need only tally his score."[155]

Instead, the district court relied on antitrust's more defendant-friendly legal standard, the rule of reason.[156] This was because the algorithmic hub-and-spoke collusion was not, as the court found, "a traditional straightforward price-fixing conspiracy."[157] Under the rule-of-reason standard, proving an agreement is only the first part of the first step. Unlike the per se illegal standard, plaintiffs must also prove the anticompetitive effects of this agreement. This can consist of direct evidence but typically is proven circumstantially by defining and proving the relevant product and geographic markets, establishing the defendants' collectively high market share in those markets, and showing the restraint's likely anticompetitive effects in those markets.[158] Only after making this showing does the burden shift to the defendants, who have the opportunity to offer a procompetitive business justification.[159] Because the college students, unlike the apartment renters, failed to adequately plead in their complaint the anticompetitive effects of the alleged hub-and-spoke agreement, the district court dismissed their complaint.[160]

The district court left open the possibility of reverting later in the litigation to the per se illegal standard.[161] Otherwise, the plaintiffs and the district court are stuck with the rule of reason, a legal standard that the Supreme Court created but now criticizes as an "elaborate inquiry" that "produces notoriously high litigation costs and

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154.   United States v. Socony-Vacuum Oil Co., 310 U.S. 150, 218 (1940).

155.   Med. Ctr. at Elizabeth Place, LLC. v. Atrium Health Sys., 922 F.3d 713, 718 (6th Cir. 2019) (quoting United States v. Realty Multi-List, Inc., 629 F.2d 1351, 1362–63 (5th Cir. 1980)).

156.   *See In re RealPage, Inc*., 2023 WL 9004806, at *23, *24.

157.   *Id.* at *24.

158.   *See* Ohio v. Am. Express Co., 138 S. Ct. at 2284 (2018); *In re RealPage, Inc.*, 2023 WL 9004806, at *25.

159.   *Ohio*, 138 S. Ct. at 2284 ("The plaintiff has the initial burden to prove that the challenged restraint has a substantial anticompetitive effect that harms consumers in the relevant market. If the plaintiff carries its burden, then the burden shifts to the defendant to show a procompetitive rationale for the restraint. If the defendant makes this showing, then the burden shifts back to the plaintiff to demonstrate that the procompetitive efficiencies could be reasonably achieved through less anticompetitive means.").

160.   *In re RealPage, Inc.*, 2023 WL 9004806, at *34.

161.   The district court noted "that many courts routinely decline to choose between the per se or Rule of Reason standards prior to discovery" and that its "analysis only determines whether Plaintiffs have sufficiently alleged their Sherman Act Section 1 claims, not which standard should control following discovery." *Id.* at *22.

unpredictable results."[162] Likewise, several Justices have called the rule of reason "amorphous"[163] and "unruly."[164] Thus, the Supreme Court's rule of reason standard significantly lowers the odds of success for the government and private antitrust plaintiffs to challenge algorithmic collusion.

Even though the antitrust risks are relatively more apparent when many rivals use the same pricing hub, as in the RealPage cases, it remains uncertain what antitrust legal standard the courts will employ to evaluate these cases. And the choice of standard can affect the plaintiffs' incentive to bring a case, since rule of reason cases generally are more expensive and time-consuming, and the results are more unpredictable.[165]

Further compounding the difficulties attending rule of reason analyses is the resulting added legal complexity when plaintiffs allege STC. In the secondary market, STC is made possible through conscious parallelism between the hubs. Neither Section 1 of the Sherman Act nor its equivalent European provision—Article 101 of the Treaty on the Functioning of the European Union (TFEU)—contain provisions for challenging tacit collusion.[166] As this Article has discussed, Section 1 of the Sherman Act requires proof of an agreement, which requires evidence that tends to exclude the possibility of independent action.[167] Article 101 of the TFEU similarly excludes from its remit unilateral actions not amounting to an agreement or concerted practice.[168] In both the United States and Europe, plaintiffs cannot rely exclusively on the defendants' parallel behavior, since that behavior does not always arise

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162. Kimble v. Marvel Ent., LLC, 576 U.S. 446, 459 (2015) (quoting in part Ariz. v. Maricopa Cnty. Med. Soc., 457 U.S. 332, 343 (1982)). For criticisms of this standard, see Maurice E. Stucke, *The Good, the Bad, and the Ugly of US Antitrust*, 11 J. OF ANTITRUST ENF'T 283 (2023); Maurice E. Stucke, *Does the Rule of Reason Violate the Rule of Law?*, 42 U.C. DAVIS L. REV. 1375, 1379 (2009).

163. Oneok, Inc. v. Learjet, Inc., 575 U.S. 373, 398 (2015) (Scalia, J., dissenting, with Roberts, C.J., joining).

164. FTC v. Actavis, Inc., 570 U.S. 136, 173 (2013) (Roberts, C.J., dissenting, with Scalia, J., and Thomas, J., joining). As they commented, "[g]ood luck to the district courts that must, when faced with a patent settlement, weigh the 'likely anticompetitive effects, redeeming virtues, market power, and potentially offsetting legal considerations present in the circumstances.'" *Id.* (quoting the majority at 149).

165. Stucke, *The Good, the Bad, and the Ugly of US Antitrust*, *supra* note 162, at 289; Stucke, *Does the Rule of Reason Violate the Rule of Law?*, *supra* note 162, at 1378.

166. *See* 15 U.S.C. § 1; TFEU art. 101.

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

168. Under European law, parallel behavior that forms a rational reaction to market characteristics and can be explained using the theory of tacit collusion, will not be subjected to Article 101 TFEU absent direct evidence of communications and collusion. *See* Case 48/69, Imperial Chem. Indus. Ltd. v. Comm'n of the Eur. Communities, 1972 E.C.R. 619, 638.

from an agreement among rivals; instead, it may reflect a rational reaction to market characteristics.[169] Consequently, without proof of an agreement or concerted activity among the hubs, STC claims would fail. While it is difficult to challenge STC directly under Section 1 of the Sherman Act and Article 101 of the TFEU, antitrust law in both jurisdictions offers a few alternative narrow avenues to deter STC.[170]

B. The Use of Algorithms as a Facilitating Practice Among the Hubs

Although tacit algorithmic collusion does not violate Section 1 of the Sherman Act, the FTC (but not the DOJ) might reach it under Section 5 of the FTC Act.[171] In creating the FTC in 1914, Congress wanted the new agency to define and curb all "unfair methods of competition."[172] In contrast to the term "unfair competition," which courts had often construed as passing off one's business or goods for another, the term "unfair methods of competition" was relatively new to US law at the time.[173] The unique term "unfair methods of competition," as employed in the Act, was meant to have a broader meaning than the common law of "unfair competition" as well as be broader in scope than the Sherman Act and Clayton Act.[174] Under this statute, the FTC can bring claims without evidence of any agreement.[175] Congress, dissatisfied with the Supreme Court's rule of reason legal standard announced in *Standard Oil*, entrusted the FTC to continually identify and deter these unfair methods of competition.[176] Nor did Congress attempt to define the many iterations of unfair methods of

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169. Bell Atl. Corp. v. Twombly, 550 U.S. 544, 553–54 (2007); Brooke Grp. Ltd. v. Brown & Williamson Tobacco Corp., 509 U.S. 209, 227 (1993); Case T-442/08, Int'l Confederation of Societies of Authors and Composers *v.* Eur. Comm'n, ECLI:EU:T:2013:188, ¶ 87 (Apr. 12, 2013); Case 48/69, Imperial Chem. Indus. Ltd. v. Comm'n of the Eur. Communities, 1972 E.C.R. 619, 638.

170.   *See* 15 U.S.C. § 45(a)(2).

