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COMPETITION COMMITTEE**

Algorithms and Collusion - Note from the United Kingdom

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*More documents related to this discussion can be found at
www.oecd.org/daf/competition/algorithms-and-collusion.htm...*

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Executive Summary

1. This UK submission explores the potential effects on competition and consumers that may arise from the use of algorithms in the digital economy and summarises recent relevant CMA enforcement and research.
2. The ability of algorithms to sort and process huge volumes of data has been key to the development of the online commerce sector, and can generate significant benefits for consumers. However, those algorithms could also have the potential to facilitate business practices that harm competition or consumers.
3. The nature of algorithms and algorithm-driven markets, and the as-yet limited experience of applying competition laws and tools in relation to them, present challenges for competition authorities in effectively detecting, assessing and – where concerns are found – addressing such potential harm.
4. By seeking to deepen its understanding of how algorithms affect competition and consumers, and by targeted use of its full range of competition and consumer powers, the CMA aims to meet those challenges and to ensure that online markets work well for consumers.

1. Introduction

5. In recent years, the internet has witnessed a rapid expansion. It now hosts over one billion websites containing a wealth of information and offering countless products and services to users and consumers.
6. Algorithms have played a key role in that development and in the wider growth of the digital economy by enabling vast volumes of data to be captured, processed and sorted in productive ways and to deliver innovative new goods and services.¹
7. That ability to derive productive and commercial value from the large volume of consumer or market data available to businesses means that algorithms are fundamental to most online search engines, digital comparison tools, marketplaces, peer platforms and social networks. And the success or failure of those businesses – and many others – has in large part hinged on their ability to develop and continuously refine those algorithms to make them faster, more efficient and more sophisticated.
8. Algorithms can also yield significant benefits for consumers and users. For instance, by providing highly relevant results in response to users' search queries, algorithms can significantly reduce consumer search and transaction costs. In a world where consumers have access to voluminous quantities of content, digital intermediaries provide valuable services to consumers, sorting, selecting and curating the digital experience to meet consumers' needs.

¹ For the purposes of this paper, the term 'algorithm' is used to refer to a software code that employs a series of rules to generate outputs based on data inputs and decisions parameters.

9. Equally however, algorithms could, in principle, also be utilised to facilitate the restriction or foreclosure of competition – limiting choice or increasing prices. Or their use may result in consumers being misled. That could in turn lead to consumer trust and confidence being undermined and, ultimately, to consumers engaging less in online markets more generally.

10. This submission outlines relevant insights that the Competition and Markets Authority (CMA) has drawn from its recent case experience and wider work. Specifically, it:

- explains how algorithms are used by businesses and how they may impact market conditions and online firm behaviour;
- sets out certain theories of harm to which the use of algorithms could in principle give rise, with reference to recent CMA cases, research and studies; and
- considers some of the challenges for competition authorities and policy makers in assessing the competitive effects of algorithms, and the CMA’s response to those challenges.

2. The use of algorithms and their impact on the market

2.1. The use of algorithms in the digital economy

11. Algorithms lie at the heart of the business models of many online businesses and platforms. Indeed, algorithms are – even more fundamentally – the cornerstone of the internet:

- All online searching is accomplished using algorithms, and the quality of a search engine or platform will rest in large part on the performance and accuracy of its algorithms to generate relevant search results.
- Algorithms influence in various ways the material and content that people see online: retail platforms and content streaming services use them to recommend products and media, and social networks use them to personalise each user's news-feed or timeline.

12. Examples of algorithms used by businesses include²:

- **Ranking/recommendation algorithms**, which seek to predict and gauge a consumer’s preference for a good or service, with search results or content recommendations ranked and presented accordingly.
- **Matching algorithms**, which, similarly to recommendation algorithms, match ‘buyers’ with specific ‘sellers’ or service providers, based on the buyer’s circumstances or the variables they have selected. For example, algorithms may be used to match passengers with nearby taxis, or to match users of online dating sites.
- **Predictive algorithms**, which attempt to infer consumer preferences and willingness to pay, and target offers or prices based on those inferences. These algorithms may, for instance, group and classify consumers, offering deals or discounts to steer the consumer to make a purchase.

