Organisation for Economic Co-operation and Development

DAF/COMP/M(2017)1/ANN2/FINAL

Unclassified

English - Or. English

26 September 2018

DIRECTORATE FOR FINANCIAL AND ENTERPRISE AFFAIRS
COMPETITION COMMITTEE

Summary of Discussion of the Roundtable on Algorithms and Collusion

Annex to the Summary Record of the 127th meeting of the Competition Committee

21-23 June 2017

This document prepared by the OECD Secretariat is a detailed summary of the discussion help during the 127th meeting of the Competition Committee on 23 June 2017.

More information related to this discussion can be found at

www.oecd.org/competition/algorithms-and-collusion.htm

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JT03436155

Summary of Discussion of the Roundtable on Algorithms and Collusion

On the 23th June 2017, the Competition Committee held a Roundtable on Algorithms and Collusion chaired by Professor Frédéric Jenny. To introduce the roundtable, the Chair briefly mentioned the OECD's wider work on the impact of the digital economy on competition. The Hearing on Big Data (November 2016), for example, already identified some of the consequences of data-driven business models on competition policy and market regulation. He also flagged that the use of algorithms could enable new means of detection of collusion and referred to recent news according to which the Brazilian Competition Agency (CADE) has opened two investigations on suspected medical equipment cartels. In these cases, the misconducts under investigation were detected by an algorithm, which implies that algorithms have not only been used by companies to collude, but by competition agencies as well.

The roundtable discussion benefitted from seven country contributions, as well as a written contribution from **BIAC**. The discussion was complemented by papers submitted by the three experts invited to the roundtable as panellists.

- **Professor Michal Gal** (Professor and Director of the Forum on Law and Markets at the Faculty of Law at Haifa University, Israel)
- **Professor Ariel Ezrachi** (Slaughter and May Professor of Competition Law and a Fellow of Pembroke College, Oxford, Director of the University of Oxford Centre for Competition Law and Policy)
- **Professor Avigdor Gal** (Full Professor at Faculty of Industrial Engineering and Management, Technion, Israel)

After introducing the experts, the Chair explained that the discussion will focus on the relationship between algorithms and collusion and suggested that the roundtable should be organised around the following topics:

- An introduction to the technology, to the applications of algorithms and to their programming principles;
- The potential risks of algorithms for collusion; and
- Possible solutions from a competition law enforcement and a regulatory perspective.

To set the scene, the **Chair** gave the floor to the Secretariat to present the main findings of the Background Note, which focussed on how algorithms might affect the likelihood of collusion, including the possible role of algorithms as facilitators of collusion and the related law enforcement and regulatory challenges. After the Secretariat's presentation, the Chair asked Professor A. Gal to explain the fundamental concepts behind algorithms; the difference between machine learning, deep learning algorithms as well as how those differences might be relevant in reaching possible collusive outcomes.

1. Introduction to the technology – the applications of algorithms and their programming principles

According to **Professor Avigdor Gal** algorithms may come in very different shapes and forms but they share a common structure: they produce outputs from inputs. Indeed, machine learning and deep learning algorithms are first and foremost algorithms that follow detailed instructions written by humans to perform specific tasks. When it comes to teaching the algorithms how to learn, the main point is the data that the algorithm learns from. The increasing availability of data is the main reason behind the rapid spread of machine learning algorithms. The phenomenon of Big Data is therefore closely connected to algorithms. Professor A. Gal explained the different learning methods used by algorithms, such as supervised (classification) and unsupervised (clustering) learning. In order to learn from data, algorithms need features (i.e. data samples) but also need to distinguish between these features. In doing so, the algorithm sets weights on each feature in order to determine which one is more important than others.

The **Chair** then asked about poker playing algorithms, since poker involves both uncertainty and bluffing, which implies a more complex learning mechanism. The Chair also wanted to know a bit more about the difference between machine learning and deep learning; and asked especially about the mechanisms behind deep learning. More precisely, the question related to the fact that *"it would be enough to look at the data without actually looking at the mechanisms of the algorithms to detect collusion"*. **Professor A. Gal** highlighted that in games like poker, the algorithm develops a strategy, i.e. the algorithm looks at all the possible combinations of what the opponent might do. The question is *"how I am going to respond to whatever the other side is doing"*. In poker, the algorithm is trained to know how to respond. As for deep learning, Professor A. Gal pointed out that these algorithms involve matrix computation: based on the input, a computer scientist knows what is happening in the matrix and also knows what the output is. Other possibilities also include using different algorithms to get as good results as the original algorithm, but it is always easier to look at the input data, rather than trying to understand the mechanisms of the algorithms.

Japan asked how machines add weights to features, how many layers of knowledge they are supposed to have, and how can we train algorithms from machine learning to deep learning? **Professor A. Gal** highlighted that computer scientists have a lot of impact on how the algorithms learn by giving different type of features (data) to the algorithm. Afterwards, the algorithm is basically setting weights to the different features by deciding that certain features are more important than others. Computer scientists can also decide how many layers to add, since the machine does not add layers by itself.