171.   *See id.*

172.   Maurice E. Stucke, *Addressing Personal Data Collection as Unfair Methods of Competition*, 38 BERKELEY TECH. L.J. 715, 723 (2023).

173.   *Id.*

174.   *Id.*

175.   FED. TRADE COMM'N: 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/p221202sec5enforce-mentpolicystatement_002.pdf [perma.cc/KN7H-HD5Z] [hereinafter FED. TRADE COMM'N: POLICY STATEMENT]; *see* 15 U.S.C. § 45(a)(2). The FTC can also challenge practices as "unfair" act if they cause or are likely to cause "substantial injury to consumers which is not reasonably avoidable by consumers themselves and not outweighed by countervailing benefits to consumers or to competition." 15 U.S.C. § 45(n).

176.   Stucke, *Addressing Personal Data Collection as Unfair Methods of Competition*, *supra* note 172, at 724.

competition, as this was futile:

> It is impossible to frame definitions which embrace all unfair practices. There is no limit to human inventiveness in this field. Even if all known unfair practices were specifically defined and prohibited, it would be at once necessary to begin over again.[177]

Congress "designed the term as a 'flexible concept with evolving content,'" and "'intentionally left [its] development . . . to the Commission.'"[178] The Supreme Court likewise noted how the standard of "unfairness" under the FTC Act "is, by necessity, an elusive one, encompassing not only practices that violate the Sherman Act and the other antitrust laws . . . but also practices that the Commission determines are against public policy for other reasons."[179]

Consequently, algorithmic collusion can fall within the term "unfair methods of competition," which Congress intended to be both far-reaching and evolving.[180] Rather than proposing a closed universe of forbidden practices, Congress left the term open-ended "so that it might include all devices which would tend to deceive or take unfair advantage of the public and so that it might not be confined within the narrow limits of existing law."[181]

Depending on how courts apply Section 5 of the FTC Act, a narrow avenue to attack STC's conscious parallelism may emerge. The FTC's current monopolization case against Amazon includes allegations of tacit algorithmic collusion as an unfair method of competition.[182] As the FTC alleged:

> Amazon created a secret algorithm internally codenamed "Project Nessie" to identify specific products for which it predicts other online stores will follow Amazon's price increases. When activated, this algorithm raises prices for those products and, when other stores follow suit, keeps the now-higher price in place. Amazon has deemed Project Nessie "an incredible success": it has generated more than $1 billion in excess profit for Amazon. Aware of the public fallout it risks, Amazon has turned Project

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177.   F.T.C. v. R. F. Keppel & Bro., Inc., 291 U.S. 304, 310 n.1 (1934) (noting how the committee carefully considered "whether it would attempt to define the many and variable unfair practices which prevail in commerce," and concluding that "there were too many unfair practices to define, and after writing 20 of them into the law it would be quite possible to invent others"); *see also* S. Rep. No. 597, at 13 (2d Sess. 1914).

178.   F.T.C. v. Wyndham Worldwide Corp., 799 F.3d 236, 243 (3d Cir. 2015) (quoting F.T.C. v. Bunte Bros., 312 U.S. 349, 353 (1941) and Atl. Ref. Co. v. F.T.C., 381 U.S. 357, 367 (1965)).

179.   F.T.C. v. Indiana Fed'n of Dentists, 476 U.S. 447, 454 (1986).

180.   *Unfair Competition at Common Law and under the Federal Trade Commission Source*, 20 COLUM. L. REV. 328, 331 (1920).

181.   *Id.*

182.   Complaint at ¶¶ 457–63, F.T.C. v. Amazon.com, Inc., No. 2:23-cv-01495 (W.D. Wash. Sept. 26, 2023).

Nessie off during periods of heightened outside scrutiny and then back on when it thinks that no one is watching.[183]

In 2014 Amazon employed its Project Nessie algorithm to predict the likelihood that rivals would follow an Amazon price increase "across many thousands of products in its online superstore."[184]

There was some risk since rivals did not always immediately raise their prices for those products. But as the FTC alleged, "Amazon nonetheless decided that this risk was a worthwhile tradeoff if other online stores followed Amazon's price increases at least 20% of the time."[185]

Here the FTC alleged Amazon's anticompetitive intent, including efforts to avoid detection by switching up the products that this algorithm priced and turning it off, including after the FTC began investigating the company.[186] The FTC also alleged that the "sole purpose of Project Nessie was to further hike consumer prices by manipulating other online stores into raising their prices."[187] If these allegations are true, then the FTC should prevail under its Section 5 claim.[188]

Moreover, a victory would enable the FTC to tackle STC when there is ample evidence of anticompetitive effects and intent or when rivals help facilitate tacit collusion by taking additional steps, such as communications and information exchanges among hubs. To date, the FTC has been unsuccessful in bringing these "facilitating practices" claims, as is evident in *Boise Cascade* and *Ethyl*.[189] If the Court adopts the standard 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

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183.   *Id.* at ¶ 23; *see also* Dana Mattioli, *Amazon Used Secret 'Project Nessie' Algorithm to Raise Prices*, WALL ST. J. (Oct. 3, 2023), https://www.wsj.com/business/retail/amazon-used-secret-project-nessie-algorithm-to-raise-prices-6c593706 [https://perma.cc/3RCL-VQHK].

184.   Complaint at ¶ 420, F.T.C. v. Amazon.com, Inc., No. 2:23-cv-01495-JHC (W.D. Wash. Nov. 2, 2023).

185.   *Id.* at ¶ 421.

186.   *Id.* at ¶¶ 420–31.

187.   *Id.* at ¶ 424.

188.   *See* E.I. du Pont de Nemours v. F.T.C. (*Ethyl*), 729 F.2d 128, 139 (2d Cir. 1984) (holding that "before business conduct in an oligopolistic industry may be labelled 'unfair' within the meaning of § 5 a minimum standard demands that, absent a tacit agreement, at least some indicia of oppressiveness must exist such as (1) evidence of anticompetitive intent or purpose on the part of the producer charged, or (2) the absence of an independent legitimate business reason for its conduct").

189.   Boise Cascade Corp. v. F.T.C., 637 F.2d 573, 580–81, 582 (9th Cir. 1980); *Ethyl*, 729 F.2d at 141.

defendants' anticompetitive intent or purpose, or (b) the absence of an independent legitimate business reason for the defendants' conduct.[190]

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.[191] Of course, proving this motivation and awareness may be challenging, especially when the sellers will likely argue that their hub-and-spoke framework, by itself, lacks sufficient market power. Indeed, some sellers might legitimately claim that they were unaware that the hubs were tacitly colluding. Instead, the sellers believed that the hubs were competing against each other to obtain the business of more sellers in the primary market.

But, at other times, the sellers' and hubs' intentions may be anticompetitive. 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.[192] That changed in 2007, when the Supreme Court subjected RPM to the laxer rule of reason standard in *Leegin*.[193] Putting aside the merits of that choice, the Court did recognize that RPM could be anticompetitive at times.[194] One such example occurs when manufacturers use RPM to facilitate their express collusion.[195] RPM, for example, could assist a cartel in identifying any manufacturer that "cheats" by deviating from the cartel price. By observing retail prices, the manufacturers can identify when a competitor has cut wholesale prices.[196] But RPM could also facilitate tacit collusion.[197] In concentrated industries, manufacturers may use RPM to "observe each other's pricing behavior, each

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190.   *Ethyl*, 729 F.2d at 139–40.

191.   OECD: Algorithmic Collusion: Problems and Counter-Measures, *supra* note 88, at 21.

192.   Leegin Creative Leather Prod., v. PSKS, Inc., 551 U.S. 877, 899–900 (2007).

193.   *Id.* at 900.

194.   *Id.* at 892.

