COMPLIANCE AND ETHICS SPOTLIGHT

ALGORITHMS: CHALLENGES AND OPPORTUNITIES FOR ANTITRUST COMPLIANCE

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The Compliance and Ethics Committee is pleased to publish the second in a series of special reports by the Tech Compliance Working Group on the impact of new technologies on antitrust compliance. Algorithms are increasingly being used by firms for a virtually limitless range of applications driving economic growth, transforming markets around the world, improving automation, efficiency and quality. The prevalent use of algorithms—their ability to aggregate and use data to effect almost instantaneous reactions to changes in market conditions—has been attracting increasing attention from competition and consumer protection authorities around the world, who are concerned about the risk of potentially collusive outcomes that market transparency-enhancing algorithms may enable. In this report, the authors outline the potential antitrust risks and compliance challenges posed by the use of algorithms and offer practical guidelines for consideration when developing compliance programs or advising clients on their risk exposure.

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Executive Overview: Algorithms and Antitrust Compliance in a Nutshell

What is an algorithm?

- An algorithm is programmed code containing a series of rules and formulas that are performed in a specific order to accomplish a specified task.

- Algorithms range from simple formulations that involve the use of heuristic rules to perform repetitive tasks more efficiently than humans, to more complex codes able to analyze large amounts of data and solve difficult problems.

- Algorithms have a variety of uses, including use by businesses for predictive analytics and the optimization of business processes.

Why are algorithms receiving so much attention?

- Algorithms are being used throughout the digital economy and are attracting increasing attention from competition and consumer protection authorities around the world.

- Algorithms have been the topic of numerous hearings, statements and reports by international competition authorities.

What antitrust issues do algorithms present?

- Algorithms can provide significant competitive benefits for firms and consumers, but may also present novel challenges for competition authorities assessing tacit or overt collusion, price discrimination, and product market definition for merger reviews.

- While most antitrust risk related to algorithms involves coordinated conduct, some forms of unilateral conduct, such as price signaling, may also present risks.

How should antitrust counsel advise businesses developing or employing algorithms?

- Counsel should advise businesses that algorithms should be designed and operated in a way that does not enable collusion or other anticompetitive behavior.

- Businesses should be aware of how competition authorities may use algorithms both to detect anticompetitive behavior, and as evidence during a merger review or other investigation.

I. Algorithms, Artificial Intelligence and Machine Learning

A. What Are Algorithms?

At its very essence, an algorithm is programmed code containing a series of rules and formulas that are performed in a specific order to accomplish a specified task. Algorithms vary in their complexity. Simple algorithms use heuristic rules to perform repetitive tasks that would be costly and time consuming for humans to perform.[1] More complex algorithms can be used to solve difficult problems, make predictions, and analyze large amounts of data more efficiently than humans can.[2]

From a practical perspective, algorithms are already widely used in different forms. For example, algorithms enable Uber to use dynamic pricing to match the supply of drivers with consumer demand. Algorithms also allow Amazon, Expedia, TripAdvisor and other price comparison platforms to scan and compare market prices on a wide variety of goods and services for their users. Digital butlers, like Google's Assistant, Apple's Siri or Amazon's Echo, are all powered by sophisticated algorithms designed to learn about individual users, their routines, and preferences, to provide customized services.[3]

B. Artificial Intelligence and Machine Learning

Artificial intelligence (AI) is a branch of computer science that studies and designs intelligent systems to perform complex tasks.[4] Machine learning is a subfield of AI that studies and designs intelligent machines using algorithms that learn iteratively from data and experience.[5] For example, machine learning methods have been used to help reduce the time and cost involved in the litigation discovery document review process. The document review program learns which documents are relevant, nonresponsive, privileged, or falling into other designated categories, as reviewers feed it information by way of pre-selected sample documents.

In general, there are three types of machine learning algorithms, categorized based on their learning pattern: (1) supervised learning; (2) unsupervised learning; and (3) reinforcement learning.[6] In supervised learning, an algorithm uses sample data and the associated outputs to learn the general rules that map inputs to outputs. The algorithm is able to predict outputs when confronted with new sample data by applying the general rules developed from the sample data. The litigation document review platform discussed above is an example of supervised learning.

In unsupervised learning, an algorithm uses unlabeled sample data without the associated outputs to detect hidden structures and patterns in the unlabeled sample data. The algorithm is able to predict outputs for new sample data based on the identified hidden structures and patterns. The algorithm restructures data, for example, by organizing and clustering the data based on similar underlying characteristics. This type of machine learning is employed by anomaly detection algorithms, which can help detect fraud, for example.[7]

Unlike supervised learning algorithms, which are iterative and adjust until the algorithm achieves a desired level of accuracy of its general rules, the accuracy of unsupervised learning algorithms is not evaluated as the algorithm develops. As the detection of hidden structures and patterns yield additional

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[1] OECD, DIRECTORATE FOR FINANCIAL AND ENTERPRISE AFFAIRS – COMPETITION COMMITTEE, ALGORITHMS AND COLLUSION – BACKGROUND NOTE BY THE SECRETARIAT 6 (June 9, 2017) [hereinafter OECD BACKGROUND NOTE], *available at* https://one.oecd.org/document/DAF/COMP(2017)4/en/pdf.

[2] *Id.*

[3] Salil K. Mehra, *Robo-seller Prosecutions and Antitrust's Error-cost Framework*, COMPETITION POLICY INT'L ANTITRUST CHRONICLE 1 (May 2017), *available at* https://www.competitionpolicyinternational.com/wp-content/uploads/2017/05/CPI-Mehra.pdf.

[4] OECD BACKGROUND NOTE, *supra* note 1, at 9.

[5] *Id.*

[6] Ulrich Schwalbe, *Algorithms, Machine Learning, and Collusion*, INST. OF ECONOMICS, UNIV. OF HOHENHEIM 8-10 (June 1, 2018) [hereinafter *Schwalbe*], *available at* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3232631. *See also* OECD BACKGROUND NOTE, *supra* note 1, at 7.

[7] *Id.*; *see also* Ai Deng, Bates White Economic Consulting, *An Antitrust Lawyer's Guide to Machine Learning* 7 (Jan. 9, 2018), *available at* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3082514.

insights into the meaning of the data, the outcome of unsupervised learning can be used to supplement or evaluate supervised learning algorithms.[8]

In reinforcement learning, an algorithm performs a task in a dynamic environment to maximize some form of cumulative reward. The algorithm learns through trial and error; successful actions are rewarded while unsuccessful actions are punished. The algorithm acts to maximize the expected sum of discounted future rewards.[9] This type of learning is often part of gaming products. For example, *AlphaGo*, a reinforcement learning algorithm, beat world champions at the ancient game of Go in 2016 and 2017, and a later version of the program, *AlphaGoZero*, won all 100 games it played against *AlphaGo*. The program was able to train itself by playing against itself.[10]

C. Deep Learning

Deep learning is a subfield of machine learning. Deep learning does not refer to a type of learning, but rather is complex software that attempts to replicate the activity of the human brain (and human neurons) by creating an artificial neural network. Deep learning algorithms can be used to model and solve highly complex and abstract problems. However, these algorithms do not provide users with information about the rules that are used to predict outputs.[11]

D. Uses of Algorithms

Businesses use algorithms predominantly for predictive analytics and the optimization of business processes. Predictive analytics deploy algorithms to assess the likelihood of future outcomes based on an analysis of historical data. Using "if this, then that" reasoning, predictive analytics can estimate demand, forecast price changes, forecast market shocks, and predict consumer behavior and preferences to improve management decision making. Algorithms are also used to optimize business processes, for example, by reducing production, inventory levels, or personnel costs, or by setting dynamic pricing to target consumers more effectively.[12] The list below outlines some examples of specific uses of algorithms with potential implications for competition.

1. Ranking or Recommendation Algorithms

Ranking or recommendation algorithms gauge a consumer's preference for a good or service, and rank or present recommendations accordingly. A business may gather information on purchasing patterns of individuals and make predictions about product offerings and optimal marketing strategies. Drugstores such as CVS in the United States and Woolworths in Australia, for example, have rewards loyalty programs that communicate directly with customers based on their individual purchase history. Customers that use their loyalty program when purchasing diapers and baby formula are offered discounts on vitamin supplements for new mothers, a product that the loyalty program algorithm identifies is also relevant to those customers.[13]

Amazon's algorithms also rank products based on customer reviews or popularity. These rankings may affect a seller's sales dramatically. Fake or paid reviews may bolster a product's rankings and thus distort the competitive landscape. A 2018 *Washington Post* investigation found that for some popular product categories, like Bluetooth headphones and speakers, "the vast majority of reviews" appear to be fraudulent or paid for.[14]

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[8]   *Schwalbe*, *supra* note 6, at 8.
[9]   *Id.*; *see also* Deng, *supra* note 7.
[10] Deng, *supra* note 7, at 85.
[11] *Schwalbe*, *supra* note 6, at 8.
[12] OECD BACKGROUND NOTE, *supra* note 1, at 11-12.
[13] Chloe Olewitz, *The surprising places where algorithms are influencing your decisions*, TECHLY (Aug. 13, 2015), *available at* https://www.techly.com.au/2015/08/13/the-surprising-places-where-algorithms-are-influencing-your-decisions/.
[14] Elizabeth Dwoskin & Craig Timberg, *How merchants use Facebook to flood Amazon with fake reviews*, WASH. POST (Apr. 23, 2018), *available at* https://www.washingtonpost.com/business/economy/how-merchants-secretly-use-facebook-to-flood-amazon-with-fake-reviews/2018/04/23/5dad1e30-4392-11e8-8569-26fda6b404c7_story.html?noredirect=on&utm_term=.e07eea7b2b69.

