

DECODING ALGORITHMS: WHAT DOES THIS MEAN FOR COMPETITION LAW?

INTRODUCTION

Picture a world of autonomous driverless vehicles such as a car or a plane. These vehicles have no human intervention whatsoever, and in fact, the need for a driver's license would be completely irrelevant. Surprisingly, we are not very far away from this eventuality as the driving forces behind the driverless cars are the same as those that control other mediums in our everyday lives such as dialing a phone number, searching a recipe on the Internet or even calculating the location of the nearest traffic light from the street. All these examples are driven by one commonality: an algorithm. Algorithms are a pervasive aspect of modern society that it is often overlooked how much we depend on them to carry out decisions efficiently and accurately.

Recently, Algorithms lie at the heart of business models and strategies, particularly online businesses and platforms. As the cornerstone of the Internet, the algorithms carry out a variety of tasks that are relevant to the economy. Algorithms yield a number of significant benefits to consumers and other users by providing consumers with relevant information specific to their needs.¹ As a rising development, it is no wonder the market has benefited from the world of e-commerce. On the other hand, algorithms could also be used in principle to foster the restriction and closure of competition² by misleading consumers and limiting their choices, and increasing product prices. This often leads to consumer trust being undercut and fewer consumers engaging in the online market, inevitably affecting competition.

This paper aims to explore how technological advancements such as algorithms are changing, and will continue to change, the dynamics of competition in the community. The impact algorithms have had on economies, competition and

¹ Secretariat background notes, "Algorithms and collusion – note from the United Kingdom," DAF/COMP/WD(2017)19 p2.

² Secretariat background notes, "Algorithms and collusion – note from the United Kingdom," DAF/COMP/WD(2017)19 p3.

consumer welfare will be assessed through a variety of first world jurisdictions such as the United States (US) and the European Union (EU) where algorithms play a predominant role in the market. A synopsis of algorithms will be outlined as well as their application in the economy and how they are mostly used to facilitate changes to consumer welfare. Furthermore, an overview of algorithmic pricing and its ability to remain in stealth mode to stabilise or damage market competition through collusion and discrimination, while remaining under a competitive environment will be addressed. Finally, this essay will analyse the challenges that competition authorities face when enforcing legal sanctions against the use of algorithms, as well as the counter measures and resolutions which may be available to authorities when determining how to resolve the problems associated with algorithms and competition law today.

MEET ALGORITHMS

What are Algorithms?

Algorithms existed long before the creation of the first computer and they are, in fact, an essential ingredient to any computational program.³ Their purpose is to organise sequentially a set of rules in order to perform a certain task, and can have a varying range of complexity. Therefore, the essential function of an algorithm is to generate an output from a given input.⁴ Wilson and Keil⁵ define an algorithm as an “unambiguous, specific list of simple operations applied mechanically and systematically to a set of tokens or object with the initial state of the object being the input and the final state the output.”⁶

There are a variety of forms an algorithm may take, such as diagrams, codes and programs, all of which can be interpreted by a machine.⁷ Algorithms may prove to be monolithic,⁸ thus displaying a significant area of a computational progression. Alternatively, some algorithms may run only sequentially while others may be

³ Gal Avigdor, “*It’s a Feature, not a Bug: On Learning Algorithms and what they teach us,*” DAF/COMP/WD (2017) 50 p2.

⁴ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p6.

⁵ Ibid.

⁶ Wilson, R. A. and F. C. Keil, “The MIT Encyclopedia of the Cognitive Sciences,” (1999) MIT Press.

⁷ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p6.

⁸ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p6.

designed to run in parallel.⁹ However, despite how they are intended to operate, their procedure remains uniform; a certain level of input is arranged through a series of commands that produces a specific output. One of the main advantages of an algorithm is the fact that they perform tedious task that may be time consuming, costly and repetitive for humans to perform.¹⁰ This is all due to the increase in growth of Artificial Intelligence (AI) and Machine Learning (ML) in resolving complex problems, predicting decisions and achieving goals aimed at improving society and the economy.¹¹

Artificial Intelligence is a broad area of computer programming. It involves research and design using computational programs that perform difficult tasks in an “intelligent” manner.¹² This process was initially aimed at replicating human ideas, but this proved impractical, and thereafter, AI became a means of developing and teaching machines to learn “human” concepts.¹³ Machine Learning (ML), which is a subfield of AI, designs machines using algorithms that capture information through data and other experience.¹⁴ There are three categories of ML algorithms; supervised, unsupervised and reinforcement learning. Each category processes data according to their learning pattern.¹⁵ There is another subfield of ML, known as Deep Learning, that has significance in computer systems. This type of learning aims to enable computers to learn more efficiently and accurately than ML.¹⁶ Unfortunately, Deep Learning fails to explain its decision-making, thus making it harder to describe.

Application of Algorithms

Algorithms are used by a variety of stakeholders such as businesses, consumers and the government. The development of algorithms in the community has resulted in a growth of their use not only in online markets but in industrial contexts as well.¹⁷ Government agencies, especially in the US rely on algorithms to detect any criminal

⁹ Ibid.

¹⁰ Gal Avigdor, “It’s a Feature, not a Bug; On Learning Algorithms and what they teach us,” DAF/COMP/WD (2017) 50 p2.

¹¹ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p7.

¹² Ibid.

¹³ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p7.

¹⁴ Ibid.

¹⁵ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p7.

¹⁶ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p8.

¹⁷ Ibid.

behaviour,¹⁸ as well as any hint of collusion through screening mechanisms.¹⁹ Fortunately, competition agencies have successfully managed to detect bid rigging cases and anomalies through the use of reliable bidding data on public tenders.²⁰ Another advantage for the government's use of ML algorithms is the fact that they may detect tacit agreements that lead to collusion, more of which will be analysed further in this essay.

In a business context, a number of companies are adopting algorithms when utilising predictive analytics, increasing supplier power and the optimisation of business processes.²¹ Predictive analytics involves the development of algorithms to measure the possibility of future outcomes based on historical data.²² They may also be used to identify risks and predict demand, price changes, customer behaviour and any other factors that may affect the market.²³ The optimisation of business processes may provide a competitive advantage as they reduce production and transaction costs whilst segmenting consumers.²⁴ The greatest advantage of using algorithms for optimisation is the fact that computation programs are able to process data faster than humans, thus significantly reducing the costs of performing this task. The use of algorithms in a business environment allow for targeted advertising as well as product recommendation, thus resulting in an increase in supplier power. Companies use algorithms as a means of becoming more efficient, and this encourages other firms in the industry to develop similar approaches.²⁵ Thus, new technologically advanced programming principles are required for novel applications in businesses.

The use of algorithms aids consumers when it comes to buying power, information, as well as decision-making.²⁶ Algorithms advise consumers when it comes to product selection, travel options and health benefits. This can potentially lead to consumers

¹⁸ Secretariat background notes, "Algorithm and Collusion," DAF/COMP (2017) 4 p8

¹⁹ Ibid.

