

Chapter 7

Uncovering tacit algorithmic collusion in South Africa's markets

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Abstract

Algorithms are designed to teach machines to use data to predict outcomes, identify patterns and structures, or learn to perform complicated tasks. Businesses use algorithms to predict and measure the likelihood of future outcomes in a market. Such predictive analytics can be used to estimate consumer demand for a product and consumer behaviour and preferences, and to forecast internal and external risks that may cause shock to a market. Algorithms are also beneficial to consumers. They grant consumers access to information about the competitive dimensions of a market, and about product quality and prices. As a result, consumers can make informed decisions when engaging with the market. While the use of algorithms encourages efficiency in markets, it may also enable firms to engage in tacit collusion. In South Africa, collusion is prohibited by section 4 of the Competition Act No 89 of 1998 (the Competition Act). This chapter will analyse whether the Competition Act contains sufficient tools for the detection and regulation of tacit algorithmic collusion.

Introduction

Algorithms are a branch of artificial intelligence designed to perform complex tasks by analysing large amounts of data (OECD, 2017). Algorithms form part of the everyday lives of society. They make television show recommendations to individuals based on their watching and search history. It is an algorithm that predicts trading in markets, and makes weather forecasts. It is also the work of an algorithm that recommends the cheapest prices for an item that an individual searches for on the internet.

Governments have taken to using algorithms to detect fraud and other crimes. Korea successfully applied algorithms to the detection of anti-competitive behaviour (OECD, 2017). For consumers, algorithms place a variety of product information at their fingertips, enabling them to make informed decisions based on more than price (Gal & Elkin-Koren, 2016 p. 2-7). For example, comparison portals allow consumers to compare prices and services offered by respective market players. These comparison portals reduce the transaction costs relating to searching for appropriate goods or services (Gal & Elkin-Koren, 2016 p. 3). Furthermore,

they provide consumers with access to information on what is available in the market, which may result in consumers being introduced to market players that they would otherwise not have considered. These factors not only improve consumer choice, but also increase market transparency.

Businesses, on the other hand, use algorithms to secure consumers, maximise profits and ensure efficiency. Through the application of predictive analytical algorithms, which use historical data to determine the likelihood of a future outcome, businesses can estimate demand and price changes, predict customer behaviour and preferences, and assess internal and external shocks that might affect the market (Constantine & Quitaz, 2018, p.42).

Businesses use this information in their decision-making process, enabling them to plan and strategise effectively regarding changes in the market.

Unfortunately, algorithms have not only brought about pro-competitive gains; they have also introduced new ways for firms to engage in anti-competitive behaviour with impunity. For example, pricing algorithms, such as the ‘filtering and selecting’ algorithms, may result in anti-competitive outcomes when used to facilitate price discrimination (Ezrachi & Stucke, 2017). Sellers can program these algorithms to charge consumers different prices based on their individual preferences, search history, location, previous purchases, and other personal information (Baker McKenzie, 2021).

Pricing algorithms may also be used to facilitate tacit collusion. The Competition Commission of South Africa (the Commission) is of the view that section 4(1)(b) of the Competition Act 89 of 1998 (the Competition Act) (1998) is broad enough to cover tacit (algorithmic) collusion. However, the Commission has not yet had an opportunity to test whether this provision can successfully be used to prosecute tacit algorithmic collusion. This chapter will test the Commission’s hypothesis. It will analyse whether the Competition Act provides authorities with the appropriate tools to uncover and tackle algorithmic collusion. Lastly, where the Competition Act appears to be lacking, this chapter will provide guidance to the legislature on how to manage the risks associated with algorithmic collusion.

What is collusion?

Collusion refers to any form of coordination or agreement between competing firms within a market, with the aim of raising profits higher than they would have been without such

coordination. Section 4 of the Competition Act makes provision for the prohibition of collusion, under the heading ‘Restrictive horizontal practices prohibited’. Section 4(1)(a) prohibits any agreement or concerted practice between competitors that has the effect of substantially preventing, or lessening, competition in a market.