Fake reviews were characterized by repetitive wording that people simply copied and pasted into the review. Many of the reviews originated on Facebook, where sellers seek shoppers on dozens of networks to give glowing feedback in exchange for compensation. Such practices artificially inflate rankings, misleading consumers that rely on them, while undeservedly outranking potentially superior competitors.

2. Matching Algorithms

Matching algorithms are similar to ranking and recommendation algorithms, but more specifically match buyers with sellers based on a buyer's preferences or variables that they have selected. When a consumer shops online at a particular retailer for black dress shoes for women, for example, the matching algorithm will yield black dress shoe results from all the company's brands based on the criteria specified by the user.

3. Cross-Merchandising Algorithms

Cross-merchandising algorithms promote a seller's other goods and services to a buyer based on the buyer's browsing or purchasing history. An example of this would be a search on Amazon for vacuum cleaners where Amazon also recommends filters or different nozzles that a customer can buy as add-ons. The website's algorithm may also generate prompts indicating that customers who viewed a particular product were also interested in a list of other similar or complementary products.

4. Personalized Pricing Algorithms

Personalized pricing algorithms analyze consumer preferences to determine a personalized price for a particular good or service. Allstate insurance company, for example, set up an algorithm to optimize pricing by determining the likelihood that users would compare prices before purchasing insurance. The discounts some customers received as a result were as high as 90 percent and the premiums paid by others as high as 800 percent.[15] While some may frown upon this practice and view it as unfair price discrimination, others—particularly economists—point out that the algorithm efficiently allocates consumer surplus to those who most value it.

A research study recently conducted by the Competition and Markets Authority (CMA) of the United Kingdom (UK) on personalized pricing found no evidence of widespread personalized pricing that was different for different consumers. In fact, the study found that algorithms show different customers different search results on retail websites, including a different number of results or a different order of results.[16] This type of personalized pricing algorithm does not discriminate between buyers of the same product as much as tailor the results to an affluent buyer or a cost-sensitive one. The CMA report found evidence of personalized ranking offers to be prevalent online: 61 percent of the 160 e-commerce websites visited were found to personalize rankings, either based on information about the shoppers' access route to the website (for example, through a discount products aggregator like Groupon or price comparator like Kayak) or based on past browsing behavior.[17]

5. Dynamic Pricing Algorithms

Dynamic pricing algorithms automatically adjust a seller's pricing in response to competitors' prices and to changes in the market environment. These algorithms can be used to gather information about competitors through data scraping, where the algorithms search and compare pricing across platforms. In the EU, a sector

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[15] Ariel Ezrachi & Maurice E. Stucke, *Artificial Intelligence and Collusion: When Computers Inhibit Competition*, 2017 U. ILL. L. REV. 1775, 1781 (2017).

[16] U.K. Competition & Markets Auth., *Pricing Algorithms – Economic working paper on the use of algorithms to facilitate collusion and personalized pricing* 38 (Oct. 8, 2018) [hereinafter *CMA Working Paper*], *available at* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/746353/Algorithms_econ_report.pdf.

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

inquiry into e-commerce revealed that two thirds of retailers who track their competitors' prices use automatic systems to do so and some of them also use those systems to adjust prices automatically.[18]

Arguably, such comparison sites make it easier for consumers to compare pricing quickly. Retail intelligence companies like Mozenda and Upstream Commerce promise to "optimize" product pricing by price scraping their competitors' prices and product information.[19] These services use automated computer software, called "bots," to "crawl" competitor websites to extract pricing and product information and then use pricing algorithms to instantaneously match price changes.

6. Unilateral Pricing Algorithms

Unilateral pricing algorithms are closely related to dynamic pricing algorithms. They are designed to take certain unilateral steps, such as to price $1 higher or $1 lower than the firm's competitor. Competitors who use relative pricing as a way to communicate the value of their brand and create a certain perception in consumers' minds would likely use such algorithms to ensure consistency on that message.

7. Risk Assessment Algorithms

Risk assessment algorithms analyze a buyer's personal data and circumstances to assess the likelihood that an individual will act in a certain way.

8. Financial Trading Algorithms

Financial trading algorithms conduct analysis of financial markets to execute high-speed transaction decisions in the financial markets. High frequency traders, for example, often employ these algorithms to execute their trades. [20]

II. Procompetitive Effects of Algorithms

Many algorithms produce significant competitive benefits that represent a "tremendous boon to consumer welfare"[21] and are benign from a competition perspective, such as faster price adjustments, lower consumer search and transaction costs, lower prices, higher quality products and services, and more efficient resource allocation through better matching between supply and demand.

Algorithms are faster and more efficient at identifying changing market conditions, such as changes in competitive pricing, demand shocks, and environmental crises. This enables businesses to adjust prices more quickly, and, in some cases, automatically reduce excess demand and supply and increase market efficiency.[22] Algorithms that match products and services to buyers or present purchasing recommendations can significantly reduce consumer search and transaction costs and offer buyers a wider choice of options.

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[18]   Margrethe Vestager, Remarks Before the Bundeskartellamt 18th Conference on Competition, Berlin (Mar. 16, 2017), *available at* https://ec.europa.eu/commission/commissioners/2014-2019/vestager/announcements/bundeskartellamt-18th-conference-competition-berlin-16-march-2017_en.

[19]   *See* Gordon Law Group, *E-Commerce Law: Price Scraping Can Lead to Legal Troubles* (Apr. 11, 2017), *available at* https://www.gordonlawltd.com/price-fixing-allegations/; Mozenda, Inc. website, *available at* https://www.mozenda.com/software/.

[20]   In April 2017, Planet Money built a stock trading Twitter bot, named BOTUS (which even has its own Twitter account), that was designed to trade on any stock that President Donald Trump tweeted about. When President Trump tweeted something positive about a company, BOTUS would buy the company's stock, and when he tweeted negatively about a company, BOTUS would sell the company's stock short. Planet Money, *Trading Bot BOTUS Will Buy And Sell Stock Based On Trump's Tweets* (Apr. 14, 2017), *available at* https://www.npr.org/2017/04/14/523890750/twitter-bot-botus-will-buy-and-sell-stock-based-on-trumps-tweets.

[21]   Salil K. Mehra, Public Comment on the Federal Trade Commission's Hearings on Competition and Consumer Protection in the 21st Century: Protecting Consumers and Promoting Responsible Innovation in Lending [hereinafter FTC 21st Century Hearings], Topic 9 – The consumer welfare implications associated with the use of algorithmic decision tools, artificial intelligence, and predictive analytics, FTC-2018-0056-D-0028 (Aug. 20, 2018), *available at* https://www.ftc.gov/policy/public-comments/2018/08/20/comment-ftc-2018-0056-d-0028.

[22]   Oxera Consulting LLP, *When Algorithms Set Prices: Winners and Losers* 15 (June 19, 2017) [hereinafter *Oxera*], *available at* https://www.oxera.com/wp-content/uploads/2018/07/When-algorithms-set-prices-winners-and-losers.pdf.pdf.

Although certain algorithms, such as those executing personalized pricing, may engage in a form of price discrimination that reduces surplus for some consumers, personalized pricing can ensure that a greater number of consumers are satisfied. Such algorithms might achieve this beneficial outcome by increasing consumer surplus to price-sensitive consumers, as their surplus is being subsidized by less price sensitive consumers. Likewise, though dynamic pricing algorithms—like those employed by Uber or Lyft—might reduce consumer surplus at certain peak demand times,[23] they generally ensure a greater number of consumers are satisfied by responding accordingly to supply-demand market conditions. They incentivize drivers, for example, to provide services when rides are expensive, which in turn puts downward pressure on prices and maximizes total market surplus.