²⁰ OECD (2013). "Roundtable on Ex Officio Cartel Investigations and the Use of Screens to Detect Cartels," DAF/COMP(2013)14, <[http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DAF/COMP\(2013\)14&docLanguage=En](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DAF/COMP(2013)14&docLanguage=En)> last accessed 22 November 2017.

²¹ Ezrachi, A. and M. E. Stucke (2016), "Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy", Harvard University Press, United States.

²² Secretariat background notes, "Algorithm and Collusion," DAF/COMP (2017) 4 p9.

²³ Ibid.

²⁴ Secretariat background notes, "Algorithm and Collusion," DAF/COMP (2017) 4 p9.

²⁵ Ezrachi, A. and M. E. Stucke (2016), "Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy", Harvard University Press, United States.

²⁶ Secretariat background notes, "Algorithm and Collusion," DAF/COMP (2017) 4 p10.

switching between products, and thus increase competition between suppliers.²⁷ The use of algorithms is pertinent in our daily lives from our purchasing decisions to what physical activities we should carry out.²⁸ It is clear that the use of algorithms helps in almost every sector of society, whether it is business decisions, consumer purchases or even detecting cartel conduct.²⁹ Algorithms reveal unprecedented possibilities as they allow technology to determine decisions related to consumer welfare. Recently, the use of algorithms for automated pricing has led to an increase in benefits for consumers.

Algorithmic Pricing and where it is used

Pricing algorithms are computational codes used by sellers to set prices automatically in order to increase profits.³⁰ By sifting through a large variety of data, these algorithms may optimise pricing and enable faster reaction to changes in the market. Pricing algorithms may be useful when implementing continuous changes over a period of time; this is shown through dynamic pricing whereby companies react instantly to changes in supply conditions as well as fluctuations in market demand.³¹ This proves beneficial as it ensures the market remains in equilibrium and that all mutually beneficial transactions are utilised.³²

There are four relevant approaches to algorithmic pricing that are utilised by companies; they are “Heuristic,” “Analytical,” “Autonomous” and “Auctions.”³³ The first three approaches are regularly updated and fully transparent whereas the last one utilises a mechanism known to the market to determine prices.³⁴ It is important to note that these mechanisms are not effective without human intervention. Algorithmic pricing is used with the appropriate approach in a number of mediums, such as in online retail stores, insurance, airlines and accommodation. In these industries,

²⁷ Ibid.

²⁸ Oxera discussion paper, “*When algorithms set prices: winners and losers*,” (2017) p1.

²⁹ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p9.

³⁰ Chawla, S., J. D. Hartline and R. Kleinberg (2007), “*Algorithmic Pricing via Virtual Valuations*”, <<http://users.eecs.northwestern.edu/~hartline/papers/bayesian-pricing-EC-07.pdf>> Last accessed 26 November 2017.

³¹ Weiss, R. M. and A. K. Mehrotra (2001), “Online Dynamic Pricing: Efficiency, Equity and the Future of E-commerce”, Virginia Journal of Law and Technology, Vol. 6, No. 11 <<http://www.citi.columbia.edu/B8210/read10/Online%20Daynamic%20Pricing.pdf>> last accessed 27th November 2017.

³² Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p14.

³³ Oxera discussion paper, “*When algorithms set prices: winners and losers*,” (2017) p5.

³⁴ Ibid.

heuristic methods are applied as there is a goal to automatically match a competitor's price.³⁵ However, algorithmic pricing is not only limited to online use. Retail stores often have "electronic tags" on products, enabling rapid price changing. Additionally, road tolls are able to adjust prices to regulate the flow of traffic.³⁶

Who controls Algorithmic pricing and how do they learn?

Data scientists using ML methods focus primarily on predictive power to manage algorithmic pricing.³⁷ These Algorithms use past sales data and various control variables set by the user to adjust prices, and in this sense, the algorithm has "learned" how to set prices using previous experience.³⁸ Alternatively, an algorithm may also use "real world" data to learn how to set prices. This often leads to reinforcement learning approaches, which frames the problem on how to set prices in terms of learning a pricing policy that maximises the discounted stream of future profits, depending on the objective function.³⁹ Thus, it is imperative to acknowledge that there is a strong link between the actions and state of the world, and that any actions today can affect future pricing.

ALGORITHMS AND THE ECONOMY

Impact of Algorithms to the economy

Now that Algorithms and their specific uses in industry have been defined, it is essential to look at the influence Algorithms have had in the economy. Although Algorithms may be the corner stone of the Internet, it is clear that any change made to the online world inevitably affects any development in the real world. Thus, Algorithms tend to influence material and people through a variety of platforms, assessed in more detail below.

Transparency

Through the use of online media and "e-commerce," there has been an increase in price transparency and the flow of information, providing additional scope for firms

³⁵ Oxera discussion paper, "When algorithms set prices: winners and losers," (2017) p5.

³⁶ Oxera discussion paper, "When algorithms set prices: winners and losers," (2017) p7.

³⁷ Ibid.

³⁸ Oxera discussion paper, "When algorithms set prices: winners and losers," (2017) p7.

³⁹ Ibid.

to collect large amounts of data on customer behaviour.⁴⁰ This increase in monitoring can be done during smaller time intervals at a much lower cost and make it easier for customers to shop around the world and access supplier's information. This process proves advantageous for suppliers as any monitoring in the "offline" world is done through human investigations that may be costly and tedious. Thus, the use of software to automatically monitor competitor's prices allows suppliers to adjust their prices accordingly and obtain accurate up to date information through user-friendly systems.⁴¹ Certain platforms may also gather information about consumer preferences and past consumption habits to formulate an effective search. However, this increased transparency into the market may result in restrictions of competition as well as practices that mislead consumers due to the ease of accessibility on the Internet.⁴² Certain algorithmic functions fail to stipulate on platforms which supplier pays the most commission, and this can be misleading for customers as they may base their choice of purchase on the top results without a true explanation as to why the supplier is ranked in that position. The United Kingdom's (UK) Competition and Market Authority (CMA)'s market study⁴³ indicated that most consumers lack the knowledge on how comparison sites make money and most sites fail to provide the explanations on supplier positions on the platform.⁴⁴ This leads to poor transactional decisions by and greater risks to consumers.⁴⁵

Diversity

Algorithms allow prices of a diverse range of products and services to be expressed on an online platform than if they were to search in the offline world. For example, the marketplace Airbnb connects guests with local hosts that rent out an available space, mimicking the function of a hotel. Although Airbnb recommends a price based on an algorithm that takes into account location, occupancy, duration as well as other

⁴⁰ Secretariat background notes, "Algorithms and collusion – note from the European Union," DAF/COMP/WD(2017)12 p2.

⁴¹ Secretariat background notes, "Algorithms and collusion – note from the European Union," DAF/COMP/WD(2017)12 p3.

⁴² Secretariat background notes, "Algorithms and collusion – note from the United Kingdom," DAF/COMP/WD(2017)19 p3.