The Competition Act prohibits both explicit and tacit collusion. Explicit collusion is covered by the word ‘agreement’ and tacit collusion is covered by the words ‘concerted practices’ in section 4(1) of the Act. Section 1 of the Competition Act defines an agreement to include a ‘contract, arrangement or understanding, whether or not legally enforceable’ (Competition Act, section 1). It further defines a concerted practice as ‘co-operative or co-ordinated conduct between firms, achieved through direct or indirect contact that replaces their independent action, but which does not amount to an agreement’ (Competition Act, section 1).

Tacit collusion occurs when parties recognise that they share a mutual interest in maximising profits above competitive levels and act interdependently to achieve this strategy (Holland et al., 2015). As opposed to explicit collusion, parties do not enter into any agreement, but their conduct may indicate that they are no longer acting independently of each other (*Netstar (Pty) Ltd and Others v Competition Commission, South Africa and Another* para 25).

Collusive pricing can only be sustained if the members of the cartel agree to a common profit-maximising policy, monitor adherence to it, and punish any member who deviates from it (OECD, 2017). Generally, the cartel punishes the deviating firm by imposing retaliation measures against that firm. The purpose of retaliation is to ensure that deviating firms sustain a profit loss for failing to adhere to the common policy (Ivaldi et al., 2003). Retaliation may take the form of a temporary price war, which results in profits plummeting below ‘normal’ competitive levels (Ivaldi et al., 2003).

There are certain market features that affect the sustainability of collusion. In other words, these market features are conducive to collusion. These include market transparency; high levels of concentration (where there are fewer competitors); and high barriers to entry (Ivaldi et al., 2003). The risk of collusion is also greater in markets where competitors interact frequently. First, market transparency allows firms to monitor adherence to a common policy, which enables them to identify deviation quickly. The faster coordinating firms identify

deviation, the faster they can retaliate. Secondly, it is easier to sustain collusion in markets that have a small number of firms, because it is easier to reach consensus on the terms of the coordination (Ivaldi et al., 2003). Furthermore, when there are fewer competitors, each party is guaranteed a greater share of the profits obtained under the collusive agreement. Thirdly, without barriers to entry, members of the cartel run the risk of new entrants taking advantage of the collusive prices by charging lower prices (Ivaldi et al., 2003). Generally, when prices are high, consumers are driven to firms that sell the same product at lower prices. Lastly, interaction between competitors makes it easier for members of the cartel to discuss the punishment of deviating firms and to retaliate fast.

The risk of tacit algorithmic collusion

As previously discussed, the risk of collusion is greater in markets characterised by high levels of concentration, high barriers to entry, market transparency and frequent interaction between competitors. Algorithms enhance market transparency through their ability to collect large amounts of data in real time and interpret data to generate predictions on market outcomes and decisions (Monopolies Commission, 2018). In this respect, algorithms are useful for monitoring changes in the market as and when they occur. This same feature can be used to collect and store information about competitors and monitor them in real time. Cartels may also use competitor information to ensure adherence to the common policy. Moreover, because algorithms provide competitor information in real time, coordinating firms can detect deviation as soon as it occurs.

Algorithms also enhance interaction between competitors, allowing firms to make decisions and react to each other at a speed that cannot be achieved by humans (Monopolies Commission, 2018). As a result, prices can be changed as many times as firms want without any cost to the firm. This allows easy price changes when members of a cartel decide to retaliate against a deviating firm (OECD, 2017).

Firms who invest in algorithms have a competitive advantage because they will always have information about their competitors, making it easier to monitor and react to their competitor's actions. In the same breath, when applied by coordinating firms, algorithms render tacit collusion easier to sustain.

In dynamic markets, where market conditions change often, frequent interaction between members of a cartel is prudent, to enable members to renegotiate the common policy, iron out failings of their strategy or discuss issues of retaliation. Such communication increases the risk of detection. Some algorithms enhance the risk of tacit collusion by removing the need for communication between the members of the cartel. This means that members of a cartel can agree on common profit maximisation strategy without communication; and when market conditions change, they can renegotiate the terms of their coordination policy without communication. In what follows, this chapter will discuss the effect of algorithms in increasing the risk of tacit collusion. It will outline the ways in which algorithms can be used to avoid detection of collusion.