Algorithms can also indirectly help lower prices for consumers. Algorithms that optimize business processes and result in lower production, inventory, or personnel costs result in cost efficiencies that may be passed onto consumers in the form of lower prices.[24] Additionally, because algorithms can reduce the level of specified market knowledge required for businesses to enter new markets, lowering barriers to entry, they foster greater competition resulting in better prices for consumers.[25]

Algorithms can assist in improving existing products or developing new products and services. Consumer search inquiries and purchasing preferences can provide valuable information to businesses. Based on this information, businesses can identify and enhance the most important characteristics and features of products and services, better meeting consumers' needs.[26]

To illustrate, Lending Club, America's largest online credit marketplace, facilitates personal loans, auto loans, and small business loans entirely online with no branch infrastructure. The company uses technology to lower costs, assess credit risk in innovative ways, and deliver improved customer service. Algorithmic decision tools, artificial intelligence, and predictive analytics help Lending Club accurately assess creditworthiness, reduce costs to borrowers, and improve access to credit—especially for disadvantaged classes of borrowers who often are not able to obtain loans from institutional lenders at favorable rates.

Researchers at the Federal Reserve Banks of Philadelphia and Chicago looked at the role of data and machine learning in financial technology (fintech) lending and found that fintech companies were offering consumers reduced-cost products, and their interest rate spreads on loans were lower than those of traditional lenders. Innovation in credit analytics is thus helping fintech lenders such as Lending Club better serve borrowers whom traditional lenders may overlook or overprice.[27]

Another way in which algorithms may enhance competition lies in emerging data portability technology that is not yet on the market. Google, Microsoft, Twitter, and Facebook recently announced their Data Transfer Project, which is centered around supporting secure, direct service-to-service data portability. Algorithm-enabled technology will enable users to transfer data between two authenticated accounts behind the scenes, without having to download the data and relocate it themselves. As a result, the infrastructure burden on both providers and users (bandwidth requirements, for example) will be reduced, leading to more services offering portability. The participants argue that data portability and interoperability are central to innovation and will enable users to switch to other products or services more easily or try new and innovative products as a result of the improved ease and speed of data portability. Also, by reducing infrastructure constraints, portability will become more inclusive, flexible, and open to people around the globe.[28]

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[23] Grace Guarnieri, *New Year's Uber Surge Pricing Could Soar to Three or Four Times Normal Rate for Ride-Shares*, NEWSWEEK (Dec. 31, 2017), *available at* https://www.newsweek.com/new-years-uber-lyft-surge-pricing-767059.

[24] *Oxera*, *supra*, note 22, at 16; OECD BACKGROUND NOTE, *supra*, note 1, at 12.

[25] *Id.*

[26] OECD BACKGROUND NOTE, *supra*, note 1, at 13.

[27] Richard H. Neiman, Public Comment on FTC 21st Century Hearings: Protecting Consumers and Promoting Responsible Innovation in Lending, FTC-2018-0056-D-0025 (Aug. 20, 2018), *available at* https://www.ftc.gov/system/files/documents/public_comments/2018/08/ftc-2018-0056-d-0025-155151.pdf.

[28] Data Transfer Project, Public Comment on FTC 21st Century Hearings Topic 9 – The consumer welfare implications associated with the use of algorithmic decision tools, artificial intelligence, and predictive analytics, FTC-2018-0051-D-0032 (August 20, 2018), *available at* https://www.ftc.gov/system/files/documents/public_comments/2018/08/ftc-2018-0051-d-0032-154924.pdf.

III.   Anticompetitive Effects of Algorithms

Although algorithms provide significant competitive benefits for firms and consumers, they present novel challenges for competition authorities—and by extension, compliance teams. In particular, there is a rising concern that algorithms increase the potential for both tacit and overt collusion.[29]

Collusion occurs when competing firms coordinate or act in a manner to set prices above the market equilibrium with the objective of increasing profits. While this may result in short-term profits to the market actors involved in the arrangement, collusion harms consumers, is anticompetitive, and leads to poor long-term economic outcomes.[30]

There are two forms of collusion, overt and tacit. In a free market, firms are free to act to maximize their profits, as long as they are acting independently. Overt collusion refers to anticompetitive conduct that is facilitated through explicit agreements, written or oral. It is illegal in most jurisdictions around the world. Tacit collusion, also known as conscious parallelism, refers to anticompetitive conduct that can be achieved without explicit coordination between competing firms. Although competing firms decide their profit-maximizing strategies independently, they are able to arrive at and maintain a noncompetitive outcome. Conscious parallelism is generally not illegal because there is no underlying illegal behavior or action to sanction.[31]

Algorithms that facilitate overt collusion present no real new legal challenges to competition authorities. If a firm is found to have coordinated with other market actors through algorithms, provided there is evidence of direct or indirect contact showing there to be an explicit agreement between market actors, competition authorities have the necessary tools to discipline the actors involved in the arrangement.[32]

The challenge lies with tacit algorithmic collusion. Some scholars believe that algorithms could become capable of facilitating collusion without the need for any communication or coordination between market actors. Dynamic pricing algorithms, for instance, can assess and adjust prices for thousands of products and services in milliseconds in response to changes in competitor prices. The concern is that, as a result, firms might choose not to discount products and services if they perceive the benefit to be short-lived. Some have argued that this leads to tacit collusion since firms are seen as able to "set" and maintain market prices through algorithms without explicitly coordinating.[33]

In most algorithms, market actors can input the general rules that map inputs to outputs or they can at least decrypt the algorithm to understand why an algorithm behaves a certain way. Some academics have argued that deep learning algorithms create further issues for competition authorities. They have posited that the development of deep learning algorithms means that market actors may not necessarily know how or why a particular algorithm arrives at particular outputs as such algorithms would essentially act autonomously towards potentially anticompetitive outcomes.[34]

The concept of tacit algorithmic collusion is disputed, however, with prominent scholars presenting data showing that, currently, such collusion is no more than an unproven theory.[35] Professor Salil Mehra

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[29]   In fact, an entire session of the FTC 21st Century Hearings is devoted to algorithms. *See* FTC Hearing #7, Nov 13-14, 2018, https://www.ftc.gov/news-events/events-calendar/ftc-hearing-7-competition-consumer-protection-21st-century.

[30]   OECD BACKGROUND NOTE, *supra* note 1.

[31]   *Id.; see also* Terrell McSweeny & Brian O'Dea, *The Implications of Algorithmic Pricing for Coordinated Effects Analysis and Price Discrimination Markets in Antitrust Enforcement*, 32:1 ANTITRUST 75, 75 (2017) [hereinafter *McSweeny*], *available at* http://awa2018.concurrences.com/IMG/pdf/mcsweeny_and_odea_-_implications_of_algorithmic_pricing_antitrust_fall_2017_0.pdf

[32]   *Id.; see also* OECD BACKGROUND NOTE, *supra* note 1.

[33]   McSweeny & O'Dea, *supra* note 31, at 75; see also OECD, DIRECTORATE FOR FINANCIAL AND ENTERPRISE AFFAIRS – COMPETITION COMM., ALGORITHMIC COLLUSION: PROBLEMS AND COUNTER-MEASURES – NOTE BY A. EZRACHI & M. E. STUCKE n.18, (May 31, 2017), *available at* https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DAF/COMP/WD%282017%2925&docLanguage=En.

[34]   *See, e.g.*, OECD, ALGORITHMS AND COLLUSION: COMPETITION POLICY IN THE DIGITAL AGE 11 (2017) , *available at* http://www.oecd.org/daf/competition/Algorithms-and-colllusion-competition-policy-in-the-digital-age.pdf, ("[R]egardless of the quality of the results produced, deep learning algorithms do not provide programmers with information about the decision-making process leading to such results.").

[35]   Mehra, *supra* note 21; Deng, *supra,* note 7, at 85.

commented before the Federal Trade Commission (FTC) that "[t]here has been scaremongering based on fears that artificial intelligence will somehow destroy competition as we know it." In his view, "these fears are premature . . . because technological development is still far from creating some sort of autonomous algorithmic cartel robot."

As economist Ai Deng explains, although some algorithms may do a better job than humans at establishing cooperative relationships, a number of assumptions underlying antitrust fears about algorithms have little, if any, empirical support.[36] Real world competitive decisions are highly complex, presenting significant computational and technical challenges, and current research shows that designing algorithms capable of learning to cooperate in such an environment is very difficult. In fact, a growing body of theoretical and experimental economic literature posits that algorithms have to learn to communicate with one another and react to communications to achieve a collusive outcome in a market with more than two market actors. Although this may be theoretically possible, the development of algorithms that are able to communicate in this way is still in its very early stages.[37]

The debate on whether tacit algorithmic collusion is a possibility is far from settled. However, the existence of that debate does not detract from the fact that algorithms have arrived and have materially influenced the way in which market actors execute their functions.

