Written Testimony of Maurice E. Stucke
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Chair Klobuchar, Ranking Member Lee, and distinguished members of the Subcommittee:

Thank you for the opportunity to testify before you today.

Ariel Ezrachi and I raised the risks of algorithmic collusion and discrimination in our articles[1] and 2016 book.[2] Thereafter, enforcers and policymakers began taking notice.[3]

A 2022 ProPublica article examined how RealPage has sold rent pricing software to property managers, thereby boosting the landlords' profits.[4] Thereafter, over twenty private antitrust lawsuits have been brought against RealPage and some of the nation's larger property managers for colluding under Section 1 of the Sherman Act.[5] RealPage's software, AI Revenue Management (formerly known as YieldStar), "is currently responsible for the pricing of 8% of all rentals units nationwide."[6] Property managers using YieldStar saw their occupancy rate decline (from 97% to

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[1] *How Pricing Bots Could Form Cartels and Make Things More Expensive*, HARVARD BUSINESS REVIEW, Oct. 2016; *Artificial Intelligence & Collusion: When Computers Inhibit Competition*, 2017 UNIVERSITY OF ILLINOIS LAW REVIEW 1775 (2017); *Tacit Collusion on Steroids – The Tale of Online Price Transparency, Advanced Monitoring and Collusion*, 3 COMPETITION LAW & POLICY DEBATE 24 (2017); Algorithmic Collusion: Problems and Counter-Measures (23 June 2017), Report commissioned by the Organisation for Economic Co-operation and Development for its Competition Committee's Roundtable on Algorithms and Collusion (21-23 June 2017); *Antitrust, Algorithmic Pricing, and Tacit Collusion*, *in* RESEARCH HANDBOOK ON THE LAW OF ARTIFICIAL INTELLIGENCE (Woodrow Barfield & Ugo Pagallo eds., Edward Elgar Publishing 2018); *Sustainable and Unchallenged Algorithmic Tacit Collusion*, 17 NORTHWESTERN JOURNAL OF TECHNOLOGY & INTELLECTUAL PROPERTY 217 (2020).
[2] VIRTUAL COMPETITION: THE PROMISE AND PERILS OF THE ALGORITHM-DRIVEN ECONOMY (Cambridge, MA: Harvard University Press 2016).
[3] *See, e.g.*, OECD, Algorithms and Collusion (2017); OECD (2023), Algorithmic Competition, OECD Competition Policy Roundtable Background Note, www.oecd.org/daf/competition/algorithmic-competition-2023.pdf.
[4] Heather Vogell, *Rent Going Up? One Company's Algorithm Could Be Why*, PROPUBLICA (Oct. 15, 2022), https://www.propublica.org/article/yieldstar-rent-increase-realpage-rent.
[5] In re RealPage, Inc., Rental Software Antitrust Litig., No. MDL 3071, 2023 WL 2875737, at *1 (U.S. Jud. Pan. Mult. Lit. Apr. 10, 2023) (cases allege that "the lessor defendants all employed revenue management software provided by RealPage called AI Revenue Management (formerly known as YieldStar), which gathered real-time pricing and vacancy data from the lessors and made unit-specific pricing and vacancy recommendations—which the lessors allegedly agreed to adhere to, on the understanding that competing lessors would do the same—with the intent and effect of raising lease prices above competitive levels"). All of these plaintiffs alleged in their complaints that this conduct violated federal antitrust law, as well as various state antitrust and consumer protection statutes. All of these cases were transferred in 2023 to the Middle District of Tennessee for coordinated or consolidated pretrial proceedings.
[6] 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/.

95%) while their revenues increased 3-4%.[7] But RealPage is not the only pricing algorithm used in the housing markets today. Instead, according to another recently filed antitrust complaint, RealPage's primary competitor, Yardi, sets prices for at least twice the number of multi-family units than RealPage.[8] Moreover, concerns over algorithmic collusion extend beyond housing markets. Another ongoing antitrust case involves algorithmic collusion among the leading hotels on the Las Vegas Strip, which all use the same third-party algorithm.[9] The alleged consumer harm in all these cases is similar: by outsourcing their pricing to a third-party algorithm, competitors charge higher prices (despite lower occupancy levels). But even if the antitrust plaintiffs prove that the competitors use the same pricing algorithm and this leads to higher, supra-competitive pricing, they might still lose.

While enforcers and policymakers have acknowledged the risks of algorithmic collusion, their understanding varies, leading to further gaps in policy responses. Here I'll examine three policy approaches to tackle these risks. As we'll see, the overarching concern lies not only in higher prices but also in the fear of an AI-dominated bureaucracy that hinders human autonomy and well-being.