² This is necessarily some commonality and overlap between the various examples listed here, and any given algorithm may include elements or functions of several of these broad classifications.

- **Cross-merchandising algorithms**, which promote a seller's other goods or services to a buyer based on, for example, that buyer's browsing or purchasing history.
- Personalised pricing (a form of price discrimination) through '**filtering and selecting**' algorithms that use and analyse personal data about a consumer to determine a personalised price for a particular good or service.³
- **Dynamic pricing**, under which algorithms automatically adjust prices or discount offers, typically to respond to changes in competitors' prices,⁴ but also on the basis of the relative levels of supply and demand (e.g. surge pricing).
- **Risk assessment**, insurance and other companies use algorithms to analyse data about an individual's circumstances and assess the risk that that individual will, for example, claim on an insurance policy or default on a loan.
- **Algorithmic financial trading**, which underpins the workings of diverse financial services markets.

2.2. Impact of algorithms on market conditions and business behaviour

13. As the importance and popularity of e-commerce increases, the number of firms choosing to sell their goods and services to consumers via the internet has grown in parallel.

14. Having an online sales channel provides those firms with both opportunities and challenges:

- On the one hand, it can enable a business to access new consumer markets, win new business and connect more effectively with its existing customers.
- On the other hand, customers have to be able to find and choose that one particular business among a number of competing firms.

2.2.1. Search, algorithms and business behaviour

15. Search has become a critical means of consumers finding and comparing goods and services and making online purchases. The programming of search algorithms and how they rank results can therefore have a profound impact on firms' ability to compete and, in turn, on their commercial behaviour.

16. Recent CMA research⁵ indicates that past studies have shown consistently that:

³ A report commissioned by the OFT, the CMA's predecessor, found that while technically possible, the practice of using information about individuals to set higher prices to them was not widespread, given in particular the risk for a firm using such practices of losing consumers' trust. Personalised Pricing – Call for Information, May 2013.

⁴ The use of price monitoring and subsequent price adjustments (often using repricing software) have been found to be prevalent in the online world. In its e-commerce sector inquiry, the European Commission found that about half of respondent retailers tracked their competitors' online prices, and a significant majority (67 percent) used automated software to do so. The Commission also found that larger firms tended to track online prices of competitors more often than smaller firms. See European Commission, Final report on the E-commerce Sector Inquiry - Staff Working Document, 10 May 2017, paragraphs 602 - 608.

⁵ Online Search: Consumer and Firm Behaviour – A Review of the Existing Literature, CMA, 7 April 2017. This Report was based on a review of the literature currently available on various aspects of consumer online search behaviour, with a view to improving the CMA's understanding of those behaviours and of firms' responses.

- high ranking and prominent visibility in search results (whether organic or non-organic⁶) may be important to a business' ability to compete effectively; and
 - this is partly due to consumers' online search behaviours, in particular their propensity to focus their attention, clicks and purchases on links at the top of returned search results and rarely venture beyond the first results page.
17. As a result, in order to compete better, firms may seek to increase the prominence of their goods and services, including through:
- engaging in search engine optimisation. This may include, for example:
 - designing their websites in ways that make them appear higher in organic search results, or
 - improving different aspects of their websites or their product/service offering that can positively affect their search result rankings;
 - bidding for non-organic (paid for) search results to appear prominently when consumers search for certain keywords; or
 - entering into commercial agreements with a platform or intermediary (for example, 'preferred partner' programmes operated by some online travel agents).

2.2.2. Transparency, algorithms and business behaviour

18. The 'move to online' and the growth of e-commerce has led in turn to greater price transparency, increased information flow (about offers made by firms, such as free delivery or generous refund policy), and additional scope for firms to collect large quantities of data regarding their customer's individual circumstances, preferences and behaviours.