IV.   Algorithms and Antitrust Compliance in the United States

A. Collusion

Section 1 of the Sherman Act, 15 U.S.C. § 1, prohibits all agreements that unreasonably restrain trade. When discussing the application of the traditional analysis of illegal collusion in the algorithmic pricing context, U.S. antitrust officials have emphasized the importance of the existence of an agreement, which is often missing or harder to detect when algorithms are used. As Maureen Ohlhausen has explained, "[t]he type of technology used to communicate with competitors is wholly irrelevant to the legal analysis. Whether it is phone calls, text messages, algorithms or Morse code, the underlying legal rule is the same—agreements to set prices among competitors are always unlawful."[38]

The U.S. Supreme Court has defined an agreement as "a unity of purpose or a common design and understanding, or a meeting of the minds in an unlawful arrangement."[39] This broad definition includes not only explicit agreements to set prices collusively, but also exchanges of competitively sensitive, nonpublic information between competitors for anticompetitive purposes. The antitrust laws do not, however, prohibit companies from engaging in conscious parallelism or interdependent pricing, where an agreement is not present.[40] The mere fact that competitors monitor, and even match, each other's public pricing information is not sufficient to establish a Section 1 violation.

During a hearing before the Senate Subcommittee on Antitrust, Competition Policy, and Consumer Rights on October 3, 2018, Assistant Attorney General Makan Delrahim stated that the use of algorithms to create anticompetitive effects is an "important issue" that antitrust enforcers are struggling with both in the U.S. and

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[36]   *See* Ai Deng, Bates White Economic Consulting, *When Machines Learn to Collude: Lessons from a Recent Research Study on Artificial Intelligence* (Aug. 30, 2017), *available at* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3029662.

[37]   *Id.*; see also Schwalbe, *supra* note 6.

[38]   Maureen Ohlhausen, *Should We Fear The Things That Go Beep In the Night? Some Initial Thoughts on the Intersection of Antitrust Law and Algorithmic Pricing*, Remarks at the Concurrences Conference on Antitrust in the Financial Sector 8-9 (May 23, 2017), *available at* https://www.ftc.gov/system/files/documents/public_statements/1220893/ ohlhausen_-_concurrences_5-23-17.pdf.

[39]   *Copperweld Corp. v. Independence Tube Corp*., 467 U.S. 752, 771 (1984), *citing American Tobacco Co*. v. *United States*, 328 U.S. 781, 810 (1946).

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

in Europe.[41] For the most part, antitrust enforcers in the U.S. agree that allegations of collusion involving algorithms should be analyzed under the same legal standards as any other collusive conduct.[42] Barry Nigro, a deputy assistant attorney general in the Antitrust Division of the Department of Justice (DOJ), has reportedly stated that "when analyzing whether conduct constitutes collusion, an observer should 'take out' the fact that an algorithm was involved[.]"[43] Nonetheless, some officials have noted that while U.S. antitrust laws generally provide the tools necessary to address anticompetitive conduct facilitated by algorithms, the use of algorithms may make it harder to identify collusion and may require antitrust enforcers to employ new investigative techniques.[44] With respect to the difficulty of detecting algorithm-enabled collusion, Maureen Ohlhausen, former Acting Chairman of the FTC, has commented that, as with other types of price-fixing conduct, the DOJ's leniency program and the threat of criminal penalties should incentivize self-detection and cooperation with enforcers where external detection is not enough.[45]

The DOJ and private plaintiffs have brought cases involving price-fixing using algorithms or other nontraditional electronic tools. For example, in *U.S. v. Topkins*,[46] the first antitrust e-commerce criminal prosecution, DOJ charged David Topkins and his coconspirators with using pricing algorithms to engage in a conspiracy to fix the prices of posters sold in the Amazon Marketplace. Specifically, the conspirators "agreed to adopt specific pricing algorithms for the sale of the agreed upon posters with the goal of coordinating changes to their respective prices."[47] Topkins pleaded guilty to price fixing in violation of Section 1 and agreed to pay a $20,000 criminal fine.

In *Meyer v. Kalnick*,[48] private plaintiffs alleged that drivers agree with Uber to charge certain fares with the understanding that all other Uber drivers are agreeing to charge the same fares. They further alleged that this agreement is facilitated by Uber's pricing algorithm, which all drivers use to set their fares. The plaintiffs alleged that this arrangement amounted to a hub-and-spoke conspiracy in violation of Section 1.[49] The court denied the defendant's motion to dismiss, but Uber subsequently moved the matter to arbitration.

In October 2018, Assistant Attorney General Makan Delrahim stated that the DOJ had a criminal case that he expected would come to a conclusion in the next two weeks related to the use of search algorithms by

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[41]   Statement of Makan Delrahim, Oversight of the Enforcement of the Antitrust Laws, United States Senate, Committee on the Judiciary, Hearing before the Subcommittee on Antitrust, Competition Policy and Consumer Rights (Oct. 3, 2018) [hereinafter *Delrahim Statement*], *available at* https://www.judiciary.senate.gov/meetings/10/03/2018/oversight-of-the-enforcement-of-the-antitrust-laws.

[42]   *See, e.g.*, Ohlhausen, *supra* note 38 ("If it isn't ok for a guy named Bob to do it, then it probably isn't ok for an algorithm to do it either. . . . So, from my perspective, if conduct was unlawful before, using an algorithm to effectuate it will not magically transform it into lawful behavior. Likewise, using algorithms in ways that do not offend traditional antitrust norms is unlikely to create novel liability scenarios."); Pallavi Guniganti, *US DOJ Deputy: Algorithmic Cartel Requires Agreement*, GLOBAL COMPETITION REV. INT'L (Feb. 5, 2018), *available at* https://globalcompetitionreview.com/article/1153380/us-doj-deputy-algorithmic-cartel-requires-agreement (quoting comments by Barry Nigro at the GCR Live 7th Antitrust Annual Law Leaders Forum, "I don't know that the rules need to change just because we have a vehicle, a computer that can do for humans what the humans tell it to do, faster than the humans can do it."); McSweeny & O'Dea, *supra* note 31, at 76 ("Once detected, competition enforcers have the tools to challenge overt collusion. . . . Notably, the use of a pricing algorithm, by itself, does not raise antitrust concerns. And as the DOJ's successful prosecution of algorithmic price fixing shows, enforcers will be able to identify and challenge the improper use of these new technologies in many cases.").

[43]   Guniganti *supra* note 42.

[44]   *See, e.g.*, McSweeny & O'Dea, *supra* note 31, at 76 ("Detection of [algorithm facilitated cartels] may require novel investigative approaches or additional resources."); Ohlhausen*, supra* note 38, at 3 ("That said, the widespread use of these tools may necessitate changes in how the enforcement agencies investigate some forms of problematic conduct, just as the movement from paper to email and text messaging necessarily required corresponding changes in discovery techniques.").

[45]   Ohlhausen*, supra* note 38, at 9.

[46]   *United States v. Topkins*, No. 15-CR-00201 (N.D. Cal. 2015).

[47]   Plea Agreement at 4, *United States v. Topkins*, No. 15-CR-00201 (N.D. Cal. 2015), *available at* https://www.justice.gov/atr/case-document/file/628891/download.

[48]   *See Meyer v. Kalnick*, 174 F. Supp. 3d 817 (S.D.N.Y. 2016).

[49]   *Id*. at 824.

competitors to effectuate price fixing, which he added would be the "first of its kind." [50] Further details on the case that he was referring to have not yet been released.

B. Price Discrimination

Pricing algorithms can be used to discriminate among buyers. For example, a seller may use an algorithm to charge different prices or offer different discounts to customers located in different states. The DOJ and FTC have said that algorithmic price discrimination should be analyzed using the same legal framework as price discrimination in other contexts, and "[a]lgorithmic pricing that leads to price discrimination—without incorporating competitor data—is unlikely to raise competition concerns."[51]

A seller who charges competing buyers different prices for the same product may be liable for price discrimination under the Robinson-Patman Act, 15 U.S.C. § 13(a). The U.S. antitrust agencies have not actively enforced the act in decades.[52] Some enforcers have noted, however, that algorithmic pricing may lead to new and more sophisticated methods of price discrimination.[53] Private parties continue to sue under the act's provisions.[54] Companies using algorithmic pricing may face litigation from private plaintiffs if the algorithm facilitates actionable price discrimination.

As algorithms are increasingly used by businesses to narrowly target specific types of customers, their use might enhance the risk of a merger challenge where markets can be defined by differential pricing. The *2010 Horizontal Merger Guidelines*[55] authorize the agencies to challenge a proposed merger if it is likely to be anticompetitive in *any* relevant market, no matter how small. The *Merger Guidelines* instruct that the antitrust agencies will evaluate the possibility of price discrimination against targeted customers and further provide that "[w]hen discrimination is reasonably likely, the agencies may evaluate competitive effects separately by type of customer."[56]

Businesses are empowered by sophisticated pricing algorithms to process large amounts of data and analyze more granular data regarding consumer characteristics than was previously possible. Algorithms enable sellers to segment their customers into smaller and smaller groups and engage in more targeted price discrimination methods.[57] The more differentiated the algorithmic pricing program is, the narrower the antitrust agencies may define the relevant markets for purposes of evaluating the competitive effects of a potential merger.[58] A proposed merger that has no anticompetitive effects in one market segment may thus be found to substantially decrease competition in a smaller "price discrimination market."