I.   THE NARROW APPROACH

Here policymakers and antitrust agencies evaluate whether the conduct facilitated by pricing algorithms violates existing antitrust laws. If the conduct is potentially illegal, the next issue is whether enforcers can readily detect a violation, prove it in court, and effectively remedy the challenged behavior.

The easy case is when humans agree to fix prices and use pricing algorithms to monitor compliance and punish any discounting. Here the Sherman Act is up to task. For example, the United States prosecuted a price-fixing case involving posters sold through Amazon Marketplace. To implement their price-fixing agreement, the competitors agreed to adopt specific pricing algorithms to coordinate their pricing.[10]

Another simple scenario is the classic hub-and-spoke cartel,[11] where rivals use a hub's pricing algorithm to facilitate their collusion. Here too the antitrust agencies can challenge this behavior under the existing law, as two European cases reflect. In one case, an online travel booking system agreed with certain travel agents to reduce discounts to 3%. If any travel agent offered a greater discount, the hub's booking algorithm automatically reduced the discount to 3%. As a result, many

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[7] *Id*.

[8] Compl. ¶ 55, filed in McKenna Duffy v. Yardi Systems, Inc., Civ. Act. No. 2:23-cv-01391 (W.D. Wash. filed Sept. 8, 2023).

[9] Compl., filed in Gibson v. MGM Resorts Int'l, Civ. Act. No. 2:23-cv-00140 (D. Nev. filed Jan. 25, 2023).

[10] Plea Agreement, filed in United States v. Topkins, No. CR 15-00201 (N.D. Cal. 2015), https://www.justice.gov/d9/atr/case-documents/attachments/2015/04/30/313686.pdf; see also Trod Ltd. and GB eye Ltd., U.K. Competition & Mkts. Auth., CMA Issues Final Decision in Online Cartel Case, GOV.UK (Aug. 12, 2016), https://www.gov.uk/cma-cases/online-sales-of-discretionary-consumer-products#infringement-decision.

[11] Interstate Circuit, Inc. v. United States, 306 U.S. 208 (1939).

participating travel agencies decreased their discounts to 3% or less.[12] In the second case, a multiple listing service (MLS) in Spain helped realtors inflate their brokerage commissions. The realtors agreed to a minimum commission of 4% on sales and one month's rent on leases. The software company, in creating the MLS, designed the software so that a real estate broker could only list a property if the broker shared the information on their commission and the actual commission was at or above the established minimum of 4%. Here both the software designer and participating real estate brokers were fined.[13]

Thus, when humans conspire, the illegality inheres in the agreement. The use of pricing algorithms to assist their collusion might make it harder, in some cases, to detect the collusion. But the issue is the sufficiency of proof, not the law itself.

On the other hand, prosecutors will have a harder time challenging under the current antitrust law (a) tacit algorithmic collusion, (b) certain "hub-and-spoke" arrangements, and (c) secondary tacit collusion (STC).

A.   TACIT ALGORITHMIC COLLUSION

Tacit collusion or conscious parallelism alone does not violate Section 1 of the Sherman Act. There must be proof of an agreement. As the Supreme Court said,

> *Tacit 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.*[14]

Tacit collusion, of course, can happen without algorithms under certain market conditions (e.g., highly concentrated markets with homogenous products, where the transparency of the key market terms enables rivals to monitor and respond quickly to their competitors' pricing and other key

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[12] In *Eturas* (C-74/14, 2016), the European court interpreted Article 101 "as meaning that, where the administrator of an information system, intended to enable travel agencies to sell travel packages on their websites using a uniform booking method, sends to those economic operators, via a personal electronic mailbox, a message informing them that the discounts on products sold through that system will henceforth be capped and, following the dissemination of that message, the system in question undergoes the technical modifications necessary to implement that measure, those economic operators may — if they were aware of that message — be presumed to have participated in a concerted practice within the meaning of that provision, unless they publicly distanced themselves from that practice, reported it to the administrative authorities or adduce other evidence to rebut that presumption, such as evidence of a systematic application of a discount exceeding the cap in question."

[13] Press Release: The CNMC fines several companies EUR 1.25 million for imposing minimum commissions in the real estate brokerage market (Dec. 9, 2021), https://www.cnmc.es/sites/default/files/editor_contenidos/Notas%20de%20prensa/2021/20211209_NP_Sancionador _Proptech_eng.pdf.

[14] Brooke Group Ltd. v. Brown & Williamson Tobacco Corp., 509 U.S. 209, 227 (1993).

terms of sale). One case, for example, involved tacit collusion leading to higher gas prices on Martha's Vineyard.[15]

But the industry-wide use of pricing algorithms can do more than facilitate conscious parallelism in markets already susceptible to it. Instead, as Ariel Ezrachi and I discuss, pricing algorithms can expand the market conditions in which tacit collusion may be possible. The speed at which pricing algorithms can detect and respond to competitors' online pricing, can inhibit rivals from gaining sales through discounts, and thereby expand tacit collusion to markets with as many as eight rivals,[16] if not more.) The result is the same as if the companies verbally agreed to fix prices, but the agencies and private plaintiffs, without proof of an agreement, cannot challenge the behavior under the Sherman Act.