Algorithmic collusion by signalling

Cartels may avoid detection of their collusive practices by using signalling algorithms to convey their intention to collude and implement their common policy (OECD, 2017).

Signalling can occur through a follow-the-leader strategy, where a leading firm indicates its intention to collude by unilaterally announcing a price increase. If other competitors in the market accept the offer to collude, they will respond by implementing a similar price increase. If they reject it, they will simply refrain from increasing their prices. Judge Posner describes it as follows:

“If a firm raises price in the expectation that its competitors will do likewise, and they do, the firm’s behaviour can be conceptualised as the offer of a unilateral contract that the offerees accept by raising their prices.” – *High fructose corn syrup antitrust litigation appeal of A & W Bottling Inc. et al*, United States Court of Appeals, Seventh Circuit, 2002, p. 2

The process of the follow-the-leader strategy happens faster with the use of algorithms; the leading firm is able to determine whether its price increase has been rejected, and to decrease its prices in response, much faster (Monopolies Commission, 2018). This means that the cost of lost sales to the leading firm will be reduced significantly if competitors reject the price increase. A good example of the use of signalling can be found in the airline market in the USA.

In 1991, the USA's Department of Justice (the DOJ) investigated major airline companies and the Airline Tariff Publishing Company, on the suspicion that the major airlines in the industry used the Airline Tariff Publishing system (the ATP) as a signalling mechanism to set anti-competitive tariffs for air tickets (Miller, 2010). The ATP collates and publishes daily updates on air fares. Airlines and travel agents in the USA use the ATP system to obtain information about ticket prices, flight routes and ticket restrictions. On 21 December 1992, the DOJ filed an anti-trust complaint against the ATP and eight leading airlines in the market. It alleged that major airline companies were using the system to set anti-competitive prices and restrict competition in the market (Borenstein., 1999). Before discussing how the signalling operated, it is important to briefly explain how the ATP system operates and the type of information it distributes.

The ATP collates flight information from each airline and distributes that information on its website. Airlines submit their information about their ticket prices to the site. Airlines also submit a 'footnote' to their ticket prices (Borenstein, 1999). The footnote includes information about the origin and destination airport of each flight, first and last ticket dates, first- and last-day travel dates and any restrictions of those tickets. Ticket restriction information is information about the availability of advance purchases, the type of person who could purchase a ticket, flight routes, etc. First- and last-day ticket dates indicate the period when a travel agent or ticket carrier can sell tickets under specific prices, and first- and last-day tickets indicate the period in which travel can occur under specific prices. Each footnote is given a 'footnote designator', which is the name of the footnote.

According to the DOJ, a leading airline would announce a price increase to its tickets, which would come into effect weeks in the future. If other airlines agreed to the price increase, they would respond by effecting a similar price increase as the leading airline. In other cases, the airlines would repeatedly announce new price increases, almost like a bid, until they reached a point where all firms were announcing the same price increases for those dates (Borenstein, 1999). The DOJ alleged that the airlines used the ATP as a driver to signal their intention to set and implement a joint profit maximisation strategy. The airlines reached this level of coordination by monitoring their competitor's actions, matching their prices and/or using the information obtained therefrom to negotiate price increases in ways that were not as easily detectable as traditional explicit collusion (Miller, 2010).

Where a leading airline announced a price increase that the other airlines did not agree to, the disagreeing airline would not announce a price increase. In such cases, the leading firm would not implement its price increase on the effective date. Instead, the leading firm would move its effective date to a future date. This would give the disagreeing firms more time to consider the price increase (Borenstein, 1999).

The DOJ discovered this coordination by monitoring the ATP, and discovered that leading airlines were using designated fare basis codes and footnote designators to communicate with other airlines (Borenstein, 1999). It also obtained ATP records that contained phrases such as ‘we are waiting to see if [name of leading airline] is going to go along with our proposed increase’ and ‘we are abandoning the increase on [city 1]-[city 2] because [name of leading airline] has not matched’ (Borenstein, 1999).