195.   *Id.* (noting how resale price maintenance may facilitate a manufacturer cartel: "An unlawful cartel will seek to discover if some manufacturers are undercutting the cartel's fixed prices. Resale price maintenance could assist the cartel in identifying price-cutting manufacturers who benefit from the lower prices they offer. Resale price maintenance, furthermore, could discourage a manufacturer from cutting prices to retailers with the concomitant benefit of cheaper prices to consumers.").

196.   *Id.* at 911 (Breyer, J., dissenting, Stevens, J., Souter, J., & Ginsburg, J., joining) ("[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.").

197.   *Id.*

understanding that price cutting by one firm is likely to trigger price competition by all."[198] Like STC, an antitrust defendant could compartmentalize RPM by showing that neither the manufacturer nor any individual retailer has market power. Nonetheless, the Court in *Leegin* recognized that RPM, in helping facilitate tacit collusion, would be illegal.[199] In summary, while conscious parallelism may be legal, it may be illegal for rivals to take additional measures (like RPM) to achieve conscious parallelism.

Accordingly, if the hubs undertake additional steps to facilitate STC, the courts could enjoin this conduct. For example, the hubs could be prohibited from sharing confidential information with the other hubs or signaling price movements to each other before they become publicly available to customers of the primary market with the intent of coordinating pricing.[200]

Indeed, with strong evidence of such communications, a court might even use it as a "plus factor" to infer an agreement under Section 1 of the Sherman Act or concerted practice under Article 101 of the TFEU.[201] Most courts "examining circumstantial evidence of an antitrust conspiracy hold that circumstantial evidence consists of parallel conduct plus additional factors tending to make a conspiracy plausible."[202] Courts call these additional factors "plus factors."[203] One plus factor is when rivals share competitive information.[204]

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198.   *Id.*

199.   As the majority noted, "To the extent a vertical agreement setting minimum resale prices is entered upon to facilitate either type of cartel, it, too, would need to be held unlawful under the rule of reason." *Id.* at 893.

200.   *See* OECD: Algorithms and Collusion - Note From Italy 2 (June 21–23, 2017), https://one.oecd.org/document/DAF/COMP/WD(2017)18/en/pdf   [https://perma.cc/SC52-JK9H] [hereinafter OECD: Note From Italy].

201.   Lifewatch Services Inc. v. Highmark Inc., 902 F.3d 323, 333 (3d Cir. 2018); *see* Case T-35/92, John Deere Ltd. v. Comm'n of the Eur. Communities, 1994 E.C.R. II-993–94; *see also* Case C-8/08, T-Mobile Netherlands BV and Others v. Raad van Bestuur van de Nederlandse Mededingingsautoriteit, 2009 E.C.R. I-4575; Case C-883/19 P, HSBC Holdings plc and Others v. Eur. Comm'n, ECLI:EU:C:2023:11, ¶¶ 18–23 (Jan. 12, 2023).

202.   *In re* RealPage, Inc., No. 3:23-MD-03071, 2023 WL 9004806, at *8 n. 9 (M.D. Tenn. Dec. 28, 2023).

203.   *Lifewatch Services Inc.*, 902 F.3d at 333 ("For circumstantial evidence of an agreement . . . a plaintiff must allege both parallel conduct and something 'more,' which we have sometimes called a 'plus factor.'").

204.   The district court in *RealPage* noted how the Sixth Circuit recognizes four "plus factors" that, "when combined with parallel conduct, raise a plausible inference of an antitrust conspiracy." *In re RealPage, Inc.*, 2023 WL 9004806, at *8. These factors were:

> (1) whether the defendants' actions, if taken independently, would be contrary to their economic self-interest; (2) whether defendants have been uniform in their actions; (3) whether defendants have exchanged or have had the opportunity to exchange

Of particular interest would be the seemingly unilateral public statements directed from each hub to its prospective clients about how their algorithms help their clients avoid price wars.[205] Such statements may well act as a signaling mechanism among hubs to facilitate industry awareness of the desired common strategy.[206]

Likewise, courts could establish liability for the spokes when these rivals were aware that joining the hub would yield higher anticompetitive prices.[207] Their adherence could be construed as part of a horizontal conspiracy manifested through vertical spokes.[208]

Competition agencies know that these hubs are advertising their ability to raise prices and avoid competition.[209] As one economic study found, some hubs even use "economic textbook language of collusion."[210] However, as of early 2024, the antitrust agencies have

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information relative to the alleged conspiracy; and (4) whether defendants have a common motive to conspire.

Id. (quoting *In re* Travel Agent Comm'n Antitrust Litig., 583 F.3d 896, 907 (6th Cir. 2009)). "Ordinarily, an affirmative answer to the first of these factors will consistently tend to exclude the likelihood of independent conduct." *Id.*

205.   *See* Wieting & Sapi, *supra* note 123, at 5–6; *How to Avoid a Price War on Amazon: A Seller's Guide*, REPRICER.COM (Nov. 10, 2023, 5:05 PM), https://www.repricer.com/blog/avoid-price-war-on-amazon/ [perma.cc/98EM-RJUD]; *see also* OECD: Note From Italy, *supra* note 200, at 3 (observing how "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'"); 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/   [perma.cc/3YDF-EZXY] (stating that its price optimization software can "put an end to price wars before they even begin").

206.   *See* Valspar Corp. v. E.I. Du Pont De Nemours & Co., 873 F.3d 185, 207, 208, 423 (3d Cir. 2017) (Stengel, J., dissenting); William E. Kovacic, Robert C. Marshall, Leslie M. Marx & Halbert L. White, *Plus Factors and Agreement In Antitrust Law*, 110 MICH. L. REV. 393, 423 (2011) (recognizing that a company's redistributions of gains and losses—or "true-ups"—are circumstantial evidence of a conspiracy); RICHARD A. POSNER, ANTITRUST LAW 87–92 (2d ed. 2001) (explaining Posner's fourteen "plus factors" including signaling); *In re* Dynamic Random Access Memory (DRAM) Indirect Purchaser Antitrust Litig., 28 F.4th 42, 47–48 (9th Cir. 2022) (assessing the plaintiffs' eight plus factors: "(1) price signaling; (2) complex, simultaneous, and historically unprecedented decreases in capital investment; (3) supply cuts against Defendants' self-interest; (4) public statements encouraging supply cuts; (5) changed conduct between the start and end of the class period; (6) information exchanges between Defendants regarding future supply and demand; (7) high market concentration; and (8) prior criminal convictions for price fixing").

207.   *See* Case 74/14, "Eturas" UAB and Others v. Lietuvos Respublikos Konkurencijos Taryba, ECLI:EU:C:2016:42, ¶ 28 (Jan. 21, 2016).

208.   Toys "R" Us, Inc. v. F.T.C., 221 F.3d 928, 935–36 (7th Cir. 2000); *see* Interstate Cir. v. United States, 306 U.S. 208, 227 (1939).

209.   *See* OECD: Note From Italy, *supra* note 200, at 3 n.3. OECD (2017), https://one.oecd.org/document/DAF/COMP/WD(2017)18/en/pdf. These notes are shared with the competition authorities and made public.