C. Unilateral Conduct

Generally, firms are free to set whatever prices they choose, using whatever tools they choose, as long as they act independently of their competitors. Thus, unilateral implementation of pricing algorithms is not actionable under Section 1 without establishing an anticompetitive agreement with another firm regarding the

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[50]   *Delrahim Statement, supra* note 41.
[51]   OECD, DIRECTORATE FOR FINANCIAL AND ENTERPRISE AFFAIRS – COMPETITION COMM., ALGORITHMS AND COLLUSION – NOTE BY THE UNITED STATES 2 n.2 (May 26, 2017) [hereinafter OECD U.S. NOTE], *available at* https://one.oecd.org/document/DAF/COMP/WD(2017)41/en/pdf.
[52]   OECD, DIRECTORATE FOR FINANCIAL AND ENTERPRISE AFFAIRS – COMPETITION COMM., ROUNDTABLE ON PRICE DISCRIMINATION –NOTE BY THE UNITED STATES 6 (Nov. 21, 2016) [hereinafter OECD U.S. PRICE DISCRIMINATION NOTE], *available at* https://www.ftc.gov/system/files/attachments/us-submissions-oecd-other-international-competition-fora/price_discrimination_united_states.pdf.
[53]   *See* McSweeny & O'Dea, *supra* note 31, at 76-79.
[54]   OECD US PRICE DISCRIMINATION NOTE, *supra* note 52, at 6.
[55]   U.S. DEP'T OF JUSTICE & FED. TRADE COMM'N, HORIZONTAL MERGER GUIDELINES (2010), *available at* https://www.justice.gov/atr/horizontal-merger-guidelines-08192010 [hereinafter HORIZONTAL MERGER GUIDELINES].
[56]   *Id.* at 6.
[57]   McSweeny & O'Dea, *supra* note 31 at 77.
[58]   *See* Bill Baer, Sonia Kuester Pfaffenroth & Vesselina H. Musick, Arnold & Porter Kaye Scholer LLP, *Pricing Algorithms: The Antitrust Implication*s (Apr. 17, 2018), *available at* https://www.arnoldporter.com/en/perspectives/publications/2018/04/pricing-algorithms-the-antitrust-implications.

purpose or effect of the algorithm.[59] This is true regardless of whether the algorithm factors in or is responsive to competitor prices.[60] There are some scenarios, however, where antitrust liability may attach to seemingly unilateral conduct.

Legal unilateral conduct is distinguished from anticompetitive signaling, which can amount to tacit collusion. Signaling occurs when competitors provide information to each other that "signals" their price or output plans as part of an agreement to raise prices or restrict output. While most traditional signaling cases involve public announcements, this conduct can take many forms. For example, anticompetitive signaling was found in the 1993 *Airline Tariff Publishing* case where a group of airlines used a jointly owned online booking system to signal to each other about fare changes and discounts.[61]

Another example of unilateral conduct that can become illegal collusion occurs when multiple competing firms adopt the same pricing algorithm. Generally, independent adoption of the same or similar pricing algorithms by multiple firms does not violate the antitrust laws, even if it makes interdependent pricing more likely. For antitrust liability to attach to this conduct, the firms must engage in concerted action, which may arise in the form of an anticompetitive hub-and-spoke arrangement.[62] In a hub-and-spoke arrangement, competitors may independently purchase the same off-the shelf pricing algorithm but use an intermediary or "hub," which could be the supplier of the algorithm technology, to nefariously share pricing information among themselves.[63]

Antitrust liability may also attach to unilateral conduct where a firm exploits an algorithm to enhance its market power or employs tactics that create barriers for new entrants.[64]

V.   Algorithms and Antitrust Compliance in the Rest of the World

A. Canada

In Canada, the Competition Bureau has taken a measured approach to the prospect of investigating and sanctioning algorithmic collusion. On February 19, 2018, the Bureau released a report titled, "Big data and innovation: key themes for competition policy in Canada."[65] The Bureau's view (as stated in the paper) is that, as technology continues to evolve, predicting the ways in which technology can help implement anticompetitive agreements or arrangements is difficult. Each scenario is fact-specific and circumstantial. Market actors should remain alert and vigilant to ensure their use of algorithms does not result in anticompetitive conduct.

The Bureau considers its existing analytical principles and enforcement tools sufficient and appropriate to deal with any algorithmic collusion issues that may arise; its usual approaches toward enforcing sections 45 and 90.1 of the Competition Act, which prohibit collusion and anticompetitive agreements, apply equally to the use of algorithms:[66]

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[59]   OECD US NOTE, *supra* note 51, at 3.

[60]   *Id.*

[61]   *United States v. Airline Tariff Publishing Co.,* 836 F. Supp. 9 (D.D.C. 1993).

[62]   OECD US NOTE, *supra* note 51, at 6.

[63]   *See id.*

[64]   *See* Judith Chevalier, *Antitrust and Artificial Intelligence: Prepared as comments on Varian, "Artificial Intelligence, Economics, and Industrial Organization"* (Dec. 2017), *available at* http://www.nber.org/chapters/c14033.pdf; *see also Delrahim Statement, supra* note 41.

[65]   Competition Bureau of Canada, *Big Data and innovation: key themes for competition policy in Canada* (Feb. 19, 2018) [hereinafter *Big Data Report*], *available at* http://www.competitionbureau.gc.ca/eic/site/cb-bc.nsf/eng/04342.html. *See also* Anita Banicevic, *What's So Big About Big Data: Canada's Competition Bureau Issues Draft Discussion Paper for Consultation*, 1 INT'L ANTITRUST BULL. 24 (ABA Section of Antitrust Law Jan. 2018), *available at* https://nortonsinc.com/wp-content/uploads/2018/01/IAB-2018v1_2018-01-12.pdf.

[66]   Competition Bureau of Canada, Draft Discussion Paper, Big data and Innovation: Implications for Competition Policy in Canada, at 2-4, 34 (2017) [hereinafter *2017 Big Data Draft Discussion Paper*], *available at* http://www.competitionbureau.gc.ca/eic/site/cb-bc.nsf/vwapj/Big-Data-e.pdf/$file/Big-Data-e.pdf.

1. Hard-core cartels will be subject to criminal investigation and prosecution. While the Bureau acknowledges that big data "may introduce more efficient and powerful ways to implement and manage a cartel . . . it does not constitute a new kind of activity."[67] The Big Data Report notes that even with the increasing sophistication of the tools involved, the offense is still rooted in the agreement itself. That is, if companies agree to use algorithms to implement an agreement with respect to pricing (as occurred in the UK and U.S. cases involving the sale of posters via Amazon[68]), then while such an agreement uses new tools to implement and monitor the agreement, the underlying offence is no different. With these statements, the Bureau appears to be denouncing suggestions made by certain commentators regarding the need to consider amending antitrust laws to encompass a broader concept of collusion.

2. Even though conscious parallelism or tacit collusion may reduce competition, it does not fall within the purview of criminal cartel enforcement. As noted above, certain antitrust academics have suggested that the increased ability to use big data to monitor and react to competitors' pricing data may lead to acts of parallel pricing, which in turn dampen competition. However, the Bureau notes that "big data is likely to introduce a difference of degree rather than a difference of kind when it comes to conscious parallelism."[69] The Bureau also notes that there is "broad consensus that the unilateral monitoring and responding to data collected on one's competitors is legal" and that altering the existing framework would be "unworkable."

3. Facilitating practices, such as circulating price lists to competitors, advance announcements of price changes, adoption of similar pricing systems, and participating in meetings with competitors, are not in and of themselves prohibited. The Big Data Report states that to the extent that big data and algorithms are used to engage in facilitating practices, such activity may be an indicator of the existence of an illegal price fixing agreement and thus, may be examined by the cartels provision or alternatively, may be captured by section 90.1 of the act (a civil provision that prohibits agreements between competitors that result in or are likely to result in an anticompetitive effect). Given that section 90.1 also requires an agreement or arrangement, however, it is not clear that this provision could apply to situations where the facilitating practice falls short of an agreement.[70]

For now, the Bureau has taken a balanced and measured view to technology, big data, and algorithms. Although it recognizes that technological advances are occurring in unpredictable ways, it believes that technology helps drive innovation and quality improvements across Canada, which ultimately benefits consumers. While the Bureau is cognizant of the risks of both under- and over-enforcement, it sees no reason to change its policy and enforcement approach in cases involving algorithms, though it will continue to actively monitor the impact of technology and algorithms on competition.[71]

B. Australia

In Australia, the Australian Competition and Consumer Commission (ACCC) has taken a "wait and see" approach to the threat of tacit algorithmic collusion. In November 2017, the ACCC's Chair, Rod Sims,

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[67]   *Id.* at 29.
[68]   *See United States v. Topkins*, No. 15-CR-00201 (N.D. Cal. 2015); *U.S. v. Daniel William Aston and Trod Limited*, No. 15-CR-0419 (N.D. Cal. 2016); U.K., Competition and Markets Auth., Press Release, *Online seller admits breaking competition law* (July 21, 2016), *available at* https://www.gov.uk/government/news/online-seller-admits-breaking-competition-law.
[69]   *2017 Big Data Draft Discussion Paper, supra* note 66, at 30-32.
[70]   *Id.* at 33-34.
[71]   *Id.* at 2-4; *Big Data Report*, *supra* note 65, at 9-12.

publicly addressed the opportunities and threats posed by the increasing use of algorithms and big data.[72] Sims discussed the threat posed by collusive algorithms, noting that all cases around the world that have been brought to date relating to the use or misuse of online databases and pricing algorithms to set prices reflected circumstances where "something more" occurred. In other words, there have been no cases globally where algorithms have colluded autonomously.