In the ATP case, the colluding firms’ signalling was accompanied by communication in the form of codes. The DOJ also discovered patterns in the ATP’s records that made detection possible. Although the colluding parties in this case communicated in explicit ways, albeit in code, signalling does not require frequent communication. Competitors can achieve a collusive outcome by simply announcing price increases, with the expectation that other firms will follow suit or engage in repeated price increases until all firms agree on the same price increases. However, there is still some collusive action required by the parties, in that they have to set up a structure or system to facilitate the collusive outcome. This means that detection is not impossible: competition authorities may still uncover tacit collusion by signalling if they monitor market players who use algorithms to detect patterns that could point to players announcing price increases to communicate an intention to collude.

Algorithmic collusion by parallelism

Cartels may also avoid detection by simply sharing the same pricing algorithm. Since the companies operate in the same market, the algorithm will automatically respond to the same market conditions and most likely produce the same pricing outcome for every company using that algorithm (OECD, 2017).

In the United Kingdom (UK), the coordinating parties in the case of *Online sales of posters and frames* (2016) utilised similar repricing software to implement their price-fixing agreement. This case concerned competitors, Trod Ltd (Trod) and GB eye Ltd (GBE), who

sold licensed sports and entertainment posters and frames on online marketplaces. One of the marketplaces on which they operated was Amazon UK. Between March 2011 and July 2015, the competitors agreed to a price-fixing strategy. They agreed that where there was no cheaper third-party seller, they would not undercut each other's prices for certain products sold on the Amazon marketplace. During the trial phase of the implementation of their strategy, Trod and GBE adjusted their prices manually daily. This proved to be laborious and time-consuming. As a result, they struggled to match their prices at the same time.

The parties found the solution to their coordination problems in re-pricing software (*Online sales of posters and frames*, 2016). At the time, Trod was using a re-pricing software package that would monitor and undercut competitor prices. Trod achieved this by setting a 'compete rule' on its programme. The compete rule instructed the software to adjust Trod's prices automatically (every 15 minutes) in response to the competitor's pricing.

The parties agreed that GBE would use similar re-pricing software that would also monitor competitor pricing and match its own prices to Trod's prices. Trod agreed to place GBE on its software's 'ignore list'. The ignore function programmed the software to refrain from undercutting GBE's prices. The software was programmed as follows:

“[T]he software was configured to ensure that if Trod had priced a product at £3.99 and there was no other seller on Amazon UK with a lower price, GBE would also set its price at £3.99 (provided this did not go below GBE's unilaterally set minimum price). The arrangement did not, however, prevent GBE from undercutting Trod if another vendor was cheaper than the price offered by Trod (or vice versa), so if Trod priced at £3.99 but another vendor priced at, say, £3.75, GBE would and could undercut the other vendor's price of £3.75 by a parameter set by GBE (so long as this remained above GBE's minimum price). This would bring GBE's price below Trod's without violating the arrangement between Trod and GBE.” – *Online sales of posters and frames*, 2016, p. 30

In this case, the CMA only uncovered the parties' price-fixing strategy because the parties had engaged in frequent communication, via telephone and email, to implement the arrangement and to address software technical difficulties. The concern here is that the collusive outcome is possible without communication. If more firms independently invest in

re-pricing software and input an ‘ignore rule’, as Trod did, they can match their prices to competitors with whom they share a mutual interest, creating a copy-cat effect as and when competitors adjust their prices.

Companies may achieve the same outcome by hiring the same IT company or service provider to develop and/or program pricing algorithms for them (Ezrachi & Stucke, 2020). The IT company or programmer may provide the companies with the same algorithm and/or program each company’s algorithm in the same way. Once the colluding companies share the same algorithm or IT programmer, they may achieve a collusive outcome through a follow-the-leader or tit-for-tat strategy, where a leading firm is responsible for programming the algorithm with its own pricing-maximisation strategy, and the other firms in turn duplicate the leading firm’s programming. This form of collusion is referred as ‘hub and spoke’ collusion because the intermediary (either the IT company or the programmer) is used as a primary actor (the hub) for facilitating collusion for several firms (the spokes) (Ezrachi & Stucke, 2020). This removes the colluding firms from the site of the collusion, or places them at arm’s length. With this method, firms achieve collusion without any communication whatsoever, making it difficult for a competition authority to detect and prove the collusion. However, detection may then still be possible if the competition authorities monitor the types of software that competitors use and how that software is programmed to achieve tacit collusion.