⁴³ Ibid.

⁴⁴ Secretariat background notes, "Algorithms and collusion – note from the United Kingdom," DAF/COMP/WD(2017)19 p3.

⁴⁵ Ibid.

important factors, hosts are free to set their own prices..⁴⁶ Thus, pricing a diverse range of products enables Airbnb to maximise the value of their booking, ensuring that prices are optimal to both parties and that competitor's prices are taken into account.

Risk Compensation

Insurance is usually priced according to the policyholder and their risk characteristics that are a function of their behavioral and lifestyle patterns. Most insurance companies utilise algorithms to set prices for their products according to risk characteristics, which is set according to a consumer's inclination to pay.⁴⁷ This strategy is implemented by offering a lower price and then gradually increasing the price if the customer remains with the insurer over time, thus a clear indication of highly competitive price comparison websites.⁴⁸ This process often requires a large amount of personal data in order for the algorithm to base an individual price on a characteristic. This may prove controversial, as the depth of personal data obtained may lead to a price discrimination dealt with further on in this essay.

Demand and Supply

When it comes to demand and supply, data-driven marketplaces are significantly more efficient when processing data and utilising algorithm. Although the use of algorithms may increase transparency, it may also improve existing products or aid in the development of new ones, and this is evident from the OECD's work on disruptive innovation.⁴⁹ Companies are under pressure to implement the most recent changes and this usually requires the most innovative algorithms.⁵⁰ This use of algorithms when it comes to supply not only increases efficiency but also reduces production costs, improving quality as well as resource utilisation.⁵¹ This enables suppliers to offer reduced prices to consumers. Furthermore, the use of Deep Learning methods allows rapid progress in daily business operations as algorithms perform the tasks that were once carried out by humans. Algorithms tend to motivate a higher

⁴⁶ Oxera discussion paper, "When algorithms set prices: winners and losers," (2017) p13.

⁴⁷ Oxera discussion paper, "When algorithms set prices: winners and losers," (2017) p10.

⁴⁸ Ibid.

⁴⁹ Secretariat background notes, "Algorithm and Collusion," DAF/COMP (2017) 4 p12.

⁵⁰ Ibid.

⁵¹ Secretariat background notes, "Algorithm and Collusion," DAF/COMP (2017) 4 p12.

level of innovation from suppliers as consumers can easily switch between competitors if one supplier fails to meet their needs.⁵²

It is a general rule of economics that any change made to supply will automatically affect demand. Thus, algorithms are not limited to aiding business processes but as mentioned previously, they play a significant role in assisting consumers in purchasing decisions resulting in dynamic demand side effects.⁵³ Since algorithms enable consumers to compare prices, suppliers and quality online, they allow for rapid prediction and impartial decision-making that decreases transaction expenditure.⁵⁴ Furthermore, algorithms introduce a concept of the “digital butler”⁵⁵ which essentially means that the algorithm will identify the need of the consumer, search for options and execute the transaction.⁵⁶ This mechanism allows consumers to access comparative information, a wide set of quality dimension offers, and will avoid any biases that could occur in these scenarios.⁵⁷ Gal and Elkin Koren⁵⁸ explain that this will allow consumers to overcome any manipulative marketing tool of which suppliers could take advantage.⁵⁹ The use of a digital butler implements a level of equality between customers as those that lack the knowledge of using online purchasing may rely on the butler to optimise the strategies on their behalf.⁶⁰

The service provided by Uber is a clear example of how algorithms affect supply and demand. Uber is a transport company that allows customers the freedom of booking transport on short notice through the use of a smartphone application. Once the driver and customer are matched, the customer has the autonomy to track their route and pay through a variety of media such as credit or cash.⁶¹ Prices are often set by algorithms, based on the distance and time travelled, and cannot be influenced by the driver.⁶² Thus, Uber’s pricing algorithms aim to balance demand and supply; when the demand

⁵² Ibid.

⁵³ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p12.

⁵⁴ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p13.

⁵⁵ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p15.

⁵⁶ Ibid.

⁵⁷ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p15.

⁵⁸ Gal, Michal S. and N. Elkin-Koren (2017), “*Algorithmic Consumers*”, Harvard Journal of Law and Technology, Vol. 30, < <https://ssrn.com/abstract=2876201> > last accessed 26 November 2017

⁵⁹ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p15.

⁶⁰ Ibid.

⁶¹ Oxera discussion paper, “*When algorithms set prices: winners and losers*,” (2017) p12.

⁶² Uber Help, <<https://help.uber.com/h/33ed4293-383c-4d73-a610-d171d3aa5a78>> last accessed 24th November 2017.

risers, prices increase deterring price-sensitive customers from requesting rides, inevitably reducing the demand. This is termed “surge pricing” and coincidentally, the higher prices attract drivers to areas where the “surge pricing” is active.⁶³ Generally, Uber drivers keep the booking price less a percentage⁶⁴ of Uber’s service fee, and this allows Uber to maximise revenue for the service.⁶⁵

Price Matching

Algorithms provide a benefit to the economy not only through the above-mentioned factors but also through its price matching schemes. E-commerce includes a variety of competitors, quick pricing adjustments as well as possible interactions between consumers and suppliers.⁶⁶ This increase in feedback suggests high sales volumes and automatically enables sellers to appear higher on selling or browsing platforms. Amazon is a good example of price matching using algorithms; through their “Buy Box” mechanism, a seller’s offer is displayed on the homepage and tends to be the default purchase.⁶⁷ This is significant because the Buy Box doesn’t always list the lower priced product in the box, so any seller could benefit from higher sales with their higher price. Thus, an algorithm like Amazon’s Buy Box may improve not just because of their lower prices but a range of factors such as consumer feedback, and brand identity and popularity.⁶⁸ It is clear that the use of Algorithms proves beneficial, as authors such as Chen et al.⁶⁹ found that sellers that utilise algorithmic pricing are far more successful than those that do not.⁷⁰

Market entry

Algorithms allow customers to benefit during periods when sellers can freely enter and exit the market without incurring additional expenses that they would have to recover elsewhere.⁷¹ In situations where a firm raises prices or lowers them below

⁶³ Ibid.

⁶⁴ Oxera discussion paper, “*When algorithms set prices: winners and losers*,” (2017) p12.

⁶⁵ Ibid.

⁶⁶ Oxera discussion paper, “*When algorithms set prices: winners and losers*,” (2017) p9.

⁶⁷ Ibid.

⁶⁸ Oxera discussion paper, “*When algorithms set prices: winners and losers*,” (2017) p9.

⁶⁹ Chen, L., Mislove, A. and Wilson, C. (2016), “*An Empirical Analysis of Algorithmic Pricing on Amazon Marketplace*,” Proceedings of the 25th International Conference on World Wide Web (WWW ’16), pp. 1339– 49, April.

⁷⁰ Ibid.