Sims expressed confidence that Australia's revamped competition laws provide the ACCC with the legal tools to fight algorithm-enabled anticompetitive conduct.[73] In October 2017, Australia's Parliament passed legislation to amend Australia's competition laws based on the 2015 Harper Report.[74] Most notably, the amendments broadened the misuse of market power prohibition to prohibit any company from "engaging in a concerted practice that has the purpose, effect or likely effect of substantially lessening competition."[75] Thus, the amended misuse of market provision allows Australian competition authorities to address any algorithms that substantially lessen competition by focusing on the effect or likely effect of the conduct. Such a broadly worded provision may capture both overt and tacit algorithmic collusion. Moreover, to the extent that these laws are found wanting, Sims noted he had "little doubt" that the laws would be amended to deal with algorithmic anticompetitive conduct.[76]

C. United Kingdom

The CMA in the UK has taken a slightly more measured approach to algorithmic collusion than the ACCC. In May 2017, the CMA submitted a note to the OECD Roundtable on Algorithms and Collusion, in which it noted that in all cases of algorithmic collusion in the UK to date, the conduct was not fundamentally different from traditional or overt forms of collusion, which competition laws and frameworks have experience in successfully addressing.[77] Where algorithms are designed or deployed specifically to limit competition between competing firms, or to exploit a firm's dominant position in an industry, competition law applies in principle to those individuals who design and deploy the algorithms. As far as the novel and untested scenario of autonomous algorithmic collusion is concerned, the CMA noted that given the lack of conclusive evidence of the possibility of autonomous algorithmic collusion, and the substantive consumer benefits of algorithms, it would be imprudent to take preemptive sweeping action. Rather, it advocated for a "targeted, evidence-based action using the tool—or combination of tools—that allow it most effectively to address the identified harm."[78]

The CMA also expressed confidence that the principles-based UK competition law framework has sufficient flexibility to accommodate algorithms and the associated novel competition harms that arise from the use of algorithms. Specifically, the CMA noted it can: (1) carry out calls for information to better understand a market or business practice and determine whether action is warranted by it; (2) conduct market studies and investigations where competition and consumer problems emerge; (3) enforce a range of civil and criminal consumer protection laws, practices, and market conditions; and (4) prohibit or remedy anticipated or completed mergers and acquisitions that may result in a substantial lessening of competition. According to the CMA, these powers are sufficient to tackle any harms arising from algorithms, although it will continue to

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[72] Rod Sims, Australian Competition and Consumer Comm'n, *The ACCC's approach to colluding robots*, Remarks at Can Robots Collude? Conference (Nov. 16, 2017), *available at* https://www.accc.gov.au/speech/the-accc's-approach-to-colluding-robots; *see also* James Panichi, Phoebe Seers & Matthew Newman, *Australia reckons it's ready to fight algorithmic collusion as world scrambles to review laws*, MLEX (Nov. 21, 2017), *available at*: https://mlexmarketinsight.com/insights-center/editors-picks/antitrust/cross-jurisdiction/australia-reckons-its-ready-to-fight-algorithmic-collusion-as-world-scrambles-to-review-laws.

[73] Sims, *supra* note 72.

[74] Ayman Guirguis & Jessica Mandla, K&L Gates, *Harper Amendments to Australia's Competition Laws Passed: ACCC Heralds a 'new era' in Competition Law* (Oct. 20, 2017)*, available at* http://www.klgates.com/harper-amendments-to-australias-competition-laws-passed-accc-heralds-a-new-era-in-competition-law-10-20-2017/.

[75] Panichi et al., *supra* note 72.

[76] Sims, *supra* note 72.

[77] OECD, DIRECTORATE FOR FINANCIAL AND ENTERPRISE AFFAIRS – COMPETITION COMM., ALGORITHMS AND COLLUSION – NOTE FROM THE UNITED KINGDOM (May 30, 2017) [hereinafter OECD UK NOTE], *available at* https://one.oecd.org/document/DAF/COMP/WD(2017)19/en/pdf.

[78] *Id.*

develop its understanding of new technologies and algorithms, and it will continue to review existing competition and consumer laws, principles, and procedures to ensure that they are fit for the "algorithmic age."[79]

In October 2018, the CMA published a comprehensive economic working paper on pricing algorithms.[80] The paper describes how pricing algorithms are used by firms and explores whether, and under what conditions, the use of pricing algorithms could potentially lead to antitrust concerns. It focuses mainly on economic rather than legal analysis and considers the existing literature and evidence of the effects of algorithms on competition. The CMA also carried out some primary evidence gathering to fill some of the gaps it saw in the existing literature on algorithms. Among other things, the CMA found:

1. There is evidence of widespread use of algorithms to set prices, particularly on online platforms;
2. There is limited evidence of personalized pricing in practice, though algorithms are used to personalize ranking, advertising and perhaps discounts;
3. In relation to tacit coordination, some of the models used or referenced in the academic literature suggest that certain pricing algorithms can lead to collusive outcomes even where firms are each setting prices unilaterally; however, these models typically treat the choice of algorithm as exogenous, which leaves unanswered the question of whether individual firms would have an incentive to deviate, for example by changing the algorithm to undercut the collusive price; and
4. Algorithmic pricing may be more likely to facilitate collusion in markets which are already susceptible to coordination, such as where firms' offerings are homogenous.[81]

D. European Union

The European Commission (EC) has taken a strong stance against algorithmic collusion.[82] In the Bundeskartellamt 18th Conference on Competition, the Commissioner of Competition for the European Union (EU), Margrethe Vestager, referred to the risk that algorithms pose, noting that the way algorithms make decisions automatically may undermine democracy.[83] Although this does not mean that competition enforcers should be suspicious of everyone who uses any algorithm, competition enforcers must be vigilant and able to deal with the competition challenges posed by algorithms. Vestager endorsed a "compliance by design" approach, stating:

> What businesses can—and must—do is to ensure antitrust compliance by design. That means pricing algorithms need to be built in a way that doesn't allow them to collude. . . . And businesses also need to know that when they decide to use an automated system, they will be held responsible for what it does. So they had better know how that system works.[84]

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[79]   *Id. See also* Matthew Hunt, Bristows LLP, *Antitrust Authorities are Increasingly Interested in Pricing Algorithms* (2017), *available at*: https://www.lexology.com/library/detail.aspx?g=c60c30f8-711a-4f21-8688-13d17275a155.

[80]   *CMA Working Paper, supra* note 16.

[81]   *Id.* at 3-6.

[82]   In June 2018, two of the European Union's largest competition authorities, France and Germany, announced a joint-project to further research and understand algorithms and their potential anticompetitive effects. The Bundeskartellamt and Autorité de la concurrence will be developing a typology of algorithms, study their potential anticompetitive effects and assess algorithms' detection and examination. AUTORITÉ DE LA CONCURRENCE AND BUNDESKARTELLAMT, COMPETITION LAW AND DATA (2016), *available at* https://www.bundeskartellamt.de/SharedDocs/Publikation/DE/Berichte/Big%20Data%20Papier.pdf;jsessionid=79977A401874C7A91284962F1ED25FCF.1_cid371?__blob=publicationFile&v=2.

[83]   Vestager, *supra* note 18.

[84]   *Id.*

In June 2017, the EU submitted a note to the OECD Roundtable on Algorithms and Collusion, which noted that the treatment of pricing algorithms under EU competition law depends on how the algorithms in question are used:[85]

1. Algorithms that are used to implement pre-existing overt collusion.
If firms engage in overt collusion through any means of communication and use algorithms to implement the arrangement, they will have infringed competition law and be legally liable. It is the overt collusion through communication that constitutes the infringement of competition law, not the implementation strategy.

2. Algorithms that are used to facilitate overt collusion.
Practices that are illegal when implemented offline, will remain illegal when implemented online. Firms must ensure that their algorithms are not engaging in illegal behavior. For instance, "signaling" is illegal, whether it occurs offline by way of signaled communication between two competitors, or whether it occurs online by way of two algorithms using coded messages.