Interestingly, the FTC's current monopolization case against Amazon includes allegations of tacit algorithmic collusion. The complaint's allegations involving Amazon's pricing algorithm, internally codenamed Project Nessie, were heavily redacted. But as the *Wall Street Journal* reported, the algorithm "helped Amazon improve its profit on items across shopping categories, and because of the power the company has in e-commerce, led competitors to raise their prices and charge customers more, according to people familiar with the allegations in the complaint. In instances where competitors didn't raise their prices to Amazon's level, the algorithm—which is no longer in use—automatically returned the item to its normal price point."[17] Amazon reportedly made more than $1 billion in revenue from this tacit algorithmic collusion.[18]

Since tacit algorithmic collusion does not violate Section 1 of the Sherman Act, the FTC instead is challenging Amazon's "Project Nessie" pricing system as an unfair method of competition under

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

[16] Wieting, Marcel and Sapi, Geza, Algorithms in the Marketplace: An Empirical Analysis of Automated Pricing in E-Commerce (September 30, 2021). NET Institute Working Paper No. 21-06, Available at SSRN: https://ssrn.com/abstract=3945137 or http://dx.doi.org/10.2139/ssrn.3945137. For experiments with pricing algorithms, see Bingyan Han, Understanding algorithmic collusion with experience replay, Working Paper, (March 21, 2021), arXiv:2102.09139 (finding in an infinitely repeated pricing game, pricing algorithms based on artificial intelligence (Q-learning) may consistently learn to charge supra-competitive prices even without communication); Xu, Xingchen and Lee, Stephanie and Tan, Yong, Algorithmic Collusion or Competition: the Role of Platforms' Recommender Systems (September 22, 2023). Available at SSRN: https://ssrn.com/abstract=4579458 or http://dx.doi.org/10.2139/ssrn.4579458; Emilio Calvano, Giacomo Calzolari, Vincenzo Denicolò & Sergio Pastorello, *Artificial Intelligence, Algorithmic Pricing, and Collusion*, 110 AMERICAN ECONOMIC REVIEW 3267 (2020).

[17] 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.

[18] *Id.*

Section 5 of the FTC Act.[19] Whether the court will agree (without evidence of anticompetitive intent or lack of procompetitive business justification) is another matter.[20]

B. "HUB-AND-SPOKE" ALGORITHMIC COLLUSION

Instead of using their own algorithms, rivals, over time, might outsource their pricing to a third-party vendor. Consider the pending class action lawsuit against the leading hotel operators on the Las Vegas Strip, including the Bellagio, Wynn, Caesar's Palace, MGM Grand, and Mandalay Bay. The complaint alleges that the Las Vegas Strip hotels "colluded" by outsourcing their pricing for their hotel rooms to the same company, the Rainmaker Group.[21]

The legal challenge for the antitrust enforcers and courts is in determining whether these agreements are purely vertical (between the hub and hotel) or also horizontal (among the rival hotels acting through the hub). This distinction is critical in jurisdictions, like the United States, as it determines the legal standard under which the agreement is evaluated. In the United States, purely vertical agreements are reviewed under the rule of reason standard, which as the Supreme Court recognized, entails an "elaborate inquiry" that "produces notoriously high litigation costs and unpredictable results."[22] Likewise, several justices called the rule of reason "amorphous"[23] and "unruly."[24] In contrast, a horizontal hub-and-spoke conspiracy would be per se illegal.

A hub-and-spoke antitrust conspiracy, as the courts have held, "involves a hub, generally the dominant purchaser or supplier in the relevant market, and the spokes, made up of the distributors involved in the conspiracy. The rim of the wheel is the connecting agreements among the

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[19] Compl. ¶¶ 457-63, filed in FTC v. Amazon.com, Civ. Act. No. 2:23-cv-01495 (W.D. Wash. filed Sept. 26, 2023); see also Fed. Trade Comm'n, Policy Statement Regarding the Scope of Unfair Methods of Competition Under Section 5 of the Federal Trade Commission Act (November 10, 2022), https://www.ftc.gov/legal-library/browse/policy-statement-regarding-scope-unfair-methods-competition-under-section-5-federal-trade-commission.

[20] E.I. du Pont de Nemours v. Fed. Trade Comm'n (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").

[21] Compl. filed in Gibson v. MGM Resorts Int'l, Civ. Act. No. 2:23-cv-00140 (D. Nev. filed Jan. 25, 2023).