⁷¹ Ezrachi, A. and M. E. Stucke (2016), “*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*”, Harvard University Press, United States p5

competitive levels, entrants and incumbents would take advantage of this period to profit, thus restoring competition.⁷² For an online retailer, an algorithm reduces the amount of market knowledge required to penetrate into the market. In fact, existing retailers have ease when expanding their products as the algorithm sets the price for the expanded products and this inevitably leads to stronger competition.⁷³ Online platforms have the added advantage of reducing advertising expenses, as suppliers who wish to advertise directly on search engines will bid for certain words.⁷⁴ Additionally the use of price comparison websites allows customers a greater variety of products and facilitates easy and rapid access to the markets.⁷⁵ The acceleration of online markets enables healthier competition as entries and exits to the market are characterised by well-informed suppliers and better prices between buyer and seller.⁷⁶

Conclusion

It is clear that through the use of algorithms the economy has significantly been affected. Algorithms allow a variety of factors to influence the way in which suppliers price their products and customers purchase their goods. Whilst this improves certain inefficiencies with the economy, most companies do not benefit from the same effects. Clearly, the impact of these algorithms affects both the offline and the online world. Thus, it is imperative to address how far the use of algorithms in pricing affects competition law and whether machine learning may be an area of concern.

ALGORITHMIC PRICING AND COMPETITION LAW

Now that the extent to which algorithms affect the economy has been established, it is important to assess how this affects Competition law. Competition is the driving force behind a free enterprise system.⁷⁷ Capitalism relies heavily on decentralised planning, which includes an amalgamation of producers and consumers making a variety of decisions on how the market works. An important factor of competition is that it

⁷² Ibid.

⁷³ Oxera discussion paper, "When algorithms set prices: winners and losers," (2017) p16.

⁷⁴ Ezrachi, A. and M. E. Stucke (2016), "Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy", Harvard University Press, United States p6.

⁷⁵ Ibid.

⁷⁶ Ezrachi, A. and M. E. Stucke (2016), "Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy", Harvard University Press, United States p10.

⁷⁷ *United States v Syufy Enterprises*, 903 F.2d 659, 662-63 (9th Cir.1990).

instills an essence of discipline in the economy and filters out any bias activity between producers. The need for competition is evident in that it promotes diversity, options, avoids concentration of market power and allows a wide variety of resources to circulate for higher-valued uses.⁷⁸ The rise of technology has resulted in a change in the dynamics of competition and this is due to the fact that algorithms are creating a new environment that portrays a large comparative market.⁷⁹ The question to be addressed now is whether algorithms are a detriment to consumer welfare and competition law. The next section deals with how the use of algorithms could facilitate harmful conditions such as collusion, price discrimination and barriers to entry into the market.

Collusion and Online Cartels

Collusion refers to “any form of co-ordination or agreement among competing firms with the aim of raising profits to a higher level than the non-cooperative equilibrium, resulting in deadweight loss.”⁸⁰ Collusion is seen as a much easier means of operating as opposed to competing, and with a mutual agreement on stabilising prices to raise profits, both producers can dominate the market.⁸¹ Economists have identified two forms of collusion, namely explicit and tacit. Explicit collusion is more common and is, as the name suggests, more expressly carried out whether it be an oral or written agreement that is directly communicated between firms.⁸² Alternatively, tacit collusion occurs when anti-competitive targets can be achieved without the need for any expressed agreement.⁸³ There is a rising concern that algorithms make reaching collusive outcomes easier and more likely, as markets are becoming more transparent and machine learning enables suppliers to interact rapidly and more efficiently.

Messenger

According to Ezrachi and Stucke,⁸⁴ there are four situations in which algorithms may

⁷⁸ Ibid.

⁷⁹ Ezrachi, A. and M. E. Stucke (2016), *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy*, Harvard University Press, United States p27.

⁸⁰ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p17. See also O’Sullivan and Sheffrin (2003) and Green et al. (2013).

⁸¹ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p17.

⁸² Ibid.

⁸³ Ibid.

⁸⁴ Ezrachi, A. and M. E. Stucke (2016), *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy*, Harvard University Press, United States

lead to tacit collusion. The first scenario, known as the “Messenger,”⁸⁵ involves the use of the computer algorithms to monitor and maintain a cartel which in itself would be illegal.⁸⁶ This scenario is present in situations where executives of firms secretly fix prices in an agreement between themselves and use algorithms to monitor and enforce the agreement.⁸⁷ A relevant case in this area is the *Topkin*⁸⁸ case, whereby the department of justice warned antitrust lawyers of the use of price fixing schemes using algorithms. In this case, David Topkin and his co-conspirators adopted specific pricing algorithms that collected competitors’ pricing information for posters sold online and applied it to the seller’s prices.⁸⁹ The goal was to coordinate changes to their prices for the sale of their posters, to which Topkin pleaded guilty.⁹⁰ In the European Union (EU), there was a similar issue whereby a Greek competition authority fined Carrefour Marinopoulos⁹¹ for a number of infringements, including resale price maintenance through their IT system’s ability to monitor any deviations.⁹² There are cases in different jurisdictions whereby algorithms are used to facilitate anticompetitive agreements. However, collusion may also be established through weaker forms of communications, which do not give to an agreement but are still termed under an antitrust law.⁹³ Therefore, it is clear that through the Messenger scenario, an agreement or collusion among parties is paramount while there is less need for evidence of intent to establish an agreement’s purpose.⁹⁴ Therefore, the Algorithm acts as a “Messenger” by facilitating the desire and extension of the operator’s will.⁹⁵

⁸⁵ Ezrachi, A. and M. E. Stucke (2016), *Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*, Harvard University Press, United States p39.

⁸⁶ Ibid.

⁸⁷ Ezrachi, A. and M. E. Stucke (2016), *Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*, Harvard University Press, United States p39.

⁸⁸ *United States v Topkins*, CR 15-00201 WHO (N.D. Cal. Apr 30, 2015)

⁸⁹ Ibid.

⁹⁰ *United States v Topkins*, CR 15-00201 WHO (N.D. Cal. Apr 30, 2015)

⁹¹ Hellenic Competition Commission. *Decision Concerning Infringements of Articles 1 of Law 703/77 and Article 101 TFEU by the Retailer Carrefour Marinopoulos S.A. in Connection with the Franchise Network for the Operation of “5 Marinopoulos” Retail Stores* (Athens: Hellenic Competition Commission, July 15, 2010), http://www.epant.gr/img/x2/news/news270_1_1279200461.pdf.

⁹² Ibid.

⁹³ Ezrachi, A. and M. E. Stucke (2016), *Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*, Harvard University Press, United States p41.

⁹⁴ Ibid.

⁹⁵ Ezrachi, A. and M. E. Stucke (2016), *Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*, Harvard University Press, United States p44.