3. Algorithms that are used to facilitate tacit collusion.
Firms that are involved in illegal competition practices cannot avoid legal liability on the basis that their algorithm acted in an autonomous manner. The way an employee, agent, or third-party works under a firm's "direction or control," an algorithm remains under a firm's control, and thus the firm will be liable for an algorithm's actions.[86]

In *Eturas*, the European Court of Justice[87] (ECJ) considered the extent to which existing price fixing principles could be applied to interactions between the users of a shared technology platform and the platform administrator.[88] In *Eturas*, thirty Lithuanian travel agencies used a common online travel booking system, E-TURAS. On August 25, 2009, the director of Eturas sent an email to several travel agencies, asking them to "vote" on the appropriateness of reducing the cap on the online discount rate from 4 percent to between 0 and 3 percent.[89] Eturas then proceeded to unilaterally make technical modifications to the system, which, while not preventing travel agencies from granting customers discounts greater than 3 percent, required agencies to take additional technical steps in order to do so.[90] The use of the E-TURAS system in this manner (restriction of discounts via algorithms) raised the question of whether the system had been used to facilitate a hub-and-spoke agreement amongst the travel agencies to reduce the discount rates.

In its decision, the ECJ reiterated that companies should make their own independent business decisions and should not engage in any direct or indirect contact between economic operators that may influence market conduct or reveal an economic operator's future strategy.[91] However, the ECJ also determined that some proof that the travel agencies were aware of the message from Eturas was required in order for liability to be

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[85]   OECD, DIRECTORATE FOR FINANCIAL AND ENTERPRISE AFFAIRS – COMPETITION COMM., ALGORITHMS AND COLLUSION – NOTE FROM THE EUROPEAN UNION (June 14, 2017) [hereinafter OECD EU NOTE], *available at* https://one.oecd.org/document/DAF/COMP/WD(2017)12/en/pdf. *See also* Sathya S. Gosselin, April Jones & Annabel Martin, Hausfeld LLP, *Are Antitrust Laws Up to the Task? A US/EU Perspective on Anti-Competitive Algorithm Behavior* (Aug. 10, 2017), *available at* https://www.lexology.com/library/detail.aspx?g=8210db07-cff3-4e1d-85e2-28542b18ba0d.
[86]   OECD EU NOTE, *supra* note 85.
[87]   Although the case was heard in Lithuania, two questions of law were referred to the European Court of Justice.
[88]   For further commentary, see Cooley Alert, *European Court Provides Guidance on Application of Antitrust Rules to IT Platforms* (Feb. 9, 2016), *available at* https://www.cooley.com/news/insight/2016/2016-02-09-european-court-provides-guidance-on-application-of-antitrust-rules-to-it-platforms.
[89]   [*Eturas v. Lithuanian Competition Council*, (2016)], Case C-74/14 at para. 10, *available at* http://curia.europa.eu/juris/document/document.jsf;jsessionid=B37C92A6481C0F236E4A01525916729F?text=&docid=173680&pageIndex=0&doclang=EN&mode=lst&dir=&occ=first&part=1&cid=2173601.
[90]   *Id.* at para 12.
[91]   *Id.* at para 27.

imposed and that the agencies could not be presumed to be aware from the "mere dispatch" of a message from the administrator of a shared technology platform.[92] That said, the ECJ did leave open the possibility that an agency could be found liable if it could be "established on the basis of other objective and consistent indicia that it tacitly assented to an anticompetitive action."[93] Finally, the ECJ also noted that it was possible for a travel agency to rebut any presumption that they had been tacitly involved by publicly distancing itself, or adducing "other evidence to rebut that presumption, such as evidence of a systematic application of a discount exceeding the cap in question."[94]

The ECJ referred the case back to the Lithuanian Supreme Administrative Court (LSAC) for a further determination.[95] In light of the ECJ's guidance, the LSAC considered whether the travel agencies knew about the concerted practice and whether they had objected to it.[96] Upon evaluating evidence gathered by the Lithuanian Competition Council, the LSAC grouped each of the travel agencies into three categories: (1) those that knew about Eturas' imposed restriction and did not oppose it; (2) those that knew about Eturas' imposed restriction and opposed it; and (3) those travel agencies with respect to which there was insufficient evidence to determine whether they knew about Eturas' imposed restriction. The LSAC ruled that only the agencies in the first category could be found to have tacitly participated in a concerted practice but there was insufficient evidence to find that the travel agencies in the second and third categories had engaged in an anticompetitive practice. All the travel agencies in the first category and Eturas were fined for their actions.[97]

In the EU, the use of algorithms or electronic platforms has also been at the center of enforcement related to minimum price resale price agreements, which are considered "hard core" violations of EU competition law. More specifically, in June 2018, the EU fined four consumer electronics manufacturers—Asus, Denon & Marantz, Philips, and Pioneer—for imposing minimum resale prices on their online retailers and using algorithms to monitor compliance with these policies.[98] The four manufacturers used sophisticated monitoring algorithms to track online retail prices and promptly intervene as soon as price decreases were detected. The European Commission found that the actions of the four manufacturers reduced price competition between online retailers and increased prices for consumers.[99]

E. Japan

In January 2017, the Japan Fair Trade Commission (JFTC) established a Study Group on Data and Competition Policy, chaired by Akira Goto, an Emeritus Professor at the University of Tokyo. The Study Group (consisting mainly of academic professionals and antitrust law practitioners) released a report on June 6, 2017 (JFTC Report), that generally endorses the notion that accumulation and utilisation of data promotes competition and stimulates innovation, while recognizing situations where refusals regarding access to data or the accumulation of data may justify intervention under the Anti-Monopoly Act.[100]

With respect to the use of algorithms, the JFTC Report draws from the various submissions made in connection with the 2017 OECD Roundtables, noting that data accumulation and utilisation may facilitate collusion among companies, leading to "digital cartels." In particular, the JFTC report observes that such

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[92]   *Id.* at paras 34, 39.
[93]   *Id.* at para 45.
[94]   *Id.* at para 50.
[95]   *Id.* at para 50.
[96]   Press Release, Supreme Administrative Court of Lithuania, *SACL has rendered a decision in the travel agencies' case* (May 16, 2016), *available at* https://www.lvat.lt/en/news/sacl-has-rendered-a-decision-in-the-travel-agencies-case/390 [*SACL*]; *see also* Sophie Lawrance & Marc Linsner, *Eturas – Any conclusions on platform collusion?* (2017), Kluwer Competition Law Blog, *available at* http://competitionlawblog.kluwercompetitionlaw.com/2017/01/19/eturas-conclusions-platform-collusion/.
[97]   *Id.*
[98]   Press Release, European Comm'n, *Antitrust: Commission fines four consumer electronics manufacturers for fixing online resale prices* (July 24, 2018), *available at* http://europa.eu/rapid/press-release_IP-18-4601_en.htm.
[99]   *Id.*
[100]   JAPAN FAIR TRADE COMM'N, REPORT OF STUDY GROUP ON DATA AND COMPETITION POLICY (2017), *available at* https://www.jftc.go.jp/en/pressreleases/yearly-2017/June/170606_files/170606-4.pdf; Press Release, Japan Fair Trade Comm'n, Report of Study Group on Data and Competition Policy (June 6, 2017), *available at* https://www.jftc.go.jp/en/pressreleases/yearly-2017/June/170606.html.

concerns may arise where there are several enterprises sharing "AI technology that is able to determine the price that will maximize profits, resulting in the convergence of prices charged by different enterprises."[101] The report goes on to state that [i]f such digital cartels serve to substantially restrain competition, they will probably need to be strictly dealt with in the same way as other traditional cartels. Therefore, it would be desirable to keep a close eye on the situation, and if necessary, to discuss on issues with 'liaison of intention' in the interpretation of the 'unreasonable restraint of trade.'"[102] Based on media reports, it appears that there is continued vigorous debate in Japan as to whether collusion via algorithms warrants a new model of competition law and that the JFTC plans to further explore the issue shortly.[103]

In early 2018, the JFTC announced the launch of a sector inquiry in the e-commerce area. As part of the sector inquiry, the JFTC intends to gather information relating to the use of algorithms in the ecommerce sector. While the JFTC has yet to announce the results of its inquiry, its findings are likely to influence the JFTC's future policy stance in this important area.[104]

F. Singapore

In August 2017, the Competition Commission of Singapore ("CCS") published the *Handbook on Competition and E-Commerce in ASEAN*.[105] The Handbook incorporates input received from the competition authorities of Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand, and Vietnam. On the topic of algorithms, the Handbook notes that "[g]reater price transparency, and the development of advanced price setting algorithms have made establishing and enforcing price coordination easier for firms in some markets. Evidence from cases in the US and the UK have shown that existing competition policy and law are largely sufficient to deal with the challenges raised by price algorithms at this stage."[106]

The Handbook also notes that no equivalent cases have been investigated in ASEAN and that only one of the jurisdictions queried "currently considers price-setting algorithms to be a competition concern within its jurisdiction"[107]; as the e-commerce sector continues to grow, this concern may become more prevalent as price-setting algorithms become more sophisticated and increase their self-learning capabilities.

