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Executive Summary of the Roundtable on Algorithmic Competition

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The opinions expressed and arguments employed herein do not necessarily reflect the official views of the Organisation or of the governments of its member countries.

More documentation related to this discussion can be found at:
www.oecd.org/competition/algorithmic-competition.htm

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Executive Summary of the Roundtable on Algorithmic Competition

By the Secretariat¹

On 14 June 2023, the OECD Competition Committee held a roundtable to discuss algorithmic competition. Considering the background note prepared by the OECD Secretariat, the written contributions, as well as the discussion by delegates, the following key points emerged:

1. An algorithm is essentially a list of operations that transform an input into an output. This is a broad definition. The discussions focused on search, recommendation, allocation, monitoring and pricing algorithms. Many of these algorithms are built using artificial intelligence, in particular machine learning and deep learning methods. However, there are many examples of simpler rule-based non-learning algorithms, particularly when considering pricing algorithms.

Algorithms are developed and used for different purposes and can usefully be classified using the following functional typology. The discussion focused on search, recommendation, allocation, monitoring and pricing algorithms.

Search algorithms present and order information based on certain input (e.g., search engines), which could be a search for products or services (e.g., e-commerce platforms). Recommendation algorithms recommend certain information or products mostly on the basis of data (including behavioural data) about the user, the product and/or other parameters (e.g., content streaming platforms). Allocation algorithms automatically execute transactions, determining the distribution and allocation of supply and demand. For example, in the automated real-time bidding selling of online advertisement space, or linking a customer with an available taxi, or algorithmic trading. Monitoring algorithms track the behaviour and strategic decisions of competitors, such as prices. And finally, pricing algorithms use available information on observable customer characteristics or market conditions to set or recommend prices.

Algorithms can also be classified by type of technology. Many of these algorithms are based on artificial intelligence (AI), machine learning and deep learning. Artificial intelligence (AI) is the science and engineering of making intelligent machines, while machine learning is a specific sub-field of AI that tries to create intelligent machines using algorithms that iteratively learn from data and experience. Deep learning is a sub-field of machine learning (and thus a sub-field of AI) that broadly replicates neurons in the human brain through an artificial neural network.

2. Algorithms can be pro-competitive and efficiency-enhancing. For example, algorithms can contribute to new and better products, lower production costs, lower barriers to entry, lower search costs, and better balance between supply and demand. However, they can also harm competition.

¹ This Executive Summary does not necessarily represent the consensus view of the Competition Committee. It does, however, encapsulate key points from the background note, the discussion, and the delegates' written submissions.

Algorithms provide many efficiency-enhancing and pro-competitive effects, including both demand-side and supply-side efficiencies. It is widely accepted that pricing algorithms can create substantial efficiency gains and reduce transaction costs.

There are several ways in which algorithms can be efficiency-enhancing and pro-competitive. First, they can be the basis of disruptive innovation that results in new or improved products. For example, products can be personalised and tailored to the specific needs of the consumer. Second, they can reduce costs through improved production processes or more productive workers. Third, they can reduce barriers to entry by allowing smaller new entrants to gain market insights or develop new disruptive products at lower cost. Fourth, algorithms can reduce customer search costs by providing consumers with a range of suitable products with comparable information on the key dimensions of competition (such as price, quality and consumers' preferences). For example, price comparison websites provide consumers with an instant comparison of prices across a range of goods and services, price monitoring tools can inform customers when prices are particularly low, and AI is even being used for product recognition to enable consumers more easily find precisely what they are looking for. Finally, algorithms can better balance supply and demand. Dynamic pricing can optimise pricing to reflect changes to market conditions.

3. Several competition authorities have surveyed firms to understand how prevalent pricing algorithms are in the wider economy. Although limited to relatively small samples, the evidence suggests that firms operating online frequently use monitoring and dynamic pricing algorithms, while there does not seem to be much use of personalised pricing. However, increasing availability of data on customer characteristics makes personalised pricing more feasible.

The OECD considered personalised pricing and found that it was difficult to determine how common personalised pricing was given most examples were anecdotal. In the intervening period, there have been several surveys by competition authorities and researchers trying to investigate the prevalence of pricing algorithms.

The competition authority studies are mostly European (EU, Denmark, the Netherlands, Norway, Portugal and the UK). The academic research included is for non-European jurisdictions (Singapore and the US). These studies are typically surveys of a sample of firms in the given jurisdiction. They are usually one-off surveys, that provide a single snapshot in time, conducted over a single one- or two-month period. The year of the collection period depends on the jurisdiction, but ranges from 2015 to 2021. The surveys typically focus on a sample of firms with an online presence (ranging from 38 to thousands of firms). Some surveys sample firms from across the economy, while other surveys focus on sectors that have many firms with an online presence.