19. In those conditions, the use of algorithms can have pro-competitive effects and benefit consumers:

- They can lower search costs and make it easier for consumers to shop around, which can increase the price pressure on firms as consumers find themselves able to access instant pricing information and to switch between suppliers with increasing ease.
 - Similarly, businesses can, for example use algorithmic repricing software to compete vigorously with other online sellers, automatically adjusting the prices of their products to beat the live prices of competitors' products.⁷
 - Platforms can use information gathered about consumer preferences and past consumption habits to surface personalised recommendations and curated experiences so as to make search more effective.
20. Equally however, in online markets characterised by the transparency and data flows described above, the use of algorithms may in principle also create the conditions for, or be used to facilitate:

⁶ 'Organic' search results are generated by the search engine's sorting algorithms and rank webpages according to relevance. 'Non-organic' results are paid-for results and are a form of online advertising, where firms can submit bids to the search engine to have their websites displayed prominently.

⁷ Such market conditions need not lead to uniform and flat prices, however: the CMA's recent report on online search behaviour (see footnote 5 above) found evidence from past studies showing price variation in a number internet markets, even where competitors' pricing data were instantly accessible and displayed in the same search results. See *Online Search: Consumer and Firm Behaviour – A Review of the Existing Literature*, pages 67-69.

- restrictions or distortions of competition, or
 - practices that mislead consumers or undermine consumer trust.
21. These concerns are considered further below.

3. Theories of harm

22. To date, the legal and economic assessment of whether and when the use of algorithms could create conditions for competition and consumer harm or could facilitate harmful business practices has tended to be focused principally on the following broad theories of harm:

3.1. The use of algorithms to facilitate or support collusive agreements

23. By automating business processes, such as price increases, and by facilitating monitoring, algorithms could in principle facilitate the implementation or maintenance of a collusive agreement entered into between competitors. For example, algorithms (whether operated by competitors or in a ‘hub and spoke’ arrangement) could be used automatically to align prices pursuant to a pre-agreed arrangement, or to detect deviation from that agreed position and retaliate speedily against it.⁸

24. An example of this is provided by the CMA’s investigation in 2016 into price fixing between two competing online sellers.⁹ In this case, Trod Ltd (Trod) and GB eye Ltd (GB eye) each sold posters and frames online, including on Amazon Marketplace.¹⁰

25. Rather than compete, however, Trod and GB eye agreed not to undercut each other’s prices in certain circumstances for particular products sold through Amazon’s UK website. To give effect to the agreement, both sellers used automated re-pricing software to monitor and adjust their prices, and ensure that neither was undercutting the other. Trod and GB eye kept in contact to make sure the pricing arrangement was working and to deal with issues regarding the operation of the re-pricing software.

26. The CMA found both companies liable for breaching competition law. Trod was fined over £160,000¹¹ and its managing director disqualified from acting as a director for five years for his role in the infringement. GB eye (and its cooperating directors) received

⁸ Under this theory of harm, algorithmic software is used to facilitate a separate ‘real world’ collusive agreement between competitors. As discussed further in section D.1 below, a further challenge for regulators and enforcers will be to: a) better understand whether, and if so in which circumstances, algorithms (in particular through so-called ‘self-learning’) could result in potential harm to competition or consumers where there is no such discrete, explicit agreement or where potential harms are more difficult to detect; and, b) adapt their analytical approaches and investigative tools to ensure identified concerns are addressed effectively.

⁹ Online sales of posters and frames, Case 50223, Decision of the CMA, dated 12 August 2016

¹⁰ Amazon Marketplace is an online retail platform that allows businesses to sell directly to consumers via Amazon’s UK website. Amazon was not itself involved in the anticompetitive agreement between Trod and GB eye.

¹¹ This figure included a 20% discount to reflect the resource savings to the CMA as a result of Trod’s admission and co-operation with the CMA’s investigation.

immunity by reporting the cartel to the CMA and co-operating with the CMA's investigation in accordance with the CMA's leniency policy.¹²

3.2. The use of algorithms to facilitate behavioural discrimination

27. Algorithms can be used to set different prices for different customers, including through online tracking and profiling of consumers. The combination of: a) the greater and greater volume of data available to firms about customers, and b) the increasingly sophisticated means of using algorithms to swiftly analyse this data and gather very granular intelligence about customers' preferences, purchases or price sensitivity, is likely to increase further the opportunities for firms to engage in detailed segmentation and price discrimination.¹³

28. Price discrimination is generally regarded as having ambiguous effects on consumer welfare, meaning that a case-by-case assessment is necessary to determine the effects on and possible benefits or harms to consumers in a particular scenario.