Hub & Spoke

The second scenario explores the use of algorithms as a central “hub” to coordinate online pricing or other related activities, while the competitors have no direct contact between each other.⁹⁶ The hub functions at a level of the market structure that coordinates a price fixing agreement amongst competitors at a different level, the “spokes.”⁹⁷ In this scenario, each competitor in a local market sees the shift to dynamic pricing; they do not interact with one another but they use the “upstream supplier’s”⁹⁸ algorithm. This determines the market price and compels competitors to be in sync with this dynamic behaviour and use similar mechanism to determine their pricing strategy.⁹⁹ This scenario may lead to collusion as an effect rather than an intentional aim as each competitor opts for the same pricing scheme.¹⁰⁰ As opposed to the Messenger scenario, the algorithm is not necessarily a mechanism to carry out a cartel but it is rather used to monitor a process that leads to unintentional price fixing.¹⁰¹ In the case of *Eturas*,¹⁰² the administrator of the Lithuanian travel booking system sent out an electronic notice to its travel agents setting a cap on discount rates. The European Court of Justice (ECJ) clarified that any agents aware of this notice were assumed to have been a participant to the cartel unless they publicly distanced themselves.¹⁰³ Therefore, algorithm developers need to be cautious as an effect of creating an algorithm may result in vertical or horizontal collusion.

Another area where algorithms are utilised as part of the hub-and-spoke method is through platforms that bring together sellers and purchasers. Competitors may decide to apply the platform’s price as a way of dampening horizontal competition, and this strategy is apparent in companies such as Uber.¹⁰⁴ As mentioned earlier, Uber’s algorithms could have a greater market power as they are likely to set the price and

⁹⁶ Ezrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p46.

⁹⁷ *United States v Newton*, 326 F.3d 253,255 (1st Cir.2003).

⁹⁸ Ezrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p47.

⁹⁹ Ezrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p48.

¹⁰⁰ *Ibid.*

¹⁰¹ *Ibid.*

¹⁰² *Eturas and Others*, Case C-74/14 (2016).

¹⁰³ *Ibid.*

¹⁰⁴ Ezrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p53.

increase profits for drivers.¹⁰⁵ If every taxi service used Uber's pricing algorithm it may be unclear as to whether it can be seen as collusion.¹⁰⁶ The algorithms' possible manipulation of the market price and platform may cause confusion amongst competition authorities. The effects on the market may resemble horizontal collusion although the conditions for establishing a hub-spoke scenario may not be present, and this could present difficulty for the courts when determining illegality.¹⁰⁷

Predictable Agent

This scenario involves a situation whereby a company could unilaterally choose an algorithm that monitors its rivals' behaviour and directs its prices towards the collusive price.¹⁰⁸ If each seller relies on the same algorithm, market transparency is likely to increase.¹⁰⁹ This is carried out in two main stages; first the computer will have to access and process market data of all relevant competitors and respond to the changes.¹¹⁰ Secondly, once each firm has adopted the pricing algorithm, the supply of market data will increase and therefore result in transparency.¹¹¹ Thus, the whole purpose of the "Predictable agent" is to rapidly update prices so quickly so as to reflect the market demand and any participants will expect the price posted to be the actual price.¹¹² This scenario does not require any predetermined agreement and all that occurs is the company's wish to develop its economic self-interest, which results in conscious parallelism at both a machine and a human level.¹¹³ Whilst there is no evidence of an agreement, there is a possibility of anti-competitive intent.¹¹⁴ Although

¹⁰⁵ Ibid.

¹⁰⁶ A case was brought against Uber in Canada for price fixing by Edmonton taxi companies. See "Uber Accused of Price-Fixing in \$150M Lawsuit by Edmonton Taxi Companies," CBC News (September 14, 2015), <http://www.cbc.ca/news/canda/edmonton/uber-accused-of-price-fixing-in-150m-lawsuit-by-edmonton-taxi-companies-1.3228115>.

¹⁰⁷ Ezechai, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p53.

¹⁰⁸ Ezechai, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p56.

¹⁰⁹ Ibid

¹¹⁰ Ezechai, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p57.

¹¹¹ Ezechai, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p59.

¹¹² Ibid.

¹¹³ Ezechai, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p64.

¹¹⁴ Ezechai, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p66.

price monitoring is legal, it is difficult to enforce legal restrictions under competition law.

The *Athena*¹¹⁵ case applies to this scenario, whereby the US Securities and Exchange Commission sanctioned Athena Capital Research for using complex algorithms to manipulate stock prices.¹¹⁶ This algorithm allowed Athena to overwhelm the market's available liquidity and artificially pushed the market price in Athena's favour.¹¹⁷ This case demonstrates the ability of a company's use of a complex algorithm not only to increase transparency but also to manipulate the market. Although Athena had to pay a fine, the court struggled to find the predominant purpose for using the algorithm.¹¹⁸ Thus, this scenario is clearly challenging as the information and data that is available to any consumer may be utilised for conscious parallelism.

Artificial Intelligence

The final scenario involves the use of two predominant advancements that amplify tacit collusion to a new level of stability.¹¹⁹ The first advancement is the rapid response of computers to process data in real time and the second involves the increasing complexity and development of algorithms as they engage in autonomous decision-making and artificial intelligence. These advancements allow a broader overview of the market, a faster reaction time to competitive changes and could result in expanded tacit collusion.¹²⁰ Unfortunately, as with the Predictable Agent scenario, there remains ambiguity on how to enforce legal sanctions, as there is no clear intention for collusion. This proves that tacit collusion leads to far worse side effects comparable to explicit collusion.

Price Discrimination

Another significant harm to competition law and consumer welfare through

¹¹⁵ US Securities and Exchange Commission, *Administrative Proceeding File No. 3-16199* (October 16, 2014), See <http://www.sec.gov/litigation/admin/2014/34-73369.pdf>

¹¹⁶ Ibid.

¹¹⁷ Ibid.

¹¹⁸ Ibid.

¹¹⁹ Ezrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy*", Harvard University Press, United States p71.

¹²⁰ Ibid.

Algorithms is by the online tracking and profiling of consumers. As opposed to collusion, whereby pricing algorithms increase the transparency of the terms of sale and coordinate agreement of pricing, this harm aims at using data-driven algorithms to target consumers with modified market pricing and products.¹²¹ Price discrimination occurs through charging customers different prices based on the customer's willingness to pay and their reservation price,¹²² despite the cost difference between similar products.¹²³ The reason why firms engage in this activity is because it generates profits.¹²⁴ In the online world, pricing is usually based on the different traits surrounding consumers, making it dynamic and personalised.¹²⁵ By gaining the necessary information on consumers, a seller is able to calculate a discount to induce the consumer into purchasing products whilst the customer remains unaware of this profiling activity.¹²⁶

Furthermore, retailers' use of loyalty programs aid the collection of consumer data and allow retailers to target them with tailored adverts and discounts.¹²⁷ In the US, the retail store Target manages to extract your online information through relevant sites, and Target is still able to collect data even if the consumer blocks tracking.¹²⁸ In the United Kingdom (UK), the supermarket Tesco utilises similar techniques with their club card loyalty scheme to target individual consumers with relevant product advertising and information.¹²⁹ Aside from data collection, brokers are often found to have analysed customers' response to marketing, purchases on the web or influences

¹²¹ Secretariat background notes, "Algorithms and collusion – note from the United Kingdom," DAF/COMP/WD(2017)19 p7.