210.   Wieting & Sapi, *supra* note 123, at 5.

not challenged STC under this signaling theory. One potential obstacle is that the pricing hubs will likely argue that their marketing statements merely form unilateral action and do not show that the hubs agreed among themselves to tamper with prices.[211] The hubs will likely point to evidence of the hubs competing against each other for more customers. Thus, the hubs' signaling may not suffice for antitrust liability under Section 1 of the Sherman Act[212] or Article 101,[213] but if coupled with evidence of anticompetitive effects and intent should violate Section 5 of the FTC Act.[214]

C. Target the Data Exchange Within Each Hub

Whereas pure tacit collusion will escape scrutiny under Section 1 of the Sherman Act and Article 101 of the TFEU, enforcers could challenge the hub-and-spoke structures at the base of STC.[215] One avenue, which the plaintiffs are pursuing in *RealPage* and *Yardi*, is to focus on the exchange of information between the spokes and the hub.[216] To continually calculate the profit-maximizing price, the hub's algorithms need data—in particular, as the *Yardi* complaint outlines, "detailed, timely, competitively sensitive, and nonpublic information" from each subscribing rival about their operations to continually update their dynamic pricing.[217] As the court in *RealPage* noted, a company using the services of a hub would not turn over this highly sensitive

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211.   *See In re* Dynamic Random Access Memory (DRAM) Indirect Purchaser Antitrust Litig., 28 F.4th at 48 ("even if Samsung intended to signal the other Defendants to raise prices, Samsung's unilateral action does not suggest a conspiracy under the Sherman Act"); Williamson Oil Co. v. Philip Morris USA, 346 F.3d 1287, 1310 (11th Cir. 2003) (finding that the alleged signaling by the cigarette manufacturers does not "tend to exclude the possibility that the primary players in the tobacco industry were engaged in rational, lawful, parallel pricing behavior that is typical of an oligopoly").

212.   *See* 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, 1323 (11th Cir. 2003).

213.   *See* Kelvin Hiu Fai Kwok, *The Concept of 'Agreement' Under Article 101 TFEU: A Question of EU Treaty Interpretation*, 44 EUR. L. REV. 196 (2019). A key factor is the extent to which signaling lessens each company's uncertainty as to the future attitude of its competitors. Joined Cases C-89, 104, 114, 116, 117, 125, 126, 127, 128 & 129/85, A. Ahlström Osakeyhtiö and Others v. Comm'n of the Eur. Communities (Wood Pulp II), 1993 E.C.R. I-1599.

214.   FED. TRADE COMM'N: POLICY STATEMENT, *supra* note 175, at 5–6.

215.   *See* Complaint at ¶ 117, Duffy v. Yardi Sys., No. 2:23-cv-01391 (W.D. Wash. Sept. 8, 2023); Kleen Products LLC v. Georgia-Pac. LLC, 910 F.3d 927, 931 (7th Cir. 2018); *In re* RealPage, Inc., No. 3:23-MD-03071, 2023 WL 9004806, at *15 (M.D. Tenn. Dec. 28, 2023).

216.   *See* Complaint at ¶ 117, Duffy, No. 2:23-cv-01391; *In re RealPage, Inc.*, 2023 WL 9004806, at *15.

217.   Complaint at ¶ 117, Duffy, No. 2:23-cv-01391.

data about its current supply, production, and pricing plans to the hub if the algorithm would then use the data to help other rivals better compete.[218] Instead, each competitor turns over its sensitive data to the hub knowing that rivals subscribing to the same algorithm will do the same and that doing the same will not place them at a competitive disadvantage.[219]

One potential obstacle is when the information exchange travels in one direction: namely, when the downstream competitors share their data with the hub, and the hub does not reshare the rivals' information with other downstream competitors. In both the Las Vegas case (*Gibson v. MGM Resorts International*) and *RealPage*, the plaintiffs alleged that the spokes supplied the hub's algorithm with competitively sensitive, nonpublic data.[220] But for the District of Nevada court, this was insufficient: "Plaintiffs never quite allege (though they suggest by implication) that Hotel Operators get nonpublic information from other Hotel Operators by virtue of using insufficiently specified algorithmic pricing software."[221] Basically, the commercially sensitive data has to flow in both directions. The *RealPage* court sensibly never required the hub to recirculate each rival's nonpublic, confidential data back to the rivals.[222] It was sufficient to plead that the hub maintained a common pool of commercially sensitive information at its disposal, skillfully interpreted the data, and proposed a supracompetitive price that the spokes nearly always adopt.[223] This exchange, as the *RealPage* court

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218.   *In re RealPage, Inc.*, 2023 WL 9004806, at *15 ("Viewing all of the alleged circumstantial evidence holistically, including the parallel conduct discussed earlier, the Court finds that the Multifamily Complaint's most persuasive evidence of horizontal agreement is the simple undisputed fact that each RMS Client Defendant provided RealPage its proprietary commercial data, knowing that RealPage would require the same from its horizontal competitors and use all of that data to recommend rental prices to its competitors.").

219.   *Id.*

220.   Plaintiffs' Memorandum of Points and Authorities in Opposition to Defendants' Joint Motion to Dismiss the Complaint with Prejudice, Gibson v. MGM Resorts Int'l, No. 2:23-cv-00140-MMD-DJA (D. Nev. May 11, 2023), 2023 WL 4264109 (alleging that the hub's algorithms were "fueled by real-time access to [the defendants'] competitively sensitive and nonpublic data regarding occupancy, rates, and guests, and output pricing recommendations that can then be uploaded directly into clients' property management systems"); *In re RealPage, Inc.*, 2023 WL 9004806, at *17.

221.   Gibson, No. 2:23-cv-00140-MMD-DJA, 2023 WL 7025996, at *4. The court recognized that "confidential information is fed in, but less clearly out, of the algorithms." *Id.* at *5. To be illegal, the court seemed to require that each hotel operator receives confidential information belonging to another hotel operator. *See id.*

222.   *In re RealPage, Inc.*, 2023 WL 9004806, at *15 (defendants arguing that plaintiffs never alleged that the defendants "shared their sensitive pricing and supply information with each other").

223.   *Id.*

noted, along with the other "plus factors" were sufficient to allege a conspiracy even though each rival did not see the information.[224]

Interestingly, a case over a century old, *American Column & Lumber, Co.*, supports the *RealPage* court's interpretation.[225] There, the Supreme Court noted that:

> Genuine competitors do not make daily, weekly, and monthly reports of the minutest details of their business to their rivals, as the defendants did; they do not contract, as was done here, to submit their books to the discretionary audit, and their stocks to the discretionary inspection, of their rivals, for the purpose of successfully competing with them; and they do not submit the details of their business to the analysis of an expert, jointly employed, and obtain from him a "harmonized" estimate of the market as it is, and as, in his specially and confidentially informed judgment, it promises to be. This is not the conduct of competitors, but is so clearly that of men united in an agreement, express or implied, to act together and pursue a common purpose under a common guide that, if it did not stand confessed a combination to restrict production and increase prices in interstate commerce, and as, therefore, a direct restraint upon that commerce, as we have seen that it is, that conclusion must inevitably have been inferred from the facts which were proved. To pronounce such abnormal conduct on the part of natural competitors, controlling one third of the trade of the country in an article of prime necessity, a "new form of competition," and not an old form of combination in restraint of trade, as it so plainly is, would be for this court to confess itself blinded by words and forms to realities which men in general very plainly see, and understand and condemn, as an old evil in a new dress and with a new name.[226]

In that case, the fact that the commercially sensitive information went to each rival was not determinative.[227] The defendants would likely have been liable even if they did not receive information from their rivals. Instead, two things were paramount for the Court: first, the rivals shared their commercially sensitive data with a hub, in that case, a "skilled interpreter of the published reports," who analyzed the data "to insistently recommend harmony of action likely to prove profitable in proportion as it is unitedly pursued."[228] Second, the rivals complied with the "skilled" interpreter's recommendations, thereby inflating lumber prices.

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224.   *Id.* at *16–17. The district court also distinguished the alleged facts in *RealPage* and *Gibson*. In Las Vegas, the court found that "it is unclear whether the pricing recommendations generated to Hotel Operators include [competitors'] confidential information fed in; perhaps they only get their own confidential information back, mixed with public information from other sources." *Id.* at *17. In contrast, the Multifamily Complaint in *RealPage* "unequivocally alleges that RealPage's revenue management software inputs a melting pot of confidential competitor information through its algorithm and spits out price recommendations based on that private competitor data." *Id.* This "critical difference" between the complaints "destroy[ed] the analogy." *Id.*

225.   Am. Column & Lumber Co. v. United States, 257 U.S. 377, 410–12 (1921).

226.   *Id.* at 410.