29. However, concerns could in principle arise where such use of algorithms results in differentiated prices set at the highest price that a given consumer is likely and is willing to pay.¹⁴

30. Broadly, concerns regarding price discrimination are more likely to occur where, for example:

1. there is no competition between firms; or,
2. if competition does exist:
 - a. the form of price discrimination is particularly complex or opaque to consumers. Consumers may for example be unaware that the price for a given product displayed to them is different from the price displayed to another consumer.¹⁵ Or, even if they are aware, they may have little understanding of how that price was determined. This may reduce the ability of customers to make fully informed buying decisions or to act as a 'discipline' on firm behaviours (and thereby to drive competition); or
 - b. consumers more generally lose trust in the market and reduce their online purchases because of fears (whether genuine or misplaced) about the practice of online price discrimination.¹⁶

¹² <https://www.gov.uk/guidance/cartels-confess-and-apply-for-leniency>.

¹³ This was supported by the OFT's Call for Information on Personalised Pricing in 2013 (the 'OFT 2013 research'), which found price discrimination to be more prevalent online.

¹⁴ Concerns about, on the one hand, the ability of algorithms to facilitate price discrimination on the one hand, and on the other their ability to facilitate collusion (see subparagraph C(i)) are likely to be mutually exclusive. That is, price discrimination is typically the result of unilateral conduct by a single firm, and results in multiple prices, in contrast with the 'single' or 'agreed' price that results where companies collude.

¹⁵ See UK submission to the OECD Roundtable on Price Discrimination.

¹⁶ The OFT's Personalised Pricing Call for Information found that online price discrimination was more likely to be a concern when: a) the market is characterised by consumer inertia in switching (such that firms may be able to exploit their "inactive" customer base); b) price discrimination is used in an exclusionary way to engage in predatory behaviour through selective discounts; c) the groups disadvantaged by price discrimination were considered vulnerable; and/or, d) systematic price discrimination leads to a reduction

31. Furthermore, the OFT's 2013 research pointed to further characteristics common to online retailing markets that may increase the potential for *online* algorithmic price discrimination to lead to consumer harm. These included the possibility that the greater ability to price discriminate online could harm customers through the reduction of consumer surplus (although this effect may be offset by the expansion of output and the potential for price discrimination to intensify competition), and that fully personalised online prices could increase consumers' search costs.

3.3. The use of algorithms to reinforce dominance or raise barriers to entry

32. Harm to competition or consumers may arise if an incumbent is able to use algorithms to exclude competitors or limit competition in a market. Broadly put, algorithms 'feed' on data: the greater the volume or detail of data to which an algorithm has access, the better able it will typically be to provide relevant (or 'personalised') outputs for consumers.¹⁷ This will often result in benefits for consumers in the form of products or services that better fit their individual needs. However, it is conceivable that in certain circumstances the combination of exclusive access to a large volume of detailed consumer data on the one hand¹⁸, and sophisticated algorithms capable of interrogating that data to create highly tailored services on the other, could help to reinforce a firm's market power or raise entry barriers – for example, if it serves to limit realistic opportunities or reduce incentives for customers to switch to competitors who may not (initially at least) be able to provide similarly 'personalised' services.

33. Alternatively, a dominant, vertically-integrated platform could, for example, use algorithms to systematically favour its own downstream products and services or to otherwise¹⁹ make it harder for consumers to find its competitors' products or services, potentially limiting the opportunity for those competitors to compete on the merits.²⁰

34. A further, related theory of harm could, in principle, flow from a firm's use of a pricing algorithm to automatically match a competitor's price.