¹²² Reservation price is termed as a latent variable that is inferred based on how much a customer is willing to pay for a particular product. See Ezrahi, A. and M. E. Stucke (2016), *Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*, Harvard University Press, United States p96.

¹²³ Ibid.

¹²⁴ Ezrahi, A. and M. E. Stucke (2016), *Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*, Harvard University Press, United States p87

¹²⁵ Ezrahi, A. and M. E. Stucke (2016), *Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*, Harvard University Press, United States p90.

¹²⁶ Ezrahi, A. and M. E. Stucke (2016), *Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*, Harvard University Press, United States p92.

¹²⁷ Ezrahi, A. and M. E. Stucke (2016), *Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*, Harvard University Press, United States p91.

¹²⁸ Ibid.

¹²⁹ Brad Howarth, "How Tesco's Loyalty Card Transformed Customer Data Tracking," CMO (May 21, 2015), <http://www.cmo.com.au/article/575497/how-tesco-loyalty-card-transformed-customer-data-tracking/>; Krish Swamy, "Analyzing Tesco – The Analytics behind a Top- Notch Loyalty Program," Big Data Analytics (August 21, 2011), <http://stat-exchange.blogspot.com/2011/08/analyzing-tesco-analytics-behind-top.html>.

over others.¹³⁰ Nowadays, it is quite rare to find someone not on his or her smartphone or tablet whether it be for socialising or shopping. Through these activities, sellers will invest more money into shadowing our activities and identify the right time when to advertise their products.¹³¹ Therefore, an algorithm can allow an in depth investigation into an individual's reservation price and may calibrate and refine customers into groups of customers with similar pricing limits to aid targeted marketing.¹³²

Furthermore, as more online sellers participate in dynamic pricing, it becomes harder for consumers to discover a general market price and to assess their options beyond the world of e-commerce.¹³³ The ability of consumers to discriminate between sellers' prices may be limited through possible pushback programs that may outsmart the algorithms, but these consumers may often be in the minority.¹³⁴ Price discrimination clearly raises concerns for firms not only in exploiting consumer's information but also through the increase in barriers to entry.¹³⁵ The UK CMA notes that where a firm uses consumer data to segment customer groups, it affects small to medium-sized businesses, as they may not have the same amount of customer base so they may not be able to compete.¹³⁶ This exclusion of competitors is further recognised by the European Commission in *AKZO*,¹³⁷ whereby the court described price discrimination as a competitive disadvantage to the structure of competition.¹³⁸

The increase in data collection and analytics often leads to the ability to discriminate. Price and behavioural discrimination raises a number of privacy concerns as consumers are unaware they are being monitored online.¹³⁹ In the odd chance that consumers are aware, there is clearly an underestimation of how much data is being

¹³⁰ Ezrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p95..

¹³¹ Ezrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p96.

¹³² Ezrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p97.

¹³³ Ibid.

¹³⁴ Ezrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p118.

¹³⁵ Ibid.

¹³⁶ Ibid.

¹³⁷ Commission Decision 85/609 *ECS/AKZO*, OJ L 374 (December 31, 1985), para. 83.

¹³⁸ Ibid.

¹³⁹ Ezrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p91.

collected which could potentially disrupt trust and safety in the market.¹⁴⁰ The absent legal intervention and the increase in online seller scrutiny may be the new “norm” as more generations become accustomed to the Internet and price discrimination.¹⁴¹

Price Comparison Websites (PCW)

Another important aspect of discrimination in competition law is through comparison intermediaries. Price comparison websites are an integral part of the Internet whether it is through Google, Yahoo and Bing. These intermediaries provide a link for consumers to search their queries and allow an overview of competitors in the market. Comparison intermediary websites widen the realm of the market at a national and international level.¹⁴² These platforms allow a coherent competitive market to be established whereby consumers can identify various products and services. However, there are certain effects that can distort competition; with search engines extracting a consumer’s data, there are more personalised adverts created in order to increase the number of consumers.¹⁴³

These platforms tend to resemble that of a “gatekeeper”¹⁴⁴ between buyers and seller, as the information shared tends to increase the platforms bargaining power. As the market power increases, transparency becomes opaque as the platform operators carry out the regulations of these online markets.¹⁴⁵ Many of these platforms benefit from a commission from sellers, to which they provide preferential treatment, often distorting competition as consumers are unaware of the preferential positioning.¹⁴⁶ This issue was evident in 1984 with the US airlines’ computerised reservation systems, of which several airline sellers took advantage.¹⁴⁷ Majority of these airlines possessed the algorithms relevant in manipulating the listings of sellers. The government handled this abuse, as they required that the algorithms generate results

¹⁴⁰ Ibid.

¹⁴¹ Eyrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p130.

¹⁴² Eyrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p131.

¹⁴³ Eyrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p132.

¹⁴⁴ Eyrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p135.

¹⁴⁵ Eyrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p136.

¹⁴⁶ Ibid.

¹⁴⁷ *Competitive Enter.Inst. v US Department of Transport.*, 856 F.2d 1563,1564-65 (D.C.Cir. 1988).

based on “neutral characteristics.” Additionally, the use of Most Favoured Nation (MFN) clauses has proved problematic due to their anti-competitive effects.¹⁴⁸ These provisions require one party to give the other the best terms that it makes available to any competitor.¹⁴⁹ MFNs usually combine with an agency model to resolve the hold-up problem often manifested in vertical relationships. However, these combinations fail to offer lower prices on their platforms as they would have to offer the same discount to other PCWs.¹⁵⁰

Barriers to entry

Another potential threat to competition and consumer’s welfare is the use of algorithms to facilitate exclusion among competitors. Despite the increase of transparency in the market, there are still downfalls, as the increase in data increases the volume of data accessible by the algorithm.¹⁵¹ The combination of data and sophisticated algorithms could help reinforce a firm’s market power or raise entry barriers.¹⁵² This can be shown in situations where an algorithm may limit chances for customers to adjust to competitors who may not be able to provide similar “personalised” services.¹⁵³ There are situations where a vertically integrated dominant platform could use algorithms to benefit its own downstream products and make it more difficult for consumers to find its competitors.¹⁵⁴ Furthermore, a benefit to the economy such as price matching may not entirely be beneficial to competition law. Instant price matching can often reduce incentives for competitors to undercut the price or seek entry into the market.¹⁵⁵

Conclusion

Due to the rapid development of machine learning and pricing algorithms, it appears that companies are using sophisticated and subtle strategies to collude. Furthermore, the threat of coordinating prices using much more efficient methods than humans

¹⁴⁸ Ezrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p140.

¹⁴⁹ Oxera discussion paper, "*When algorithms set prices: winners and losers*," (2017) p21.

¹⁵⁰ Ezrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p140.