[22] Kimble v. Marvel Ent., LLC, 576 U.S. 446, 459 (2015) (quoting in part Arizona v. Maricopa County Medical 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 JOURNAL OF ANTITRUST ENFORCEMENT 283 (2023); *Does the Rule of Reason Violate the Rule of Law?*, 42 U.C. DAVIS LAW REVIEW 1375 (2009).

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

[24] FTC v. Actavis, Inc., 570 U.S. 136, 173 (2013) (Roberts, C.J., dissenting, with Justices Scalia and Thomas 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 570 U.S. at 149).

horizontal competitors (distributors) that form the spokes."[25] So, a critical legal issue for a per se violation of the Sherman Act "is how the spokes are connected to each other."[26]

On the one hand, to be liable, the Las Vegas hotels need not agree with each other to fix prices or outsource their pricing to Rainmaker all at the same time.[27] In the leading antitrust hub-and-spoke case, the Supreme Court held that the movie distributors (the spokes) could be liable when

> *[e]ach distributor was advised that the others were asked to participate; each knew that cooperation was essential to successful operation of the plan. They knew that the plan, if carried out, would result in a restraint of commerce, which, . . . was unreasonable within the meaning of the Sherman Act, and knowing it, all participated in the plan. The evidence is persuasive that each distributor early became aware that the others had joined. With that knowledge they renewed the arrangement and carried it into effect for the two successive years.*[28]

On the other hand, if each Las Vegas hotel chain independently decided to use Rainmaker's algorithm after independently calculating that it would be more profitable to do so, then it is unlikely that a court would find any horizontal conspiracy. Instead, there are a series of vertical agreements, which would be evaluated under antitrust's problematic rule of reason standard.

To illustrate the difficulty in challenging this behavior, suppose the first Las Vegas hotel used Rainmaker's dynamic pricing algorithm to increase its profits. Also, suppose that it was never told (nor did it anticipate) that its rivals would use Rainmaker's algorithm. Suppose the second and third Las Vegas hotels later opt to use Rainmaker's pricing algorithm for its efficiency gains rather than any anticompetitive purpose. As more Las Vegas hotels use Rainmaker's pricing algorithm, the company acquires even more data for its price optimization algorithm, which, as a result, can better assess market conditions (and pricing strategies of subscribers). As more Las Vegas hotels rely on Rainmaker for pricing their rooms, the hub's pricing algorithm incrementally affects more of the Strip's hotel market. As Rainmaker's pricing accounts for a larger share of the Strip, the Rainmaker's pricing can increasingly behave independently of the remaining hotels on the Strip (who are not using its pricing algorithm). Rainmaker's success and data reach can now attract the remaining Las Vegas hotels, making it harder for another AI pricing optimization company to enter and compete. As Rainmaker's clients' profits increase, it might become harder for the remaining

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[25] In re Elec. Books Antitrust Litig., 859 F. Supp. 2d 671, 690 (S.D.N.Y. 2012) (quoting Howard Hess Dental Laboratories Inc. v. Dentsply Int'l, Inc., 602 F.3d 237, 255 (3d Cir. 2010)).
[26] In re Ins. Brokerage Antitrust Litig., 618 F.3d 300, 327 (3d Cir. 2010) (quoting Total Benefits Planning Agency, Inc. v. Anthem Blue Cross & Blue Shield, 552 F.3d 430, 436 (6th Cir. 2008)).
[27] Interstate Cir. v. United States, 306 U.S. 208, 227 (1939) (noting that it "is elementary that an unlawful conspiracy may be and often is formed without simultaneous action or agreement on the part of the conspirators").
[28] *Id*. at 226-27.

hotels to forego these profits. So, they too switch to Rainmaker, and eventually 90+% of rivals coalesce around one AI revenue management provider. Rainmaker's pricing strategy becomes the de facto market price. The evidence in the case may prove otherwise. The point here is that pricing algorithms can create substantial efficiency gains and reduce transaction costs.[29]

The legal challenge is when does a series of vertical agreements become an illegal horizontal hub-and-spoke? Certainly, the first hotel operator could not be liable for collusion when it initially outsourced its pricing to Rainmaker's algorithm, as none of its rivals were using Rainmaker at the time. It might not even be when the second or third hotel operator join, if the prices were not supra-competitive (given the competition from the remaining hotel operators). One can imagine the difficulty in assessing when the arrangement started resembling a hub-and-spoke and when does liability accrue. And who is liable? The early adopters? Late adopters? Or everyone? The early adopters would likely argue that when they joined, they did not anticipate the other rivals to join. Nor was there any understanding to that effect. So it would be unfair to hold them liable for the later actions of their rivals, which they neither wished nor anticipated.