The relatively small sample of studies does not provide conclusive evidence on the prevalence of pricing algorithms. The studies are too sparse and infrequent to make general conclusions. Nonetheless, while it varies by jurisdiction, the available evidence suggests that: (i) a substantial minority of firms across the economy use price monitoring algorithms (mostly with an online presence); (ii) of which, most of these manually adjust their prices or use a dynamic pricing algorithm for price recommendations, while only a small proportion use an algorithm to automatically update their prices; and (iii) there does not seem to be much evidence of personalised pricing. In other words, price monitoring algorithms and dynamic pricing algorithms are relatively common in online markets, while personalised pricing is not.

4. There are several algorithmic theories of harm, including algorithmic collusion, algorithmic unilateral conduct (self-preferencing, predatory pricing, rebates and

tying and bundling) and algorithmic exploitative conduct (excessive pricing, unfair trading practices, and price discrimination). Most algorithmic enforcement cases pertain to self-preferencing. The other theories of harm have few, or no, existing cases. However, the increasing adoption of algorithms may mean more of these types of cases in future.

There is a concern that pricing algorithms can facilitate coordinated conduct that results in inflated prices. There are broadly three main ways that algorithms can help to facilitate collusion: (1) Algorithms that facilitate explicit collusive agreements: automated pricing systems based on available pricing data can detect and respond to pricing deviations, making explicit collusion between firms more stable (such as to implement resale price maintenance or a price fixing agreement); (2) Algorithms in hub and spoke settings: several firms using the same third-party pricing software that determines their pricing decisions, resulting in a hub and spoke setting that can facilitate information exchange; (3) Autonomous / tacit algorithmic collusion: self-learning autonomous algorithms can decide to collude (or at least avoid reaching a competitive outcome) without information sharing or explicit coordination.

Other unilateral conduct also threatens competition. This can be exclusionary. Self-preferencing can harm consumers. This occurs when a dominant firm instructs its algorithm to favour its own (or affiliated) products and services over rival competitors, meaning the ranking is not based on ‘competition on the merits’. It can harm competition when it excludes competitors in a related market. Personalised pricing and algorithmic targeting can also make traditional exclusionary theories of harm (such as predatory pricing, rebates, and tying and bundling) more feasible. ‘Personalised pricing’ involves tailoring prices for different consumers based on information about personal characteristics or conduct. ‘Algorithmic targeting’ allows the firm to price differently for marginal and inframarginal customers (i.e., prices for two groups of consumers: (i) at-risk; and (ii) safe); algorithmic targeting is much less technically demanding than personalised pricing.

Finally, a dominant firm can use its market power to engage in exploitative conduct such as: (i) excessive pricing (e.g., unfair purchase or selling prices); (ii) unfair trading conditions (e.g., unilaterally imposing other unfair trading conditions); and (iii) price discrimination (e.g., dissimilar conditions to equivalent transactions putting a customer at a competitive disadvantage). Exploitative abuses are very rarely prosecuted in most OECD countries, either because they are not contemplated within competition rules (e.g., US, Canada and Mexico) or because they are only very occasionally investigated (e.g., Australia, EU, Japan, Korea and Turkey). The German Bundeskartellamt case against Facebook was the first sanctioned digital exploitative conduct case.

5. The magnitude of the threat from algorithmic collusion by autonomous self-learning algorithms is still disputed in the academic literature and there are few known cases. However, many consider it is a serious concern.

While there were early accounts of the potential for algorithmic collusion by legal scholars, it is only relatively recently that economists have started to work on this topic. However, despite the now considerable research on algorithmic collusion, the scale and feasibility of it occurring is still relatively unclear. While the adoption of pricing algorithms has grown considerably, they are not yet universal, never mind the use of self-learning pricing algorithms. Even if firms use self-learning pricing algorithms, there is not conclusive evidence that algorithmic collusion is a significant issue. Nonetheless, competition authorities should remain vigilant.

In general, some authors consider the risks posed by algorithmic collusion are overstated and that continued research and enforcement efforts may be unwarranted, while others

consider that the lack of cases is misleading, and it should remain a key priority. There have been relatively few cases of algorithmic collusion. However, in the first of its kind, a recent empirical academic paper found that the adoption of third-party pricing software by petrol stations in Germany inflated prices in local markets for retail gasoline. Third-party pricing software was again under the lens in a recent complaint of algorithmic collusion in the US and a recent academic paper suggesting signs of algorithmic collusion. There have been allegations that hoteliers on the Las Vegas strip used third-party pricing software set supra-competitive prices. In a separate case, renters filed federal lawsuits in the US alleging that RealPage's YieldStar software, that recommends rent prices to landlords, may facilitate price coordination among landlords. Competition authorities could consider identifying markets where third-party software is used, as these markets may be the most susceptible to algorithmic collusion.