¹⁵¹ Secretariat background notes, "Algorithms and collusion – note from the United Kingdom," DAF/COMP/WD(2017)19 p8.

¹⁵² Ibid.

¹⁵³ Ibid.

¹⁵⁴ Ibid.

¹⁵⁵ Ibid.

proves to be an area of concern to consumer privacy and choice. The rise of personalised pricing in the online world through consumer behaviour and intentionally or unintentionally influencing prices for a wider variety of products may prove prejudicial to consumers. Algorithms are complex, thus making them difficult to understand and making it harder to detect abuse amongst suppliers. Furthermore, the idea of collusion and the effect this may have on competition law springs up a variety of questions over how pricing algorithms should be built. Although monitoring competitors' prices and reacting to any price change is legal, it may result in anti-competitive effects. Thus the question arises as to how algorithms should be regulated and if any legal action should be enforced.

REGULATION CONCERNS OVER ALGORITHMS

Having explored the effects algorithms have on competition law – algorithmic collusion, hub-and-spoke, price discrimination and barriers to entry – we now consider the regulation challenges they raise and whether they should be addressed. With the ever-growing technological market influenced by a data-driven environment, the question arises as to whether a digital hand is displacing the “invisible hand”¹⁵⁶ of competition. Without overlooking the advantages of pro-competitive efficiencies associated with machine learning such as cost reduction, quality improvement and a better use of resources, the analysis in the previous section creates concerns over the risks that algorithms may formulate. Thus, it is clear that the risks they create to competition law be dealt with or regulated in a manner whereby there are no complex challenges when it comes to enforcing legality. This section presents an analysis of the problem competition law authorities face when it comes to regulating algorithmic systems, whether they should be regulated or not and how to go about resolving the complexities arising from algorithms.

Challenges for Competition law enforcement

Despite the risks and concerns mentioned over algorithms and competition, there still exists no empirical evidence of the effects that algorithms have on the actual level of

¹⁵⁶ Smith A, “The Wealth of Nations,” Book IV Chapter II 5th ed, Methuen & Co. Ltd, London (1776) para IX.

prices and whether competition authorities may enforce standard antitrust tools against an infringement.¹⁵⁷ The first challenge faced by competition agencies is the complexity of algorithms and understanding their operation and effects. As noted previously, it can often go unnoticed when an algorithm could be tracking personal information of an individual without their consent or knowledge. This abuse often goes unpunished, as there is no direct method of gathering evidence to show this.¹⁵⁸ Furthermore, the ability of algorithms to rapidly evolve through refinement or the fact that developers have built in self-learning¹⁵⁹ may heighten the lack of detection. There is also the problem surrounding the fact that most businesses tend to have access to pricing data and where market transparency is high, the risk of unlawful collusion and conduct parallelism may seem very similar.¹⁶⁰

Additionally, a problem surrounding the way competition laws are designed is through identifying an “agreement” between competitors, as it is a prerequisite when it comes to enforcing law against collusion. In the US, section 1 of the Sherman Act¹⁶¹ outlines this to refer to a variety of terms such as “contract” and “conspiracy,” which does not necessarily have to be formal or explicit.¹⁶² This principle is broad and in the case that there is no communication but merely conduct, this is sufficient to indicate coordination.¹⁶³ This raises the question as to whether a new definition of agreement should be created because of the concerns surrounding algorithmic collusion.¹⁶⁴ A clear definition of an agreement could reduce ambiguity and help businesses understand what practices are illegal, which are acceptable and address the concerns relating to algorithmic collusions.

¹⁵⁷ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p32.

¹⁵⁸ Capobianco A & Gonzaga P, “*Algorithms and Competition: Friends or Fores?*,” (2017) p5.

¹⁵⁹ Secretariat background notes, “Algorithms and collusion – note from the United Kingdom,” DAF/COMP/WD(2017)19 p12.

¹⁶⁰ Ibid.

¹⁶¹ The Sherman Antitrust Act of 1890, section 1

¹⁶² *Monsanto Co. v. Spray- Rite Serv. Corp.*, 465 U.S. 752, 768 (1984); *In re Flat Glass*, 385 F.3d at 357.

¹⁶³ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p35.

¹⁶⁴ Ibid.

Another enforcement issue is the fact that competition agencies fail to look beyond whether competitors are aiming at exploiting consumers.¹⁶⁵ Whilst algorithms may improve customization to meet consumer needs, the algorithms can lead to segmentation and behavioural advertisements.¹⁶⁶ The current antitrust tools do not address non-collusive behavioural discrimination and this highlights the issue of agencies being fully aware of the problems but failing to apply any enforcement.¹⁶⁷ Furthermore, another challenge for competition law is the legal conceptuality arising from man and a machine.¹⁶⁸ If algorithms partake in collusion or price discrimination, the question of who remains liable is observed as automation is controlled through human control.¹⁶⁹ The current competition laws may not address this issue and fail to encourage individuals to take responsibility for their actions through algorithms.¹⁷⁰

Regulation of algorithms and resolutions

The debate about whether to regulate the digital economy is ongoing amongst competition authorities. Despite the infinite value the Internet and machine learning has brought to the economy, concern rising over companies' dependence on algorithms indicates that automated systems may be an area to regulate rather than the companies itself. Artificial Intelligence has been associated with many risks outside antitrust issues¹⁷¹ which includes breach of privacy rights, bias and discrimination against certain demographic groups of individuals. Furthermore, governments have adopted a market-orientated approach to regulations with minimum regulatory intervention. This has proved beneficial as it has led to the rapid growth of the digital economy and extraordinary gains for consumers.

Developments in Europe and the US further motivate to make algorithms more transparent and accountable for infringements.¹⁷² An idea to regulate this was to implement complete transparency, which would require a full explanation as to why

¹⁶⁵ Ezrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p220.

¹⁶⁶ Ibid.

¹⁶⁷ Ibid.

¹⁶⁸ Ezrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p222.

¹⁶⁹ Ibid.

¹⁷⁰ Ibid.

¹⁷¹ Ezrachi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p222.

¹⁷² Secretariat background notes, "Algorithm and Collusion," DAF/COMP (2017) 4 p46.

an outcome was produced.¹⁷³ However, the question remains as to which authority would be placed to review and supervise algorithms. Online companies operate at the interface of existing laws such as competition law, privacy and intellectual property law. Therefore, the question as to which agencies should enforce their authority is difficult to answer. Another issue with regulating transparency is that a complete disclosure of pricing strategies may enhance further collusion that can be counterproductive.¹⁷⁴ In fact, the regulation of algorithms in collusion matters may prove ineffective as machine-learning algorithms work at excessively high speeds and therefore any regulations may quickly become obsolete. If a policy maker were to enforce lag times on price adjustments, it could result in restrictions to competition by preventing adjustments from meeting demand and supply.¹⁷⁵

Business strategies based on algorithms can't be ignored, yet policy makers are likely to be walking on eggshells when it comes to regulating algorithms. Any future regulation would need to impose rules on competition, which would not overly regiment competition.¹⁷⁶ Thus, before taking any necessary action to regulate algorithms, policy makers should evaluate the risks of over-enforcement as over-regulation could result in barriers to entry and reduce the incentive for companies to invest in algorithms that have been beneficial to the community.¹⁷⁷ Whatever the path the authority aims to take, a balanced approach should be used in order to protect the competitive process in digital arenas.