If the hub's algorithm uses purely public information, it will be difficult to challenge these vertical agreements as a hub-and-spoke. Instead, the plaintiff would have to challenge each vertical agreement under the Supreme Court's "amorphous," "unruly" rule of reason standard – a costly endeavor yielding unpredictable results. So, as with tacit algorithmic collusion, the harm to consumers may be the same as if the rivals actually conspired, but challenging it will be difficult under current antitrust laws.

There may be another avenue for liability, namely, if the competitors continuously share competitively sensitive, non-public data with the hub. That is what the plaintiffs in the Las Vegas class action alleged.[30] A company ordinarily would not share competitively sensitive and nonpublic data with the hub, if it knew that the hub's algorithm could use that data to help rivals undercut the company. Thus, the rivals will continuously share this non-public information with the knowledge that the hub will use it to their mutual advantage.[31] Consequently this information sharing could be used as a plus factor to establish a conspiracy or challenged by itself (albeit under the Court's rule of reason standard[32]).

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[29] 2023 OECD Report at 10-11.

[30] Plaintiffs' Memorandum of Points and Authorities in Opposition to Defendants' Joint Motion to Dismiss the Complaint with Prejudice, filed in Gibson v. MGM Resorts International, 2023 WL 4264109 (D. Nev. filed May 11, 2023) (alleging that "Rainmaker's algorithms are 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").

[31] *Id.* (alleging that each defendant hotel operators knows that its "competitors participate in and contribute data to Rainmaker's pricing and forecasting algorithm and were thus assured that their supracompetitive pricing would not be undercut").

[32] United States v. U.S. Gypsum Co., 438 U.S. 422, 441 n. 16 (1978).

C.   SECONDARY TACIT COLLUSION

Now consider a market in which many different sellers outsource their pricing to different competing pricing hubs. In theory, this should not raise any antitrust concerns, with so many sellers in the primary market and multiple pricing hubs in the secondary market. After all, one hub would not recommend to its clients higher prices for their products, when doing so risks their clients' losing significant sales to rival sellers, using pricing algorithms by rival hubs. As a result, the hubs' price optimization algorithms, in theory, should compete against each other, and both the primary and secondary markets should remain competitive.

But as Ariel Ezrachi and I discuss in a recent paper, when the secondary market satisfies the conditions for tacit algorithmic collusion (such as transparency of the prices that the rival algorithms recommend to its clients and the speed to respond to any discounts that the rival sellers' offer, based on the rival hub's suggestion), we may witness the emergence of conscious parallelism.[33] Basically, under these conditions, the hubs' pricing algorithms learn to collude, by suggesting higher prices to their clients, in the recognition that suggesting lower prices will erode the clients' profits and willingness to use the hub's services.

That may be the case in the RealPage and Yardi antitrust cases – numerous property managers relied on either Yardi's or RealPage's price optimization software. So, even if the plaintiffs prove that millions of tenants were harmed by having to pay higher rents, they might still lose if the court finds that the hubs' algorithms were tacitly colluding.

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

Indeed two recent economic studies have found evidence of higher prices as a result of pricing algorithms, and both cases appear to fall within the category of secondary tacit collusion. The first economic study was of German gas station markets. In dividing their sample between monopoly and non-monopoly markets, the study's authors found that when gas stations operating in Germany adopted algorithmic-pricing software, the margins in *non-monopoly* markets

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[33] Ezrachi, Ariel and Stucke, Maurice E., *The Role of Secondary Algorithmic Tacit Collusion in Achieving Market Alignment*, VANDERBILT JOURNAL OF ENTERTAINMENT AND TECHNOLOGY LAW (forthcoming 2024); working paper (August 21, 2023), University of Oxford Centre for Competition Law and Policy, Working paper CCLP(L)54, University of Tennessee Legal Studies Research Paper, Available at SSRN https://ssrn.com/abstract=4546889 or http://dx.doi.org/10.2139/ssrn.4546889.

increased by 11% on average over pre-adoption levels.[34] In comparison, in monopoly markets, these gas stations experienced only a small, non-statistically significant change in their margins. Likewise, average prices rose in *non-monopoly* markets, but not in monopoly markets.[35] This is consistent with tacit collusion rather than efficiencies. The economic study next examined duopoly markets. When one gas station adopted the pricing algorithm, and the other did not, margins and prices, on average did not change. But when both gas stations adopted the algorithms, the algorithms learned to tacitly collude, margins gradually increased on average by nearly 38%, and "the distribution of margins and prices generally shifts right."[36]

The study did not focus on which gas stations relied on which particular pricing hubs. But the gas stations did not rely on a single hub. Instead, there were multiple hubs, including a2i and Kalibrate that had contracts with German brands Orlen and Tamoil/HEM.[37] Other rivals included PDI[38] and PriceAdvantage.[39]