227.   *Id.* at 410–11.

228.   *Id.* at 411.

The plaintiffs in *RealPage* used the information exchange as a "plus" factor to prove circumstantially a hub-and-spoke conspiracy.[229] Alternatively, plaintiffs can challenge solely the agreement to transfer sensitive information to the hub to optimize the collective position of the spokes. Today, information exchanges among rivals are typically reviewed under antitrust's rule of reason standard,[230] the very same standard the Supreme Court criticized for "produc[ing] notoriously high litigation costs and unpredictable results."[231]

D. Targeting the Joining of the Hub-and-Spoke Framework

A different approach to tackling STC focuses on the sellers in the primary market outsourcing their pricing to the hub. The outsourcing of dynamic pricing to a third-party provider may reflect a common business practice, but it is not always procompetitive. Instead, as more competitors rely on hubs for pricing, STC may result.

One issue with this approach is whether outsourcing pricing to a hub can be procompetitive. As the BOL study found, pricing algorithms benefitted consumers for products in markets with many competitors (at least nine sellers) and at least two sellers were using an outside pricing hub.[232] While the Buy Box price significantly declined under that circumstance, as of early 2024 the price impact when most of the nine sellers relied on third-party pricing hubs is unknown.[233]

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229.   *In re RealPage, Inc.*, 2023 WL 9004806, at *9, 15.

230.   As Justice Sotomayor, as an appellate judge, noted:

The Supreme Court resolved the confusion in United States v. Citizens & Southern National Bank, clarifying that "the dissemination of price information is not itself a per se violation of the Sherman Act." 422 U.S. 86, 113, 95 S.Ct. 2099, 45 L.Ed.2d 41 (1975). In United States v. United States Gypsum Co., the Court explained its reasoning: "The exchange of price data and other information among competitors does not invariably have anticompetitive effects; indeed such practices can in certain circumstances increase economic efficiency and render markets more, rather than less, competitive." 438 U.S. 422, 441 n. 16, 98 S.Ct. 2864, 57 L.Ed.2d 854 (1978). The Court then set out the basic framework for the rule of reason inquiry in this context: "A number of factors including most prominently the structure of the industry involved and the nature of the information exchanged are generally considered in divining the procompetitive or anticompetitive effects of this type of interseller communication."

Todd v. Exxon Corp., 275 F.3d 191, 199 (2d Cir. 2001).

231.   Kimble v. Marvel Ent., LLC, 576 U.S. 446, 459–60 (2015) (quoting in part Arizona v. Maricopa Cnty. Med. Soc., 457 U.S. 332, 343 (1982)).

232.   *See* Wieting & Sapi, *supra* note 123, at 33–34.

233.   *See, e.g.*, *id.* at 34.

Nor are the efficiencies from outsourcing pricing to third-party algorithms apparent.[234] In the German gas station study, the monopoly gas stations' use of a third-party pricing algorithm had no discernable impact on their margins and price.[235] This would suggest that outsourcing the pricing to the hubs had no quantifiable efficiencies. In the BOL study, by contrast, the Buy Box price "decreased [on average] by 13 percent if the monopolist seller" was using a pricing algorithm compared to traditional sellers in the same position.[236] This would suggest significant efficiencies. The defendants in *RealPage* made only "a fleeting reference" to the procompetitive benefits of their use of a common pricing hub.[237] But the defendants' proffered justifications—namely how the use of RealPage's algorithm "can help users maximize asset value and reduce vacancy," "eliminates manual research into market conditions and other manual tasks," and "manages inventory to avoid large numbers of residents moving in or out of a property at the same time"—were not procompetitive.[238] Instead, as the plaintiffs argued and the court agreed, the proffered efficiencies were "all about making more money for the defendants."[239] But we should expect that defendants (whether in *RealPage* or other cases) will offer procompetitive justifications, especially if these algorithms can increase competition and lower prices for consumers. Thus, an open empirical question is when does the outsourcing of pricing to a third-party hub yield substantial efficiencies.

If the answer is rarely, and if, instead, the outsourcing of pricing to hubs will generally be anticompetitive, then the antitrust standard is straightforward: competitors cannot outsource. Here courts can employ the per se illegal standard or a modified quick-look standard;[240] whereby the outsourcing is presumed anticompetitive,

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234. *See infra* note 235 and accompanying text.

235. *See* Assad et al., *supra* note 47, at 27 n.47.

236. Wieting & Sapi, *supra* note 123, at 31.

237. *In re* RealPage, Inc., No. 3:23-MD-03071, 2023 WL 9004806, at *29 (M.D. Tenn. Dec. 28, 2023).

238. *Id.*

239. *Id.* (noting how defendants' "proffered justifications only concern Defendants themselves—their desires to maximize revenue, syncopate move-out dates, and reduce their own administrative costs. Defendants have offered no explanation for how their desires benefit the market as a whole.").

240. Much confusion surrounds the application of the quick-look approach endorsed by the Supreme Court in several cases. *See infra* note 241. Therefore, this Article offers a modified, clearer quick-look standard.

unless the defendants can prove that the outsourcing yields significant procompetitive benefits and no lesser restrictive alternatives exist.[241]

Otherwise, if competitors' outsourcing of their pricing to hubs yields mixed outcomes, whereby it can be procompetitive under some circumstances, and anticompetitive under other circumstances, then at least three problems arise.

First is deterrence. If courts cannot easily and quickly discern when the outsourcing is anticompetitive under the rule of reason standard, then the result will likely be under deterrence. Few plaintiffs would undertake the expense of this massive undertaking if they would likely fail. So the anticompetitive conduct would go unchallenged.

Second is the rule of law. Suppose the courts can easily discern when the outsourcing is anticompetitive. Nonetheless, it would be difficult to discern at what point the rivals' outsourcing to hubs tips the market toward STC. Such a standard is fraught under the rule of law ideals, as it is difficult for market participants and the courts to accurately and predictably determine when one is liable under this post hoc market inquiry. Is a company liable when the second seller joins the hub, the third, tenth, or hundredth? Does liability depend on market characteristics or the scale of analytical services that evolved after the seller joined the hub?

A third problem is the antitrust remedy. If procompetitive effects can arise if fewer rivals outsource their pricing to hubs, then it becomes unclear which rivals must cease using the hubs. One approach is to require rivals with relatively larger market shares to cease using a pricing hub, leaving smaller rivals to the hubs. But when rivals have similar market shares, it will be hard to decide which rivals can use the hub and which ones cannot. With evolving technology and

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241.   This modified quick-look standard circumnavigates the confusion inherent in the Supreme Court's quick-look approach. *See* Stucke, *supra* note 162, at 1410–12. For example, under the Supreme Court's quick-look approach, it is unclear what happens after the defendants offer a viable procompetitive justification under the quick look. Does the standard revert to a full-blown rule of reason where the plaintiffs must prove anticompetitive effects under the first step of the rule of reason or does the court move on to the third step of the rule of reason where the plaintiff must show a lesser restrictive alternative? In United States v. Brown Univ., 5 F.3d 658, 668 (3d Cir. 1993), the court opted for the latter. But that case settled after being remanded. It is also unclear whether the rule of reason has three or four steps, where under the last step, the plaintiffs show that the anticompetitive effects outweigh the procompetitive benefits. *See* Epic Games, Inc. v. Apple, Inc., 67 F.4th 946, 993 (9th Cir. 2023). If the rule of reason has four steps, then even if the plaintiffs cannot show lesser restrictive alternatives under the third step, it could proceed to the fourth step. But, as defendants would argue, after the defendants proffer a procompetitive business justification, the quick look ultimately must revert to the first step of the rule of reason where the court assesses the restraint's anticompetitive effects. Our modified quick-look approach reflects this and subsequently limits itself to the first step of the Supreme Court's approach.

analytical capabilities, the limiting principles that will govern intervention in such cases are likely to be difficult to ascertain. Uncertainty as to the point at which intervention may be triggered risks chilling valuable innovation on the market.[242] Difficulties ascertaining the nature of services each hub provides further compound the problem.[243]

A possible means of addressing these challenges is if the antitrust agencies design an auditing algorithm that monitors these hubs' pricing suggestions.[244] However, this assumes that one can audit how the hub's algorithm reached its recommendation for each client and the competitive price benchmark, especially in markets with dynamic pricing. Moreover, as more market participants outsource pricing to third-party hubs, the principal question remains: At what level of analysis should one intervene? Relatedly, is intervention merited when alignment emerged organically using similar data points and advanced analytics? Would intervention be justifiable when the hub occupies a small portion of the market, just because of the risk of STC? The answer is simple when outsourcing pricing is more often anticompetitive than procompetitive: Prohibit outsourcing. But there is no clear answer when the competitive effects are mixed.