G. Indonesia

In December 2017, Indonesia's Komisi Pengawas Persaingan Usaha ("KPPU"), or the Commission for the Supervision of Business Competition, released a report titled "The Digital Economy in Indonesia."[108] The report notes that the "growing use of algorithmic pricing for digital services, such as taxi-hailing apps, erodes consumer surplus—the difference between higher prices consumers are willing to pay and lower prices they are required to pay. The analytical challenge posed by competition is that, like collusion, it produces similar prices for similar products and services in the marketplace. Digitalised OTT services and the use of algorithms make these distinctions more difficult for regulators to judge."[109] Like the JFTC, the KPPU appears cognizant of potential issues that may arise and is committed to monitoring developments in this area as they evolve.

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[101] *Id.* at 8.
[102] *Id.* at 66.
[103] Yusuke Takamiya, *Understanding Japan's approach to competition and big data*, GlobalCompetitionReview.com (July 25, 2017), *available at* https://globalcompetitionreview.com/article/1144911/understanding-japans-approach-to-competition-and-big-data.
[104] Yusuke Takamiya, *Japan: E-Commerce,* GlobalCompetitionReview.com (Mar. 20, 2018), *available at* https://globalcompetitionreview.com/insight/the-asia-pacific-antitrust-review-2018/1166813/japan-e-commerce.
[105] COMPETITION COMM'N SINGAPORE, HANDBOOK ON E-COMMERCE AND COMPETITION IN ASEAN (2017), *available at* https://www.cccs.gov.sg/media-and-publications/publications/in-house-publications/asean-ecommerce-handbook.
[106] *Id.* at 6.
[107] *Id.*
[108] KOMISI PENGAWAS PERSAINGAN USAHA, THE DIGITAL ECONOMY IN INDONESIA (2017), *available at* http://eng.kppu.go.id/newkppu/wp-content/uploads/REPORT_Digital_Economy_27-December-2017-FINAL.docx.pdf.
[109] *Id.* at 20.

VI.   Practical Considerations for Practitioners

It is generally accepted that the use of algorithms will evolve and become an ever more prevalent aspect of doing business. Given today's globalized digital economy, in which many companies operate in multiple jurisdictions with differing legal standards, legal and compliance teams need to navigate the complex issues raised by the use of certain types of algorithms and counsel their clients accordingly, while keeping in mind the commercial realities in which they operate. Outlined below are some specific practical considerations and best practices firms should consider adopting when implementing algorithms in their business operations:

A. Algorithms as Evidence

Competition authorities are already using their own algorithms to detect anticompetitive behavior. One example of this is the cartel screening tool that the CMA has developed to help public bodies and others running procurement. Specifically, the tool helps procurers screen their tender data for signs of cartel behavior by looking at various factors, including the text of the bids.[110]

In addition to using algorithms in the area of cartel detection, regulators may use algorithms to enhance their own economic modelling of the potential effects of a merger. Regulators might also request the production of any pricing algorithms that are being used by the merging firms (and possibly third parties) in order to determine, for example, whether the merger parties view each other as competitors or how they react to each other's pricing movements. In situations where one or both of the merger parties possesses a significant amount of algorithmically-generated data, regulators may consider the non-price effects of the proposed transaction on consumer privacy as well as quality and innovation. Firms should therefore be vigilant in their compliance efforts to make sure that such tools are not used anticompetitively and are consistent with their respective advocacy positions.

B. Promote Antitrust Compliance By Design

Algorithms should be designed and operated in a way that does not allow them to collude or engage in anticompetitive behavior.[111] Firms should understand the algorithms they use, their purpose, the information they track, and their functionality, including predictive capacity and decision-making abilities. Accordingly, compliance personnel should engage with those employees who have responsibility and insight into the design and functioning of the algorithms. Such employees should understand the types of information considered competitively sensitive and whether such information is to be shared via the algorithm.

C. Establish Appropriate Training and Communications Programs

All employees, senior management, board members, and third parties who have any degree of control or influence over the firm's algorithms—especially ones dealing with competitively sensitive information—should be appropriately trained and made aware of the constraints imposed by the antitrust and competition laws in their respective jurisdictions. It is important to include individuals who may not be consumer or outward facing (technical engineers) but who understand whether the algorithm's technical capacities might

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[110]   *CMA Working Paper, supra* note 16, at 20; *see also* José Alexandre Buaiz Neto, *Brazil*, Ch. 5, THE CARTELS AND LENIENCY REVIEW 36 (Christine A. Varney & John Terzaken eds., 2017), *available at* https://thelawreviews.co.uk//digital_assets/2df178e9-df30-4bef-9743-55ee3e9f9776/TLR-Cartels-and-Leniency-5th-ed---Book.pdf (describing how CADE, the agency responsible for enforcing the competition laws in Brazil, continued its efforts to modernize cartel prosecution by developing investigative tools and state-of-the-art intelligence to track down cartels and obtain evidence of wrongdoings, including the Brain Project, which uses big data and economic filters to identify potential cartel activities in tenders that take place throughout Brazil).
[111]   *See* Vestager, *supra* note 18 ("[P]ricing algorithms need to be built in a way that doesn't allow them to collude. Like a more honorable version of the computer HAL in the film *2001*, they need to respond to an offer of collusion by saying 'I'm sorry, I'm afraid I can't do that.'").

facilitate deliberate or inadvertent anticompetitive conduct. Legal and compliance professionals should keep up with the state of the art, so they fully understand the technology and the current risks it presents.

Employees who are involved in pricing or software decisions should also be sensitized to the implications of adopting a particular algorithm or software platform on the basis that its competitors are using it or will be using it, if its use may dampen or stabilize some element of competition. Even more prudent is to counsel these decision makers to document the independent and unilateral nature of a decision to adopt a particular algorithm or software and any business justifications for such decisions. Similarly, if the company is evaluating software that is developed by a third party, discourage representations by the software manufacturer about sales to your company or competitors or other competitively sensitive information regarding (e.g., how competitors use the software).

D. Consider Using Algorithms for Compliance Screening

Firms can use algorithms to screen and identify those individuals who are in positions that carry greater antitrust risk and would benefit from compliance training. They can also employ algorithms to monitor internal activity, identify any behaviors that raise "red flags," and address those behaviors promptly.[112]

E. Foster Open Reporting and Advice Channels

Firms should maintain clear and open internal reporting channels. All individuals in a company, including those who have any degree of control on the use of the algorithms should feel comfortable to raise questions, concerns, or issues relating to the algorithm to the legal and compliance office. Such channels should be widely known and accessible, and employees should feel free to raise issues without fear of retaliation.

F. Develop Robust Internal Controls and Governance Procedures

Firms should develop robust internal controls and governance procedures, which monitor the actions of their algorithms and ensure their compliance with competition laws in the appropriate jurisdictions. Firms should also consider how algorithms and AI itself can be used to enhance their own antitrust compliance programs.

G. Periodically Review and Evaluate Your Algorithms

Firms should periodically review and reevaluate their use of algorithms. The assessment should ensure that all algorithms are continuing to operate in a procompetitive manner. There should also be ongoing assessments of all the compliance program steps applied in this area, to ensure that they are effective and up to the current state of the technology.

H. Monitor Algorithmic Use By Third Parties

Firms may also use algorithms to monitor third-party algorithm users, such as actors along supply chains, and in other situations where the firm has no control over the algorithms but may be deemed to be responsible by virtue of the relationship or apparent acquiescence in questionable conduct.

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[112] For example, a company could implement antitrust auditing and compliance algorithms that monitor internal communications, including emails, phone calls, and text messages, to detect potentially problematic communications by taking into account the timing, nature, and regularity of communications. *See* Vera Cherepanova, *AI doesn't solve ethical dilemmas, it exposes them*, THE FCPA BLOG (July 9, 2018, *available at* http://www.fcpablog.com/blog/2018/7/9/vera-cherepanova-ai-doesnt-solve-ethical-dilemmas-it-exposes.html; Rosa M. Abrantes-Metz, Patrick Bajari & Joseph E. Murphy, *Antitrust Screening: Making Compliance Programs Robust* (July 26, 2010), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1648948.

VII.   Concluding Thoughts

Algorithms are a central facet of doing business in today's digital economy and a driving force for innovation and increased efficiency. From a competition perspective, most uses of algorithms are completely benign but the possibility that such technology may be used in a socially harmful manner has garnered attention from antitrust regulators around the world. Legal and compliance teams should be well versed in the issues involved and prepared to take reasonable measures to minimize their clients' exposure to antitrust risk under the rules of each of the jurisdictions in which they operate.

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2018-2019 COMPLIANCE AND ETHICS COMMITTEE