Collusion by self-learning algorithms

The biggest challenge for competition authorities is the use of self-learning technologies that can achieve collusive outcomes without human programming. Unlike programmed algorithms, self-learning algorithms can detect patterns and independently find solutions, or complete a task, without any programmed instructions (Monopolies Commission, 2018). They do not require instructions to complete a task because they develop their own instructions, based on data and experience, to achieve an outcome. What makes self-learning algorithms more pervasive is that humans are not privy to, nor can they interpret, the rules used by the algorithm to achieve the outcome.

In markets that are prone to collusive outcomes, self-learning pricing algorithms use their learning capabilities to independently determine price maximisation strategies that harm consumers (Ezrachi & Stucke, 2020). Furthermore, where there are several anti-competitive

prices that can be sustained, self-learning algorithms are more equipped to pinpoint the most appropriate strategy to maximise joint profits faster, and with more precision, than human beings (Monopolies Commission, 2018). Because the algorithms set their own rules, firms are not able to decipher the rules applied by the algorithms. In addition, it is difficult – and in some cases, impossible – to program algorithms to exclude certain anti-competitive rules that result in collusive outcomes. Lastly, some algorithms change the applicable rule, making it impossible to trace the rule and the pathway of an outcome. This is referred to as obfuscation (Monopolies Commission, 2018). Consequently, where self-learning algorithms decide to coordinate with competitors, the firms using the algorithms benefit from the collusive outcome without any knowledge of the collusive strategy or the instruction applied by the self-learning algorithm to achieve that outcome.

Does South Africa's Competition Act contain appropriate tools for detecting and regulating algorithmic collusion?

It is our opinion that competition authorities should be concerned that firms will be incentivised to dispense with traditional explicit collusion altogether in favour of the more elusive algorithmic tacit collusion, to avoid the risk of detection (Monopolies Commission, 2018). Take collusion by signalling, as an example: competition authorities would have to monitor a market for a prolonged period to detect the pattern that competitors are using to coordinate, and the effects of that signalling on the market – the effects being that firms will continue to rake in maximum profits at the expense of consumers until such time as the pattern of signalling is uncovered.

In what follows, this chapter will consider whether South Africa's Competition Act provides sufficient tools to uncover and regulate tacit algorithmic collusion. This analysis will be divided into two questions. First, what tools are presently available in the Competition Act to assist the Competition Commission to detect tacit algorithmic collusion? Second, does section 4(1)(b) provide an appropriate legislative mechanism through which authorities can protect consumers against, and neutralise the effects of, tacit algorithmic collusion?

Detecting algorithmic collusion

One of the most important enforcement tools in a competition authority's arsenal is the power to conduct market enquiries. Its aim is to uncover anti-competitive practices that raise competition concerns in markets, and mitigate their effects, through either policy reform or

other market-specific remedies. In terms of section 21 read with section 43 of the Competition Act, the Competition Commission has the power to initiate and conduct market inquiries if it has “reason to believe that any feature or combination of features of a market for any goods or services impedes, distorts or restricts competition within that market” (Competition Act, sections 21 & 43). As recommended by the United Kingdom (Constantine & Quitaz, 2018) and Germany (Monopolies Commission, 2018), the Competition Commission should use market enquiries to monitor the use of algorithms in markets that are characterised by a high risk of collusive outcomes, and/or where there is concern that firms could be using algorithms to facilitate collusion. These market enquiries will allow authorities to look for patterns or conduct which points to collusion (Constantine & Quitaz, 2018). Should the Commission find evidence of tacit algorithmic collusion, it has the power to initiate a complaint against the colluding firms for further investigation; or it may refer a complaint to the Competition Tribunal without further investigation.

The elusive nature of algorithmic collusion means that the Commission may not find any evidence of collusion, even if firms are indeed colluding. In such cases, the market enquiry still performs the crucial function of providing information to the Commission about the type of algorithms popularly used in that market, and how they are developed and programmed. This type of information can be obtained from the participation proceedings followed during a market inquiry. Section 43G of the Competition Act allows firms that operate within the market to be subjected to an inquiry, and allows persons who have a material interest in the inquiry to participate in the inquiry by making representations. The insights obtained during these proceedings will assist the Commission in any further investigations into specific firms.