Resolutions

Despite the concerns surrounding competition law regulation over algorithms, competition is not obsolete and therefore any regulation issues facing traditional laws were once in the same position as algorithms and competition law. Although more evidence surrounding algorithms needs to be gathered in order to allow machine learning to operate alongside competition coherently, the concerns need to be addressed. Each resolution may aid in providing some insight into regulating algorithms, although they are not without their own flaws.

¹⁷³ Ibid.

¹⁷⁴ Ezechia, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy*", Harvard University Press, United States p229.

¹⁷⁵ Secretariat background notes, "Algorithm and Collusion," DAF/COMP (2017) 4 p49.

¹⁷⁶ Capobianco A & Gongzaga P, "*Algorithms and Competition: Friends or Foes?*" (2017) p6.

¹⁷⁷ Ibid.

In dealing with the issue of tacit collusion through algorithms, a solution proposed by Ezrahi and Stucke¹⁷⁸ would be to decrease transparency. This could be carried out through discount cards providing secret discounts without the need to extract data on the users.¹⁷⁹ The government may also regulate the speed at which sellers adjust prices; this has been implemented in Austria when it comes to petrol prices.¹⁸⁰ This regulation will enforce a delay when changing the prices of a product and may allow profits to be generated if the delay is long enough.¹⁸¹

Another recommendation would be to audit the algorithm as this may help address the problem of manipulating search results and will safeguard the intellectual property rights of online competitors and mitigate quality degradation.¹⁸² Unfortunately, this resolution comes with its flaws as controlling an algorithm does not allow a true assessment to be made. Additionally, this method coincidentally enabled tacit collusion as it would be impractical for competitors to ignore information on consumers worldwide that is readily available.¹⁸³ Thus, although this investigative route may prove beneficial, it may be a better approach to adopt once technology and competition authorities develop.¹⁸⁴

To reduce the abuse arising from behavioural discrimination, privacy provisions may be a potential route to safeguarding consumer welfare.¹⁸⁵ One way to carry this out would be through consumers attaining more control over their personal data. In the EU, privacy remains an essential right and through the implementation of the EU data Protection Regulation, there remains a clear aim to protect individuals' rights while creating opportunities for innovation.¹⁸⁶ Algorithms could be created to provide consumers with the knowledge that they are being tracked as well as a clear indication

¹⁷⁸ Ibid.

¹⁷⁹ Ezrahi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p229.

¹⁸⁰ Ibid.

¹⁸¹ Ezrahi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p230.

¹⁸² Ibid.

¹⁸³ Capobianco A & Gongzaga P, "*Algorithms and Competition: Friends or Fores?*"(2017) p6.

¹⁸⁴ Ezrahi, A. and M. E. Stucke (2016), "*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*", Harvard University Press, United States p227.

¹⁸⁵ Ibid.

¹⁸⁶ Ibid.

of when personalised prices have arisen.¹⁸⁷ Adopting an approach akin to this would give privacy regulators more power and allow consumers the autonomy of providing their consent for sellers to use their data.

CONCLUSION

It is apparent that the developments in the economy have resulted in significant changes to competition law and consumer welfare. Technological development in the economy was aimed at increasing competition, faster networking and enabling the extraction of a large amount of information at a reduced cost.¹⁸⁸ This essay aimed to analyse and investigate the use of algorithms in the economy and how their use significantly affects competition law. Without overlooking the benefits of algorithms in the community, this essay attempted to frame the impact that algorithms may have on discrimination and collusion, and whether there should be a call for regulation.

Algorithms affect our market conditions which results in high transparency not only between companies but also amongst society.¹⁸⁹ The challenges that automated systems create are very real. If they help companies to fix prices, they could threaten our economy. This concern is causing competition authorities to question the use of algorithms and how they are formulated. Algorithms can result in multiple successes in aiding consumers specifically to gain information about the market and remain aware of any changes. Thus, in that sense it may seem impartial to suggest that the end justifies the mean, because algorithms are still more beneficial to the community and therefore any enforcement should be approached cautiously.

Competition authorities need to consider whether the use of algorithms to foster tacit collusion is generated through software that is benefiting consumers. If there is any illegal activity evidenced, then competition enforcers need to remain aware and alert. Companies need to be held accountable and scrutiny needs to be placed on their

¹⁸⁷ Gal M, “*Algorithmic- Facilitated Coordination: Market and Legal Solutions*,” (2017) p1.

¹⁸⁸ Gal M, “*Algorithmic- Facilitated Coordination: Market and Legal Solutions*,” (2017) p1.

¹⁸⁹ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p49.

conduct especially in circumstances that are illegal under competition law.¹⁹⁰

Automated systems used for price fixing may be a good decision for online cartellists but remains detrimental to consumers. Thus, policy makers need to consider revising the definition of an “agreement” as well as the legal sanctions against tacit collusion.¹⁹¹

Additionally, the crucial factor of discrimination and extracting private data proves that AI is associated with a number of risks that require regulation.¹⁹²The EU’s legislature towards data protection proves to be a significant benchmark for the US to follow. It provides competition authorities with an idea of how to tackle the issues surrounding antitrust and produce a regulation with a similar framework. Therefore, if firms were to collude, exclude liability or extract private data, there should be mechanisms that give consumers the autonomy to consent to having their data use, and companies must face higher administrative costs¹⁹³ if they failed to comply.

To conclude, a cooperative effort is required from businesses and competition authorities if the “brave new world”¹⁹⁴ where algorithms make decisions on how markets operate wishes to remain. Although machine learning is still a developing field in society, it is necessary that legal reactions take place in order to keep alert and regulate the necessary downfalls of algorithms. Therefore, regulation to algorithms should be enforced but there should be careful intervention such that consumers are able to enjoy the benefits of the digital world and there is no excessive damage to the market. When the time comes to deal with these issues, enforcers must be equipped to enforce the relevant provisions of competition law.

¹⁹⁰ Secretariat background notes, “Algorithm and Collusion,” DAF/COMP (2017) 4 p50.

¹⁹¹ Ibid.

¹⁹² Capobianco A & Gongzaga P, “*Algorithms and Competition: Friends or Fores?*,”(2017) p6.

¹⁹³ Ezzachi, A. and M. E. Stucke (2016), “*Virtual Competition: The Promise and Perils of the Algorithm- Driven Economy*”, Harvard University Press, United States p227. See also Article 83, EU Data Protection Regulation which imposes a hefty fine if there is a lack of compliance.

¹⁹⁴ Gal M, “*Algorithmic- Facilitated Coordination: Market and Legal Solutions*,” (2017) p7.