- As noted above, repricing software can be used by companies to compete vigorously on price, driving down prices.
- Such instantaneous price-matching by a firm (in particular, one with a degree of existing market power) may however serve to reduce incentives for that firm's competitors to seek to undercut it or for new entrants to seek to enter the market via 'low cost' business models.

of consumer trust in online markets. These conditions were explored in more detail in an accompanying OFT economics paper on personalised pricing.

¹⁷ Algorithm-based search engines, for example, typically rely on past consumer behaviour to educate and evolve the algorithm to provide individualised result or recommendations (e.g. when searching for "CMA" in Google, different consumers may see results for Competition and Markets Authority or Country Music Awards depending on their past search history).

¹⁸ Including for example, as a result of the acquisition of a business which holds large datasets which the acquirer may be able commercially to exploit.

¹⁹ e.g. through express demotion in, or exclusion from, results.

²⁰ In any given instance, it would be necessary also to consider whether, in the circumstances, the company had the incentive to engage in such practices.

- Those or similar concerns may equally arise in markets – whether online or offline – that are not characterised by algorithms.²¹ However, real-time pricing algorithms have the potential to make it easier for a firm to detect and instantaneously respond to an online competitors’ price cut, denying that competitor any real period during which its ‘market leading’ price may enable it to win market share.

3.4. Consumers being misled by the use of algorithms

35. Certain aspects of algorithmic function, most particularly their ‘opacity’, may also increase risks that consumers are misled. For instance, where a platform or a search engine ranks results in a non-organic fashion (e.g. giving prominence to the platform’s own products, or those of suppliers who pay the most commission) but does not make this clear and transparent, consumers could be misled into thinking that the top results are most relevant when this is not the case. Without clear explanations of how content and information is presented, consumers may be less able to check their assumptions or the claims made by operators.

36. The CMA’s emerging findings from its ongoing Digital Comparison Tools²² market study indicate that users generally lack knowledge about how comparison sites make money (and the extent to which this might affect rankings). Furthermore, most sites in the “web sweep” carried out by the CMA as part of that market study appeared to provide little information up-front (i.e. prior to search) on their approach to ranking offers.²³ In such conditions, the risks of consumers being misled or otherwise making poor transactional decisions may be greater.²⁴

4. Challenges for competition authorities

37. In light of the increasingly prevalent use of algorithms and the potential concerns highlighted above, competition authorities need to remain vigilant to ensure appropriate action is taken where there is evidence of algorithms being used in ways that lead to harm to competition and consumers.

²¹ See, for example, the UK submission to the OECD Hearing on Across Platform Parity Agreements, which noted the potential for contractual ‘parity clauses’ to soften competitive incentives.

²² See Digital comparison tools market study - Update Paper, CMA, 28 March 2017

²³ These preliminary findings echo those identified in the OFT’s 2012 report on price comparison websites, which found that some websites provided only limited information about ranking methods and market coverage, and that some websites did not display clear information about the commercial relationships the business had with the vendors of products compared. Price Comparison Websites, OFT November 2012.

²⁴ Under the EU General Data Protection Regulation, which will come into effect in May 2018, where a decision having legal or significant effects on an individual (e.g. a decision as to whether to offer them insurance) is based on automated processing, businesses must ensure that individuals are able to, among other things, obtain an explanation of that decision and challenge it.

4.1. Application of existing competition laws and powers to algorithmic conduct

38. As alluded to above, potential concerns regarding algorithms may often relate to use by businesses as a means to facilitate, implement or enforce a discrete anti-competitive agreement or abuse.

- In such cases, the conduct is not fundamentally different from ‘traditional’ forms of unlawful collusion or abuse, which the competition laws and frameworks have considerable experience in addressing successfully, including most recently in the CMA’s recent *Online sales of posters and frames* case (described above).²⁵
- Similarly, where algorithms are designed or deployed specifically to limit competition between competing businesses, or to exploit a firm’s dominant position, competition law should in principle apply to those who design or deploy those algorithms, as it would in ‘non-digital’ scenarios.

39. However, the use of algorithms by businesses could also have the potential to give rise to competitive or consumer harm in more novel and untested ways, for example through independent algorithms (particularly so-called ‘self-learning’²⁶ algorithms) reacting to each other in ways that lead to the alignment and maintenance of prices above the competitive level.