6. It is generally becoming accepted that in some cases it is necessary for competition authorities to examine algorithms directly to understand how they function. The complexity of algorithms varies, and some may be easier to understand than others, however algorithmic auditing offers techniques to investigate algorithms. This is an ongoing field of research. There are a range of approaches, but those that are most effective, will often require access to both the underlying algorithm and its input and output data. The most appropriate method will usually be case-specific. Competition authorities can take a step-by-step approach, building up from less-intrusive investigation techniques to more complex methods if necessary (e.g., from internal document review as to the intention and purpose of the algorithm, to black box methods looking at the inputs and outputs of the algorithm, to obtaining access to the algorithm).

In some cases, it may not be necessary to develop a deep understanding of the algorithm, for example if it has been used to facilitate a traditional cartel. There may be evidence from internal documents, such as emails or messages, indicating intent to perform the alleged harm. While in other cases, understanding the algorithm may be unavoidable to assess whether there has been any harm. Some authors believe there is a need for competition authorities to investigate algorithms directly.

Competition authorities and governments seem to have acknowledged the need to develop the knowledge, skills and access required to investigate these algorithmic harms. This is both in terms of the creation of new digital units and in terms of the data gathering powers in new ex-ante digital regulations that are coming into force.

There is a concern that it may not be possible to understand the decision-making process of some algorithms, particularly the most complex machine learning or deep learning models. These algorithms are often referred to as "black boxes" given the difficulty of understanding the process they use to go from an input to the output. However, there is a spectrum of complexity, and this may pose different levels of difficulty for competition authorities. The developing field of algorithmic auditing offers scope to understand the functioning of algorithms. Further, the specifications of the algorithm can also shed light on how the algorithm was constructed, what its objectives are, and the data it is using to function.

An algorithmic audit can be used for regulatory inspection to determine whether an algorithm is compliant with a law, regulation or norm, where regulators or auditing professionals can use a variety of tools or methods. In recent years, several competition authorities have published policy papers in which they consider how they could investigate algorithms, either by auditing the algorithm directly or by auditing the data used by the algorithm. These competition authority reports explain that there are several possible ways that they can investigate an algorithm. Code review is just one of several possible

approaches. The scope of the investigation, and precisely what it involves, will vary on a case-by-case basis. The methods that are most effective will often require access to both the underlying algorithm and its input and output data.

7. There have now been several cases where competition authorities have successfully investigated an algorithm. Another sign of this shift is the creation of data units at competition authorities, which has led to the hiring of data scientists and technologists. The international cross-border nature of cases involving algorithms, mean that competition authorities around the world are facing similar issues. Authorities can benefit from collaboration and sharing of expertise with other competition authorities, as well as other regulators (such as financial regulators) that are also grappling with the threats posed by algorithms and AI.

While certain methods may not always be feasible given the complexity of the algorithm, there are now several cases where competition and consumer authorities have considered the functioning of more complex algorithms. For example, the Trivago case in Australia shows that even though machine learning models are sometimes treated as a ‘black box’ (particularly if they have been ‘trained’ on a particular dataset or learn through trial and error) and some machine learning models are more interpretable than others, a competition authority can benefit from investigating the algorithm. Furthermore, in the Japanese Kakaku.com case the court requested that the website disclose part of its algorithms.

The techniques to investigate the functioning and behaviour of an algorithm can be complex and technical. Therefore, competition authorities usually need a wider skill and knowledge base to investigate algorithmic theories of harm. Several competition authorities have already started this process. Many have set up data units, hiring data scientists and technologists to assist them with their market investigations, merger control, enforcement cases, and in some jurisdictions, to implement new digital regulation. Competition authorities are also using these skills to reverse-engineer and understand companies’ algorithms. By the end of 2019, 11 of 35 surveyed competition authorities had a data unit. This had increased to 19 of 32 surveyed competition authorities in 2022.

Artificial intelligence is being adopted in many parts of the economy and is thus under review across several regulatory authorities, resulting in a significant coordination problem. Therefore, governments and policymakers will need to coordinate their response to the risks posed by AI. Most large digital firms have an international cross-border reach. Competition authorities and other sector regulators around the world are grappling with similar issues. Competition authorities can learn from other regulators, as well as from each other, and benefit from collaboration. In particular, competition authorities can benefit from sharing experience and expertise, for example through workshops and roundtables at the OECD and working groups at the ICN.