Noteworthy here are the two economic studies of the algorithmic collusion happening in two significant European markets: retail gasoline and online shopping.[245] Nonetheless, as of early 2024, neither the European Commission nor member states are investigating the German gas markets or the BOL.com shopping platform. (While antitrust investigations are non-public, the press often learns of the investigation through subpoenas to third parties or disclosures in securities filings.) This most likely reflects the challenges in prosecuting STC under the current law (where the

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242.   *See* Ezrachi & Stucke, *supra* note 32, at 150–51.

243.   *See generally* Digital Regulation Cooperation Forum, *Auditing Algorithms: The Existing Landscape, Role of Regulators and Future Outlook*, Gov.uk (Sept. 22, 2022), https://www.gov.uk/government/publications/findings-from-the-drcf-algorithmic-processing-workstream-spring-2022/auditing-algorithms-the-existing-landscape-role-of-regulators-and-future-outlook [perma.cc/6M9X-K793]. Auditing the algorithms and input used may offer some insights to the level of coordination fostered by the hub. With advanced analytics and use of artificial intelligence, such tasks become more challenging. *See, e.g., id.*; OECD: Auditing as Policy – Note by Cathy O-Neill 3 (July 7, 2023), https://one.oecd.org/document/DAF/COMP/WD(2023)74/en/pdf [https://perma.cc/6ZYY-YF55].

244.   *See* OECD Background Note, *supra* note 36, at 9, 34; *see also* Gov.UK Competition & Mkts. Auth., *supra* note 60.

245.   *See* Assad et al., *supra* note 47, at 39; Wieting & Sapi, *supra* note 123, at 40.

enforcer must prove concerted activity under Article 101) rather than any apathy about the harmful effects.[246] So, what else can be done?

E. Market Investigations and Merger Control

As this Article's prior subparts have explained, enforcers other than the FTC do not have adequate tools to challenge STC directly. The FTC might do so when there is strong evidence of anticompetitive effects and intent, and the defendants lack non-pretextual, procompetitive business justifications. Two alternative enforcement tools may offer effective intervention and deter STC: market investigations and merger control.[247] The former could help the competition enforcers and courts better understand the risks of STC and possibly enable specific remedies. Furthermore, in undertaking these market investigations, the competition agencies might better realize the role of mergers in fostering STC.

1. More Market Investigations to Better Understand the Risks

As early as 2018, the German Monopolies Commission recommended that the government "systematically investigate markets with algorithm-based pricing for adverse effects on competition."[248] Among the key concerns the 2018 report raised are pricing algorithms that help competitors elude detection for their price fixing or algorithms

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246.   Challenges associated with establishing algorithmic hub-and-spoke effects on the downstream market, are compounded by challenges linked to distinguishing collusive signaling from tacit collusion on the upstream market. In its 2019 submission to the OECD, the EU Commission outlined its approach to hub-and-spoke arrangement in the online context. OECD: Hub-and-spoke arrangements – Note by the European Union 6 (Dec. 4, 2019), https://one.oecd.org/document/DAF/COMP/WD(2019)89/en/pdf   [https://perma.cc/2XNL-YYG7]. Further insight as to the EU Commission's approach may be found in the 2023 Guidelines on horizontal cooperation agreements that consider indirect information exchange. *See* European Commission, Guidelines on the Applicability of Article 101 of the Treaty on the Functioning of the European Union to Horizontal Co-Operation Agreements, 69, 75, (Jan. 6, 2023), https://competition-policy.ec.europa.eu/system/files/2023-07/2023_revised_horizontal_guidelines_en.pdf [perma.cc/7RCQ-FUJ3]; OECD: Algorithms and Collusion – Note from the European Union 7–8 (June   14,   2017),   https://one.oecd.org/document/DAF/COMP/WD(2017)12/en/pdf [https://perma.cc/E2NQ-XVP5] (discussing EU approach to algorithmic collusion). *See generally* YVES-ALEXANDRE DE MONTJOYE, HEIKE SCHWEITZER & JACQUES CRÉMER, COMPETITION POLICY FOR THE DIGITAL ERA (EU Comm'n, 2019), https://op.europa.eu/en/publication-detail/-/publication/21dc175c-7b76-11e9-9f05-01aa75ed71a1/language-en [perma.cc/X5V6-QJMF].

247.   *See* Michal S. Gal & Daniel L. Rubinfeld, *Algorithms, AI and Mergers* 17 (N.Y.U. L. & Econ. Rsch., Working Paper No. 23–36, 2023) (analyzing the possible use of merger review to limit algorithmic coordination).

248.   Press Release, Monopolkommission [German Monopolies Commission], Digital Change Requires Legal Adjustments Regarding Price Algorithms, the Media Sector and the Supply of Medicines (July 3, 2018).

that—with or without humans' help—tacitly collude.[249] Amendments introduced in 2023 to the German Competition Act expanded the powers of the German Federal Cartel office to order remedies following such a market investigation.[250]

The good news is that more agencies are reviewing means to improve the effectiveness of investigations and remedies, hiring data scientists and technologists, and critically evaluating competition dynamics in digital markets.[251] In the United Kingdom, for example, the Competition and Markets Authority has engaged in market studies and investigations examining various aspects of the digital economy, from online platforms to advertising and cloud services.[252]

In the United States, the FTC alone possesses the subpoena power to conduct these market investigations.[253] Thus, the FTC, using its authority under the FTC Act, can identify market conditions and behavior that increase the risk of STC. Moreover, the FTC can better understand when outsourcing of pricing to hubs does not yield efficiencies. Finally, market studies might identify practices that facilitate STC.

2. Improving Merger Review

As part of the appraisal of merger transactions between hubs, the relevant competition agency could inquire whether the post-

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249.   *Id.*

250.   Press Release, Bundeskartellamt/German Competition Act, Amendment to the German Competition Act [Gesetz gegen Wettbewerbsbeschränkungen – GWB; 11th amendment to the GWB] (Nov. 7, 2023).

251.   *See* OECD Background Note, *supra* note 36, at 7.

252.   For example: in October 2023, the UK CMA launched a market investigation into cloud services. *Cloud Services Market Investigation*, COMPETITION & MKTS. AUTH. (Dec. 20, 2023), https://www.gov.uk/cma-cases/cloud-services-market-investigation#:~:text=On%205%20Octo-ber%202023%2C%20Ofcom,study%20page%20for%20more%20information.&text=Re-sponses%20to%20issues%20statement%20published [perma.cc/WVD4-KPJD]. In 2019 the CMA published its 'Online platforms and digital advertising market study.' *Online Platforms and Digital Advertising Market Study*, COMPETITION & MKTS. AUTH. (July 1, 2020), https://www.gov.uk/cma-cases/online-platforms-and-digital-advertising-market-study [perma.cc/5JJL-CM76]; *see also* GOV.UK COMPETITION & MKTS. AUTH., *supra* note 60.