40. Competition authorities must therefore remain vigilant to ensure that such changes and advancements in self-learning, Artificial Intelligence or other technologies do not result in harm to competition or consumers going unchallenged.

41. Equally however, given the many consumer benefits to which algorithms can give rise:

- any case would require particularly careful assessment and consideration of if and how existing legal concepts could and should apply in the novel context at hand;
- care must be taken to avoid unduly broad or prescriptive interventions that risk inadvertently inhibiting dynamic, competitive market growth; and
- as in other fast moving markets, authorities must carefully balance the need to move sufficiently quickly to ensure that problematic behaviour is terminated (to avoid new entry and innovation being stifled) against the risks of intervening prematurely, which can again result in inadvertently ‘locking-in’ existing market structures (e.g. through prescriptive remedies) or chilling innovation.

42. In the CMA’s experience, it is through informed, evidence-based and targeted intervention that authorities can best ensure that competition and consumers in online markets are protected, without ossifying those markets or deterring lawful behaviour. As such, authorities can use their powers to:

- deepen their understanding of the effects of algorithms and other new ‘digital’ technologies, practices and business models on competition and consumers, and the application of the law to them;²⁷ and

²⁵ See speech by Lord David Currie, “The Role of Competition in Stimulating Innovation”, 3 February 2017.

²⁶ Self-learning algorithms are algorithms that can be programmed to develop the most profit maximising business strategy for its user. Such an algorithm is designed to “self-learn”, the more data it processes, the more sophisticated the algorithm becomes.

²⁷ As referred to elsewhere in this paper, this includes work by the CMA or its predecessors into Digital Comparisons Tools, online search behaviours and personalised pricing. The UK has also previous

- where particular concerns are identified, take targeted, evidence-based action using the tool – or combination of tools²⁸ – that allow it most effectively to address the identified harm.²⁹

43. The CMA has not to date taken enforcement action in relation to the more ‘novel’ potential concerns referred to above. As a general matter, however, the flexible, principles-based UK competition law framework has to date shown itself able to accommodate technological change, and to be capable of flexible and effective use to tackle a wide range of novel competition harms.³⁰ This includes the use of powers other than those to enforce prohibitions on anti-competitive agreements and abuse of dominance. For example, the CMA also has powers to:

- carry out ‘calls for information’ to better understand a market or business practice, and to determine if and where further action is warranted, whether by the CMA or others.³¹
- conduct market studies and investigations in particular markets where there may be competition and consumer problems that may not necessarily stem from individual firm conduct falling within the scope of the prohibitions on anti-competitive agreements and abuse of dominance.³²
- enforce a range of civil and criminal consumer protection laws, in particular to tackle systemic issues, and practices and market conditions that make it difficult for consumers to exercise choice.
- prohibit or remedy anticipated or completed mergers and acquisitions that risk giving rise to a substantial lessening of competition. This may include, for example, assessing whether the acquisition of control over an enterprise owning significant datasets could give the acquirer the incentive and ability to foreclose competition.

44. These powers enable the CMA to consider a broad range of potential competition and consumer concerns arising from the use of algorithms and other technologies in the

published reports on the commercial use of consumer data, online reviews and endorsements and the economics of open and closed systems (such as the iOS or Android mobile operating systems).

²⁸ By using different tools in sequence or in combination, authorities may be able to amplify the impact of their interventions in circumstances where use of just one of those tools may not, or cannot, make a market work well for consumers. For example, following its Call for Information on Online Reviews and Endorsements, the CMA launched targeted enforcement action against specific companies, and a range of broader compliance activities to improve business practices in the sector.

²⁹ Such a holistic approach may also involve competition authorities working in conjunction with other enforcement bodies with different responsibilities. In particular, this may include, for example, data protection or privacy laws, for which, in the UK, the Information Commissioner’s Office is primarily responsible.

³⁰ For examples of action that the CMA has taken in online markets, see further the CMA’s Response to the preliminary report of the European Commission’s e-commerce sector inquiry.