The second economic paper studied algorithmic pricing on Bol.com, the largest online marketplace in the Netherlands and Belgium.[40] Based on more than two months of pricing data for around 2,800 popular products, the study found evidence of algorithmic collusion by sellers that rely on at least six different pricing algorithm providers. For products with 3 to 5 sellers, for example, the study found that the Buy Box price was only very mildly affected if only one seller was using a pricing algorithm service; but prices increased 4% if two algorithmic sellers were present. This finding was compatible with secondary tacit collusion. The study found on average higher prices for products with as many as 8 sellers (some of whom were using pricing algorithms), and algorithmic sellers won the buy box more often than traditional sellers. The higher prices, the study found, was "in line with the statements made by re-pricer software vendors, who explicitly advertise their ability to raise prices and avoid competition, even using economic textbook language of collusion."

[34] Assad, Stephanie; Clark, Robert; Ershov, Daniel; Xu, Lei (2021): Algorithmic Pricing and Competition: Empirical Evidence from the German Retail Gasoline Market, CESifo Working Paper, No. 8521, Center for Economic Studies and Ifo Institute (CESifo), Munich.

[35] *Id*. at 29.

[36] *Id.* at 38-39.

[37] Moreover, fuel retailers in over 40 countries use Kalibrate's Fuel Pricing to "maximize fuel profits." - https://kalibrate.com/products/software/kalibrate-pricing/

[38] https://pditechnologies.com/convenience-retail/increase-profits/#

[39] https://www.priceadvantage.com/fuel-pricing-software/why-priceadvantage/

[40] Wieting, Marcel and Sapi, Geza, Algorithms in the Marketplace: An Empirical Analysis of Automated Pricing in E-Commerce (September 30, 2021). NET Institute Working Paper No. 21-06, Available at SSRN: https://ssrn.com/abstract=3945137 or http://dx.doi.org/10.2139/ssrn.3945137. When the number of sellers increased to six and 8 competitors, prices increased (but not as much with 3 to 5 sellers). For products with 9 or more sellers (with at least two using algorithms) prices significantly reduced: "To sum up, consistently with tacit collusion, with medium number of competitors two algorithmic agents in the market lead to increased Buy Box prices. With a high number of rivals, algorithmic sellers compete fiercely, reducing the Buy Box prices."

Thus, under all three scenarios, consumers pay higher prices, and enforcers cannot easily challenge this anticompetitive behavior under traditional antitrust law.

II.   SLIGHTLY BROADER APPROACH

This approach acknowledges the challenges in detecting and prosecuting algorithmic collusion. To prevent these risks, enforcers and policymakers should consider other available tools, such as the merger review process. One bit of good news from the online shopping study was that tacit collusion dropped off for products with more than eight sellers.[41] More empirical work is needed to understand the threshold where algorithmic collusion drops off (especially in the context of secondary tacit collusion where there may be dozens of sellers but the hubs learn to tacitly collude).

One important tool is market investigations. The DOJ Antitrust Division, however, lacks subpoena power to conduct these market investigations. But the FTC has the authority. With more data scientists and technologists,[42] the FTC can identify markets susceptible to algorithmic collusion and evaluate whether proposed mergers would facilitate such behavior. Based on these findings, the FTC and DOJ may lower their threshold for reviewing and challenging mergers in other markets susceptible to tacit algorithmic collusion, hub-and-spoke algorithmic collusion, and STC.

Thus, to combat tacit algorithmic collusion, the agency might start looking at more markets and more 7-to-6, 6-to-5, and 5-to-4 mergers, and reconsider their approach to conglomerate mergers when tacit algorithmic collusion can be facilitated by multimarket contacts.[43]

Similarly, to prevent hub-and-spoke algorithmic collusion, agencies would consider, among other things, whether:
- many competitors in that market outsource their pricing to a single third-party vendor;
- the leading pricing algorithm will likely improve post-merger, as the algorithm will have more data and more opportunities to experiment with higher prices and refine its pricing strategies for each client; and
- the leading algorithm, programmed to increase the profits of the vendor's clients, will likely tamper with market prices.

In assessing the risk of secondary tacit collusion post-merger, agencies would consider, among other things, mergers involving:
- leading vendors of price optimization algorithms (here the concern is not solely the potential increase in prices to the companies using the vendors' services, but the softening of competition in downstream markets);

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[41] *Id.*

[42] See 2023 OECD Paper at 32-33 for other jurisdictions' hiring in this area.

[43] The FTC and DOJ are updating their merger guidelines to address algorithmic tacit collusion. See DOJ & FTC 2023 Draft Merger Guidelines at 10.