253.   *A Brief Overview of the Federal Trade Commission's Investigative, Law Enforcement, and Rulemaking Authority*, FED. TRADE COMM'N https://www.ftc.gov/about-ftc/mission/enforce-ment-authority [perma.cc/54JK-UJ5D] (last visited Jan. 27, 2024) (noting the Commission's authority under Section 6(b) of the FTC Act empowers it to require an entity to file "annual or special . . . reports or answers in writing to specific questions" to provide information about the entity's "organization, business, conduct, practices, management, and relation to other corporations, partnerships, and individuals" and "conduct wide-ranging studies that do not have a specific law enforcement purpose" (citing 15 U.S.C. § 46(b)), while Section 6(f) of the Act "authorizes the Commission to 'make public from time to time' portions of the information that it obtains, where disclosure would serve the public interest" (citing 15 U.S.C. § 6(f))).

transaction market could more easily tilt toward STC. Both the FTC and DOJ can challenge mergers under Section 7 of the Clayton Act.[254] Using the FTC's market study findings, the FTC and DOJ can lower their threshold for reviewing and challenging mergers under Section 7 of the Clayton Act in markets susceptible to STC.[255] As of early 2024, however, the agencies have not raised concerns about STC in their merger review, at least not publicly.[256] In fact, the antitrust agencies under earlier administrations were relatively permissive, even when confronted with possible increases in market power that could foster a change in market dynamics.[257] The 2022 *ProPublica* article that sparked the RealPage litigation noted how a merger contributed to the anticompetitive outcome:

> 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.[258]

The US antitrust agencies typically do not disclose why they closed their merger investigation. But under traditional merger review, the agency would have likely considered the impact of the RealPage-Lease Rent Options merger on the buyers of the AI pricing software, namely the property managers. But as this Article has shown, these buyers would benefit if the merger increases the risk of STC, as this will enable them to increase their charges. So the buyers would not complain. Instead, the real victims from the merger are the millions of tenants further downstream, who likely knew nothing of the merger, but now, according to the antitrust complaints, collectively pay billions of dollars more in rent annually as a result of the secondary tacit collusion.

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254.   *Id.*

255.   *See* Terrell McSweeny & Brian O'Dea, *The Implications of Algorithmic Pricing for Co-ordinated Effects Analysis and Price Discrimination Markets in Antitrust Enforcement*, 32 ANTITRUST MAG. 75, 77 (2017). *See generally* OECD: Algorithms and Collusion – Note by the United States 4 n.11 (June 21–23, 2017), https://www.ftc.gov/system/files/attachments/us-submis-sions-oecd-2010-present-other-international-competition-fora/algorithms.pdf   [perma.cc/QWZ2-AKXR] ("Section 7 of the Clayton Act forbids mergers or acquisitions that, among other things, substantially increase the risk of anticompetitive coordination.").

256.   *See, e.g.*, *Press Releases*, FED. TRADE COMM'N https://www.ftc.gov/news-events/news/press-releases [perma.cc/GNY5-Z62P] (last visited Jan. 27, 2024) (no press releases regarding secondary algorithmic collusion).

257.   *See* Vogell et al., *supra* note 16.

258.   *Id.*

In a step forward, the DOJ and FTC's 2023 merger guidelines consider the risks of tacit algorithmic collusion.[259] This Article also advocates that they additionally assess whether the merger may facilitate STC and thereby harm customers of the primary market. The good news, at least from the BOL study, is that outsourcing pricing to hubs can, under certain market conditions, increase, rather than diminish, competition.[260] But as of early 2024, it remains unknown when STC is likelier than competition. Thus, in assessing whether the merger increases the risk of STC, the DOJ and FTC should consider the following non-exclusive factors:

(1) whether many competitors in the primary market outsource their pricing to a third-party vendor;

(2) any history of STC, which would indicate that this kind of market "has not always been protected by competitive market forces;"[261]

(3) the level of analytical and data services the hubs offer;

(4) the kind of data the hubs collect;

(5) 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 in the primary market, and any deviations from the current equilibrium;

(6) any practices contemplated or undertaken by the hubs to facilitate STC;

(7) whether conscious parallelism among the hubs would also be facilitated and stabilized to the extent (i) the rival hubs' pricing reactions are predictable, (ii) through repeated interactions, the hubs' pricing algorithms "could come to 'decode' each other, thus allowing each one to better anticipate the other's reaction,"[262] and (iii) once deviation (e.g., discounting) is detected, a credible deterrent mechanism exists;[263]

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259.   MERGER GUIDELINES, *supra* note 28, at 9.

260.   *See* Wieting & Sapi, *supra* note 123, at 34.

261.   Chi. Bridge & Iron Co. N.V., Chi. Bridge & Iron Co., and Pitt-Des Moines, Inc., F.T.C. Docket No. 9300, 2003 WL 27387332, at *9 (2003) (quoting In the Matter of the Coca-Cola Co., 117 F.T.C. 795, 960 (1994)).

262.   OECD: Algorithms and Collusion – Note from the European Union, *supra* note 246, at 8.

263.   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

(8) 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;

(9) the ability and incentives of remaining hubs, post-transaction, to foster alignment;

(10) the rationale for the merger, including whether the merger will help improve the algorithms' ability to increase the profits of the vendors' clients; and finally

(11) whether disruptive or maverick operators operate on the secondary market, how the transaction may affect their incentives and interdependence, and whether they are being acquired.

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. Instead, they ought to also consider the risk of tacit collusion in the secondary market, which in turn could result in higher prices for the ultimate consumers of the primary market (e.g., the apartment tenants).

3. Educating the Courts

Courts must also recognize the risks of STC and take these into account when considering market dynamics. In the area of merger control in particular, courts should recognize that the purpose of merger law is to address potential harms, rather than certainties, and agencies must present evidence within this framework.[264] A problem emerges when courts view themselves as "fortune tellers"[265] charged with predicting what *will* happen post-merger.[266] As courts themselves

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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.

264.   *See also* Stucke, *The Good, the Bad, and the Ugly of US Antitrust*, *supra* note 162, at 286.

265.   New York v. Deutsche Telekom AG, 439 F. Supp. 3d 179, 186 (S.D.N.Y. 2020) ("Adjudication of antitrust disputes virtually turns the judge into a fortuneteller.").

266.   The irony is that the courts often identify the purpose of Section 7 of the Clayton Act —"to arrest anticompetitive tendencies in their incipiency." Illumina, Inc. v. Fed. Trade Comm'n, 88 F.4th 1036, 1050 (5th Cir. 2023); United States v. UnitedHealth Grp. Inc., 630 F. Supp. 3d 129 (D.D.C. 2022). But these courts then effectively read the incipiency standard out of the statute. Compare 15 U.S.C. § 18 (prohibiting mergers where "the effect of such acquisition *may* be substantially to lessen competition, or to *tend* to create a monopoly") *with UnitedHealth Grp.*, 630 F. Supp. 3d at 132, 133 (explaining that "the text of Section 7 is concerned only with mergers that 'substantially . . . lessen competition,'" and by requiring on rebuttal a showing that the merger will "preserve exactly the same level of competition that existed before the merger, the Government's proposed standard would effectively erase the word 'substantially' from Section 7"); *Illumina*, 88

recognize, this soothsaying invites the "battalions of the most skilled and highest-paid attorneys in the nation" to "enlist the services of other professionals—engineers, economists, business executives, academics"—to "render expert opinions regarding the potential procompetitive or anticompetitive effects of the transaction."[267] Merger review becomes a "murky function [that] demands a massive enterprise."[268] Or consider another court describing how unwieldy antitrust merger litigation has become:

> The trial transcript surpasses 3,600 pages, accompanied by at least fifty binders containing exhibits presented to witnesses. The live testimony was augmented by more than 2,700 pages of excerpts from the depositions of seventeen additional witnesses. More than a thousand exhibits were admitted into evidence. Post-trial written submissions by the parties exceeded six hundred pages. This tidal wave of evidence reflects both the state of antitrust litigation and the "unprecedented" nature of the [challenged agreement].[269]

Judges are not innately gifted fortune tellers, nor are they charged with this function under Section 7 of the Clayton Act.[270]

The FTC and DOJ's 2023 merger guidelines seek to restore the congressionally intended "incipiency" standard and "trend toward concentration."[271] As the draft guidelines stated, Section 7 is a preventative statute that reflects the "mandate of Congress that tendencies toward concentration in industry are to be curbed in their incipiency."[272] This means mergers should not further a trend toward concentration since the Clayton Act "was designed to arrest

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F.4th at 1050 (same); F.T.C. v. Microsoft Corp., No. 23-CV-02880-JSC, 2023 WL 4443412, at *13 (N.D. Cal. July 10, 2023) ("It is not enough that a merger might lessen competition—the FTC must show the merger will probably substantially lessen competition."). As the Supreme Court observed, this reading contravenes the purpose of section 7, which sought to erect "a barrier to what Congress saw was the rising tide of economic concentration, was its provision of authority for arresting mergers at a time when the trend to a lessening of competition in a line of commerce was still in its incipiency. Congress saw the process of concentration in American business as a dynamic force; it sought to assure the Federal Trade Commission and the courts the power to brake this force at its outset and before it gathered momentum." Brown Shoe Co. v. United States, 370 U.S. 294, 317–18 (1962).

267.   *Deutsche Telekom*, 439 F. Supp. 3d at 186 (noting how in most cases, "the litigation consumes years at costs running into millions of dollars").

268.   *Id.*

269.   United States v. Am. Airlines Grp., No. CV 21-11558-LTS, 2023 WL 3560430, at *2 (D. Mass. May 19, 2023).

270.   Stucke, *The Good, the Bad, and the Ugly of US Antitrust*, *supra* note 162, at 290; *Microsoft*, 2023 WL 4443412, at *8 (citing 15 U.S.C. § 18).

271.   Merger Guidelines, *supra* note 28, at 22.

272.   Fed. Trade Comm'n & Dep't of Just.: Draft FTC-DOJ Merger Guidelines for Public Comment 1–2 (2023) (quoting Brown Shoe Co. v. United States, 370 U.S. 294, 346 (1962)), https://www.ftc.gov/system/files/ftc_gov/pdf/p859910draftmergerguidelines2023.pdf [https://perma.cc/9963-F2FT].

anticompetitive tendencies in their incipiency."[273] Accordingly, in analyzing a proposed merger, neither the agencies nor the courts are tasked with predicting the future or the precise effects of a merger with certainty.[274] Instead, "the mandate of Congress [is] that tendencies toward concentration in industry are to be curbed in their incipiency, particularly when those tendencies are being accelerated through giant steps striding across a hundred cities at a time."[275] A merger between two pricing hubs can represent such a giant step, in materially increasing the risk of STC across hundreds of markets, thereby harming millions of consumers. Thus, even if the government cannot prove definitively that STC *will* occur post-merger, it does not have to under the Clayton Act: "A requirement of certainty and actuality of injury to competition is incompatible with [the Clayton Act's] effort to supplement the Sherman Act by reaching incipient restraints."[276] Instead, the government only has to show a "reasonable probability" of STC, which means something more than "a mere possibility"[277] but far less than the certainty that some courts now require.

Since courts historically have relied on antitrust agencies' merger guidelines in assessing mergers,[278] agencies should be more direct in their guidelines. For example, the guidelines should have steps in analysis (like the 1992 merger guidelines), with step one being quite direct: The agencies and courts are not fortune tellers.[279] The legal standard is not whether the merger *will* substantially lessen competition or *will* create a monopoly. That contravenes congressional intent.[280] Instead, under Section 7 of the Clayton Act, the agency and court must assess whether the merger *may* substantially lessen competition or *tend* to create a monopoly.[281] Step two would assess

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273.   *Id.* at 1.

274.   *Id.* at 2 ("Agencies do not seek to predict the future or the precise effects of a merger with certainty.").

275.   Brown Shoe Co. v. United States, 370 U.S. 294, 345–46 (1962).

276.   *Id.* at 323 n. 39 (quoting S. Rep. No. 1775, 81st Cong., 2d Sess. 6, U.S. Code Cong. and Adm. News 1950, p. 4298).

277.   *Id.*

278.   F.T.C. v. Sysco Corp., 113 F. Supp. 3d 1, 38 (D.D.C. 2015) (noting that the "Merger Guidelines are not binding, but the Court of Appeals and other courts have looked to them for guidance in previous merger cases").

279.   *See also* FED. TRADE COMM'N & DEP'T OF JUST.: 1992 MERGER GUIDELINES 24 (1992), https://www.justice.gov/archives/atr/1992-merger-guidelines [https://perma.cc/24EQ-S6FN].

280.   *See* Stucke, *The Good, the Bad, and the Ugly of US Antitrust*, *supra* note 162, at 284.

281.   *See* Robert H. Lande, *Textualism as an Ally of Antitrust Enforcement: Examples from Merger and Monopolization Law*, 2023 UTAH L. REV. 813, 826 (2023).

whether the merger is presumptively illegal under *Philadelphia National Bank* and *Brown Shoe*.[282]

Under step three, if the merger is not presumptively illegal, courts should inquire if it runs afoul of Section 7's incipiency standard. Here, the agencies can improve their merger guidelines by not simply articulating the different theories of harm, but in in better articulating how courts should apply the law's incipiency standard to the theories of harm, including STC.

V. CONCLUSION

Antitrust enforcers and courts cannot simply accept secondary algorithmic tacit collusion as a natural market outcome. Although the enforcers' current antitrust tools are limited, they should be employed, especially when illicit actions, anticompetitive intent, and collective efforts to facilitate tacit collusion "contaminate" the hub-and-spoke framework. STC presents a challenge to digital markets and accelerates the alignment of price and business terms. Its reliance on hub-and-spoke frameworks could, however, offer a point for intervention under current laws. But agencies will need to create other tools. While regulation may offer a valuable ex-ante framework in some instances,[283] 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, market forces will not 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. As experts in their field, the pricing hubs understand the cost of price wars to their clients and the benefits of avoiding them. Now, AI can enable them to advance this strategy with limited exposure to antitrust sanctions. For the sellers on the primary market, advanced algorithmic pricing and real-time data are attractive. Sellers 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 which supports their goal for increased profitability.

While good for the hubs and sellers, consumers will pay the price—whether at the gas pump, shopping online, booking a hotel, or

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282.   United States v. Phila. Nat'l Bank, 374 U.S. 321, 362–63 (1963); Brown Shoe Co. v. United States, 370 U.S. 294, 346 (1962).

283.   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. 2022 O.J. (L 265) 1; 2022 O.J. (L 277) 1.

looking for an apartment. As the hubs' AI learns, consumers can expect a greater sophistication of price optimization software, its increased adoption in many more markets, and more instances of STC. Consumers should also expect to pay slightly more than the competitive price, even in markets that are seemingly competitive with many sellers ostensibly chasing for their business.

So, by undertaking market investigations, the agencies can better understand the risks of STC and the efficiencies, if any, in outsourcing pricing to hubs. By using Section 5 of the FTC Act, the FTC can target facilitating practices that foster STC. Finally, once they better understand the risks of STC, the agencies can educate the courts on these risks, and thereby protect consumers against the risk of STC.