³¹ Such action may involve, for example: launching a formal market study into a market or markets; advocating legislative change to government; providing guidance; seeking voluntary action from businesses in the sector; or initiating stand-alone enforcement action against identified instances of potentially unlawful conduct.

³² If, following such a market investigation, the CMA finds an adverse effect on competition, it can require market participants to take remedial action to address its concerns. More information about the CMA’s market investigation powers can be found at the CMA’s website.

data-driven digital economy, and – where justified by the evidence – to take action using the most appropriate tool.

45. Notwithstanding this, however, it is apparent that the digital economy will continue increasingly to require existing laws, legal concepts and enforcement tools to be applied in new contexts and in relation to unfamiliar conduct, testing their continued adequacy and relevance. Given the significance of data to the functioning of algorithms, questions of who ‘owns’ or who should have access to and be able to use data will also become increasingly material.³³ It is vital therefore that, as authorities’ understanding of new technologies and their effects grows, existing competition and consumer laws, principles and procedures are kept under review to ensure that they remain fit for the digital – and algorithmic – age.

4.2. The challenges of detection and investigation

46. Alongside the substantive legal challenges noted above, certain features of algorithms may also make it more difficult as a practical matter to detect and investigate unlawful collusive, abusive or harmful conduct, or to distinguish such unlawful conduct from lawful independent commercial actions.

- The complexity of algorithms³⁴ and the consequent challenge of understanding their exact operation and effects can, for example, make it more difficult for consumers and enforcement agencies to detect algorithmic abuses and gather relevant evidence.³⁵
- Such challenges of detection may be heightened by the ability of algorithms rapidly to evolve, whether through constant refinement by developers or because self-learning is built into them. Or indeed by the fact that – in a world where most businesses have instant access to pricing data and where market transparency is high – unlawful collusion and “mere” conduct parallelism may look very similar.

47. To respond to these challenges, the CMA is continuing:

1. to work to deepen its appreciation of the effect of algorithms on competition and consumers in online markets, including, for example, the circumstances or sectors in which anti-competitive harms may be more prevalent or likely to occur; and
2. more generally to invest in both its in-house ‘technological’ expertise and in new digital forensic tools and investigative technologies to more effectively uncover, investigate and take action against unlawful activity.³⁶ Indeed, it is important to note the power of algorithms can also be used by enforcement agencies to better enable them to interrogate large datasets to assess impacts on competition, detect potential anti-competitive market behaviour, or design remedies to address identified concerns.

³³ Equally, the way in which businesses and consumers interact, and how companies compete, may be further affected by upcoming legislative changes: for example, the General Data Protection Regulation, which comes into force in 2018, will give consumers greater control over their personal data, and how it is used or shared.

³⁴ Whether in themselves or when they operate in combination or sequence.

³⁵ Or, having gathered a potentially large volume of data from a company, to effectively and efficiently interrogate that data, and identify which parts of it are, or are not, relevant to the potential concerns at issue.

³⁶ See the CMA’s Annual Plan 2017/2018.

4.3. International cooperation

48. The complex and novel challenges created by algorithms – allied with the increasingly borderless nature of many online markets more generally – also place further importance on effective engagement and cooperation between competition authorities internationally. Such engagement enables authorities to share information or intelligence, address jurisdictional issues, discuss common challenges and best practices, and develop coherent, complementary responses to those challenges.³⁷

49. In the context of the *Online sales of posters and frames* case, for example, the CMA coordinated its investigation with that of the US Department of Justice Antitrust Division into conduct involving the use of algorithms to facilitate price fixing in the online sale of wall décor in the US. This included coordinating the CMA’s searches with those conducted on the Division’s behalf by the UK police.

50. The CMA remains committed to continuing actively to engage with its counterparts overseas, both bilaterally and in international fora such as the OECD.

³⁷ To the extent that the use of algorithms may raise social or economic policy issues beyond competition and consumer protection (for example, potential data protection concerns) future coherence of responses across different policy fields will also be important. Initiatives such as the OECD’s horizontal ‘Going Digital’ project’, which seek to develop cross-policy approaches to the issues created by the digital economy, have the potential to play an important role in this regard.