- acquisitions of mavericks that do not use any hubs' price optimization algorithms; or
- markets where secondary tacit collusion is already occurring.

By leveraging merger law, agencies can prevent potential harm. However, the agencies' success depends on judicial interpretation of the legal standard. Congress intended Section 7 of the Clayton Act to reach "incipient" harms.[44] What this means, as the Supreme Court "ha[s] observed many times," is that the merger law is "a prophylactic measure, intended primarily to arrest apprehended consequences of intercorporate relationships before those relationships could work their evil."[45] Given the Clayton Act's incipiency standard, the Supreme Court stated that the merger law "can deal only with probabilities, not with certainties" and that a more onerous legal burden would contradict "the congressional policy of thwarting [anticompetitive mergers] in their incipiency."[46] Consequently, the agency needs to show only "an appreciable danger" of algorithmic collusion post-merger; not that prices *will* increase post-merger.[47]

But courts must recognize that the purpose of merger law is to address potential harms, rather than certainties, and agencies must present evidence within this framework. The problem is when courts disagree. Over the past couple of decades, some courts view themselves as "fortune tellers" charged with predicting what *will* happen post-merger.[48] 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."[49] Judges are not innately gifted fortune tellers. Nor are they charged with this function under the Clayton Act.

But one thing is predictable: the agencies will likely lose these merger challenges, if the court requires them to prove, contrary to congressional intent, that prices *will* increase post-merger. And we will continue to pay the price.

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[44] Brown Shoe Co., Inc. v. United States, 370 U.S. 294, 317-23 (1962); United States v. Philadelphia Nat'l Bank, 374 U.S. 321, 362 (1963); FTC v. Procter & Gamble Co., 386 U.S. 568, 577 (1967).
[45] Brunswick Corp. v. Pueblo Bowl-O-Mat, Inc., 429 U.S. 477, 485 (1977).
[46] FTC v. Procter & Gamble Co., 386 U.S. 568, 577 (1967).
[47] See DOJ & FTC Draft Merger Guidelines (2023).
[48] 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."); United States v. Am. Airlines Grp. Inc., No. CV 21-11558-LTS, 2023 WL 3560430, at *2 n.1 (D. Mass. May 19, 2023) (noting how merger review has become an unwieldy process); Fed. Trade Comm'n v. Microsoft Corp., No. 23-CV-02880-JSC, 2023 WL 4443412 (N.D. Cal. July 10, 2023) (imposing on the government the burden to prove that the merger "will" substantially lessen competition).
[49] *Deutsche Telekom*, 439 F. Supp. 3d at 186 (noting how in most cases, "the litigation consumes years at costs running into millions of dollars").

III.   A BROADER ECOSYSTEM APPROACH

The concerns underlying algorithmic collusion go beyond economic implications. Policymakers must recognize the broader risks associated with AI and algorithmic decision-making. These risks extend to the potential dehumanization and loss of human autonomy as AI assumes critical functions in society.

Consider, for example, the Center for AI Safety's statement signed by numerous academics and AI executives: "Mitigating the risk of extinction from AI should be a global priority alongside other societal-scale risks such as pandemics and nuclear war."[50]

Why the concern?

The Biden administration's *Blueprint for an AI Bill of Rights* identifies many risks involving AI, including examples where it has already harmed individuals.[51] Many of the *Blueprint*'s examples reflect the heightened risks of an AI-dominated bureaucracy. It can be hard to deal with a bureaucracy today, whether seeking a satisfying explanation or remedy. This applies to corporate bureaucracies (such as understanding why the dominant platform delisted an app or product) or government bureaucracies (such as why the agency terminated or never approved a benefit). But the hope is that someone deep in that organization can explain the action and remedy any error.

AI-dominated bureaucracies pose greater challenges when the decision-making becomes more opaque and less accountable. As AI assumes more critical functions, and as the factors considered in reaching that decision increase in complexity, it will be harder to decipher why the algorithm did what it did and obtain relief within the bureaucracy. As the AI-dominated bureaucracy becomes harder to avoid, it becomes more dehumanizing.

Consider one example from the *Blueprint*: an insurer collects data from a person's social media presence in deciding what life insurance rates to apply. Now consider the sensitive personal data that AI can also consider in many domains where individuals cannot effectively opt out, such as "health, employment, education, criminal justice, and personal finance." Suppose the insurer's algorithm considers and weighs hundreds, if not thousands, of factors. Suppose the company cannot explain exactly how its algorithm arrived at the quoted rate, but it is less concerned given that the AI-generated rates are increasing profits. Now imagine that other insurers, to increase margins, also use AI. What option does the consumer have? Except in the more egregious cases,

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[50] Center for AI Safety, Statement on AI Risk: AI experts and public figures express their concern about AI risk, https://www.safe.ai/statement-on-ai-risk.