Lastly, because algorithmic collusion is shrouded in secrecy and conduct that involves complex technology, detecting collusion will be easier if firms who are party to anti-competitive agreements expose the cartels and how they are sustained. The Competition Act, read with the Corporate Leniency Policy (the CLP), grants the Commission the power to grant the first self-confessing cartel member immunity for its involvement in cartel activity. One of the conditions for immunity is that the cartel member must provide the Commission with evidence, information and documents in its possession that would result in the institution of legal action against the cartel. The CLP can provide the Commission with important ‘insider’ information that it would otherwise not be able to uncover.

Regulating algorithmic collusion

In a report published in 2020 (Competition Commission, 2020), the Competition Commission remarked that tacit algorithmic collusion is sufficiently regulated by section 4(1)(b) of the Competition Act. According to the Commission:

“Collusion through the use of algorithms to set prices and monitor compliance with agreed pricing would be captured by section 4(1)(b) of the Competition Act which prohibits restrictive horizontal agreements ... As such, the legal framework currently exists for the prosecution of cartel activity using more novel means to collude and by digital firms located globally.” – Competition Commission, p. 34

Section 4(1)(b) provides that an agreement between (or a concerted practice by) firms in a horizontal relationship is per se prohibited if it involves price fixing, dividing markets or collusive tendering. This means that once competition authorities find that firms have an agreement or are engaged in the concerted practice of any of the prohibited practices listed in section 4(1)(b), no further enquiry is undertaken into the effects of the conduct or agreement on the market, as the parties are in contravention of the Act simply by colluding on the prohibited practices.

The Commission envisages that the prohibition against ‘concerted practices’ will be broad enough to cover tacit algorithmic collusion. It must be recalled that section 1 of the Act defines ‘concerted practices’ as “co-operated, or co-ordinated conduct between firms, achieved through direct or indirect contact that replaces their independent action, but which does not amount to an agreement” (Competition Act, section 1). In *Netstar (Pty) Ltd and Others v Competition Commission, South Africa and Another*, the Competition Appeal Court held that to determine whether firms are party to a concerted practice, the focus must be on the conduct of the parties. By way of example, the court held that a concerted practice includes cartel arrangements in which a market leader signals its intention to increase prices by way of public announcement, and in response, competitors within its market follow its lead.

Although algorithms are used as drivers of the competitor’s intention to collude, some action, except for collusion by self-learning algorithms, is required by the colluding firms to achieve that outcome. For example, with signalling, the conduct occurs when the leader increases

prices and competitors respond to that action by increasing their own prices to match that of the leader. With parallelism, parties use algorithms to monitor competitors' actions and then instruct the algorithm to react to those actions by matching their own prices to competitor prices in a follow-the-leader strategy. Where the parties achieve the collusive outcome by using the same algorithm or employing the same IT company, the parties' conduct is in the form of employing the same pricing algorithm or service provider and programming their algorithms in the same way that the leader has, to achieve a collusive outcome. The use of these mechanisms therefore falls within the definition of concerted practice, because they all involve some form of conduct by the parties involved in the practice.

Although these forms of tacit collusion fall within the ambit of the Competition Act, there are at least two gaps that require legislative reform. The first relates to the question of whether third parties who develop and/or program the pricing algorithms should be held liable for their involvement in the coordination. This question was considered by Germany's Monopolies Commission (Monopolies Commission, 2018). It considered that an IT company could develop algorithms which it knows could be used to achieve collusion. In fact, the IT company would recognise that its algorithm would be more attractive to firms who are interested in maximising profits through (undetectable) collusion. The Monopolies Commission recommended that competition rules should be amended to include liability for IT companies that design pricing algorithms with the ability to achieve a collusive outcome. Furthermore, it recommended that liability should not be limited to the IT providers' involvement in the actual coordination between the firms. Rather, IT companies should be liable for how they design pricing algorithms. According to the Monopolies Commission:

“Through a responsibility linked to the own behaviour of the IT service providers, the service providers could be induced to refrain from a collusion-promoting design of the algorithm or to change or render algorithms in which competition problems only become apparent during their use in order to reduce their own liability risks. This would essentially amount to an ongoing product monitoring obligation and, where appropriate, product liability for the functioning of the algorithm concerned.” – Monopolies Commission, 2018, p. 25

Considering the above, it is important for South Africa to consider whether it would be appropriate to impose third-party liability on IT service providers for their contribution to the

collusion. If the answer is in the affirmative, the Competition Act would need to be amended to include considerations of the extent of the third-party liability.

The second regulatory gap in the Competition Act is in respect of collusion by self-learning algorithms. These algorithms are more sophisticated in that they can independently identify collusion as the best strategy to optimise and facilitate unique ways to achieve that outcome, without the knowledge of its user (Ezrachi & Stucke, 2020). The user of the self-learning algorithm has little to no control over the rules applied by the algorithm, and is unable to decipher what rules were applied by the algorithm because they change as the algorithm learns more information. This raises two main concerns. The first is that self-learning algorithms leave no trace of their actions, which makes detecting collusion impossible. Second, if the Commission cannot trace an algorithm's conduct, then in terms of section 4 of the Competition Act, no liability can be attributed to the firms who use and benefit from the algorithm's decision to collude. In principle, it is not desirable that firms be allowed to collude and then hide behind sophisticated computers to escape liability. However, considering the extreme detection issues surrounding self-learning algorithms, it may be close to impossible to regulate them. It is therefore necessary for the Commission to investigate ways in which it may mitigate, prevent and penalise collusion initiated and sustained by self-learning algorithms. However, it should guard against the risk of over-intervention, which may stifle the efficiency and innovation gains that come with the use of algorithms. (Constantine & Quitaz, 2018).

Conclusion

The discussion above has demonstrated that the sophistication of algorithms has the capability to render markets prime candidates for collusion. Like explicit collusion, algorithmic collusion is shrouded in secrecy; however, the latter is more difficult to prove because algorithms are difficult to understand, and they leave little or no trail of the collusive activities of a cartel. Considering the far-reaching effects of any form of collusion on consumers and businesses, competition authorities should not be weighed down by these challenges. Instead, they should find proactive ways to mitigate, prevent and avoid the effects of tacit algorithmic collusion.

The main focus of this chapter was whether South Africa's Competition Act contained sufficient tools to allow the Competition Commission to uncover, mitigate and prevent tacit

algorithmic collusion as and when it occurs in South Africa's markets. Broadly summarised, our findings were that while the Competition Act contains tools for the detection and regulation of tacit algorithmic collusion, more needs to be done. In respect of detection, the Competition Act already equips the Commission with broad investigation powers, in the form of market enquiries relevant to the detection of algorithmic collusion. In addition, the participation processes of market enquiries, coupled with the Commission's Corporate Leniency Policy, places the Commission in a position to receive insider information to which they would not otherwise have access. However, because algorithmic collusion involves advanced technology, the Commission must invest in new technologies that will be able to sweep the internet and diagnose and predict how algorithms are being and will be used in the markets under consideration.

The chapter also identified two gaps in the Competition Act that may require legislative reform. The first is that in respect of algorithmic parallelism, the Competition Act is silent on third-party liability. Considering the role of IT service providers in designing and programming algorithms, it may be necessary to impose liability on them to prevent algorithms being designed with (and marketed as having) collusive capabilities. Alternatively, to avoid such far-reaching liability, it may be necessary to limit third-party liability to the IT service providers who, with knowledge of a specific cartel's needs, design or program their algorithms to meet those needs.

Lastly, the Competition Act as it stands does not contain appropriate provisions for the regulation of self-learning algorithms. Recall that these algorithms are able to achieve a collusive outcome without human intervention and without any trace of their conduct. The legislature must consider whether it is necessary to amend the Competition Act to include provisions that deal exclusively with self-learning algorithms. However, such reform can only be done once the competition authorities understand the type of self-learning algorithms available in South Africa's markets and how they are operated.

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