[51] White House Office of Science and Technology Policy, *The Blueprint for an AI Bill of Rights: Making Automated Systems Work for the American People* (Oct. 2022), https://www.whitehouse.gov/wp-content/uploads/2022/10/Blueprint-for-an-AI-Bill-of-Rights.pdf.

consumers cannot decipher exactly how the algorithm arrived at the price, identify any spurious correlations, or show how the algorithm improperly used their sensitive personal data.

The implications of AI are, of course, broader. We might not even know if an algorithm was responsible for passing over our resume, denying our client bail, or cutting off a disabled person from Medicaid-funded home healthcare assistance.

Thus, AI, for our purposes, raises at least three overarching concerns.

First is that few people are actually considering the potential broad-scale risks of AI. As one 2023 report observed, "Despite nearly USD 100 billion of private investment in AI in 2022 alone, it is estimated that only about 100 full-time researchers worldwide are specifically working to ensure AI is safe and properly aligned with human values and intentions."[52]

Second is the legal void over the design, use, and deployment of AI to prevent harm. The Biden administration's *Blueprint*, for example, offers five principles to effectively guide this process (promoting safe and effective systems; algorithmic discrimination protections; protecting data privacy; notice and explanation – so that we know when an automated system is being used and understand how and why it contributes to outcomes that impact us; and human alternatives, consideration, and fallback – so that we can opt out, where appropriate, and have access to a person who can quickly consider and remedy problems that we may encounter). But the *Blueprint's* principles, while a good start, are non-binding and do not constitute U.S. governmental policy. So, policymakers must agree upon the principles to address potential harms from AI (including antitrust, privacy, and consumer protection concerns), and how to implement these principles into law.

A *third* concern involves the broader ecosystem underlying AI. A few data-opolies currently dominate many key sectors of the digital economy.[53] As a result they can control the path of innovation within their vast ecosystems.[54] Given the volume and variety of data and tremendous computational power to teach AI, the fear is that "training the most powerful AI systems will likely remain prohibitively expensive to all but the best-resourced players."[55] So, while there may be many applications that use ChatGBT or PaLM, only a few powerful companies will control the infrastructure underlying these generative AI models. Here, policymakers must consider the broader societal harms from such concentration, including the impact on innovation paths, and the

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[52] Future of Life Institute, *Policymaking in the Pause, What can policymakers do now to combat risks from advanced AI systems?* (April 19, 2023).
[53] For the implications on our privacy, well-being and autonomy, see MAURICE E. STUCKE, BREAKING AWAY: HOW TO REGAIN CONTROL OVER OUR DATA, PRIVACY, AND AUTONOMY (Oxford, U.K.: Oxford University Press 2022).
[54] ARIEL EZRACHI & MAURICE E. STUCKE, HOW BIG-TECH BARONS SMASH INNOVATION — AND HOW TO STRIKE BACK (New York, NY: HarperCollins 2022).
[55] Future of Life Institute at 7.

tools they will need – including updated antitrust, consumer protection, and privacy tools – to mitigate these harms.

CONCLUSION

AI will only compound the legislative deficit to date, such as failing to update the antitrust laws and providing individuals with greater control over their personal data through privacy legislation.

Consequently, addressing algorithmic collusion requires a multi-faceted approach.

The narrow approach informs policymakers of the strengths and weaknesses of their current antitrust tools. Congress might consider endorsing the FTC's use of its authority under Section 5 of the FTC Act to tackle algorithmic collusion. In addition, Congress might consider displacing the unwieldy rule of reason standard with clearer legal presumptions regarding certain vertical restraints.

The slightly broader approach can point to updating other tools, such as merger review, to minimize these risks. The good news is that Congress, through bi-partisan efforts, has proposed some of the tools necessary, such as restoring the incipiency standard in merger review.[56]

Finally, any comprehensive policy response must address not only the algorithmic collusion concerns but also the other myriad risks associated with AI. This would include privacy legislation where individuals, without penalty,
- would have to opt into the collection and use of personal data for behavioral advertising,
- could opt out of firms' combining data about them from either third parties or across their ecosystem's services to profile them (except as otherwise allowed with adequate safeguards, such as credit reports under the Fair Credit Reporting Act),
- could opt out of personalized services, and
- could decide the right to limit at the onset what personal data is collected about them and for what non-advertising purpose.

Thus under the broader ecosystem approach, Congress can promote not only competition but human autonomy and well-being in an increasingly algorithm-driven digital age.

I look forward to answering your questions. Thank you.

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[56] See, e.g., The Competition and Antitrust Law Enforcement Reform Act, S.225; Prohibiting Anticompetitive Mergers Act of 2022, S.3847.