Argentina inquired on the role of economic forecasts in distinguishing the correlation and causality to make predictions. **Professor A. Gal** explained that in computer science, correlation translates into causality in order to see that situation "A" is caused by "B". In economics, the measure of regret is also used, which says *"how much I'm going to regret if I don't decide on something and it turns out to be something else"*. In the case of algorithms, the algorithms themselves determine the correlation.

Chinese Taipei asked if the data or the algorithm is more responsible for the outcome. **Professor A. Gal** replied that the data is more important in a sense that it is more useful to audit the data than the algorithm. If we understand what kind of information a company is using, we can decide whether it is legitimate or not. According to Professor Gal, it is a good practice to start by looking at the data.

The **Chair** thanked Professor A. Gal for his insights into the technology and gave the floor to BIAC for an overview of the business perspective along with some practical examples.

First of all, **BIAC** pointed out that algorithms are not only an important field in today's businesses, but also a field where it might be difficult to distinguish between good and bad conduct. There is overwhelming evidence of very significant consumer benefits from algorithms, and many concur that only exceptionally they might raise concerns from a competition perspective. Therefore, BIAC is very supportive of today's discussion but would recommend identifying accurately, and based on evidence, those rare instances in which companies may use algorithms to behave anti-competitively. On behalf of BIAC**, Lee Callaghan** (Group Competition Counsel, AVIVA Insurance) explained how algorithms are used in a pro-competitive way by the AVIVA Insurance Company. The main objective of AVIVA is to insure people and to cover risks without asking too much information to customers about their lifestyles. By segmentation and personalisation (or hyper-personalisation) AVIVA can make targeted/specific offers to individuals that are relevant to their lifestyle. Automation and data allow, for example, seeing medical reports electronically transferred from GP to the insurer. Machine learning is used to read those reports. Another area where algorithms are used is the real-time analytics for complaint-handling. It used to be very difficult and time-consuming to determine the costs of the repair works after a car accident; now the algorithms can tell the exact cost of the repair works, without even looking at the vehicle. Mr. Callaghan concluded that digitalisation and algorithms drive competition and bring about consumer benefits; therefore interventions should focus on real anti-competitive impact and on real consumer losses.

2. The potential risks of algorithms for collusion and case examples

In the discussion on the potential risks of algorithms for collusion, **Professor Ariel Ezrachi** explained the different ways in which algorithms may foster collusion and the possible law enforcement challenges in tackling these issues under the traditional enforcement toolkit.

Professor Ezrachi described the following three scenarios.

1. The *"classic"* scenario (i.e. classic collusion), in which the cartel members are using some form of technology to facilitate the functioning of the cartel. In essence, the technology involved is a "long arm", a facilitating instrument that is helping the cartel to become more stable or more effective. In this case, the main challenge is how to identify and understand the technology.
2. Under the *"hub and spoke"* scenario, market players are using a common service provider to determine their prices (for e.g. how much to charge, when to adjust the price, etc.). In this case, there is a single service provider or a single algorithm that is actually determining the price for several competitors and potentially for a whole industry sector. This structure is very likely to create a "hub and spoke" arrangement. Companies do no longer change the prices independently, but because they rely on the same "hub" this increases the risk of interdependent pricing policies and potentially higher prices. The difference between this scenario and the classic hub and spoke cartel (i.e. horizontal competitors cooperate through a vertical link) is that there could be no element of conspiracy

here. From a legal perspective, we can see hub and spoke structure, but the question is whether there is an anti-competitive object or an effect element.

3. The *"tacit collusion on steroids"* scenario presumes that certain market conditions – such as there are few players on the market, the market is transparent, there is no countervailing buyer power, no risk of entry, homogeneous products – are present. According to Prof Ezrachi, these conditions, however, certainly do not occur in most markets. Under these conditions, companies can easily shift their decision-making process from humans to algorithms, which can increase the stability of tacit collusion. Since the prices are available online, it is easy to react swiftly to any change from the tacit equilibrium. In this new algorithmic environment, transparency, speed and the elimination of human bias are crucial. The risk of error is reduced, while the likelihood of parallel pricing increases. All these elements create a stealth version of an algorithm that is basically increasing the likelihood of tacit collusion.

Professor Ezrachi also mentioned that in online environments companies can possibly engage in tacit collusion and price discrimination in parallel, not necessarily on the same market but as a combined strategy and that this can also raise concerns. Regarding the law enforcement challenges, Professor Ezrachi highlighted that the main challenge lies in the ability of competition authorities to deal with tacit collusion, which at the moment is not illegal. In this respect, the preliminary questions is whether tacit collusion is a rational reaction to the market characteristics, or companies are actively engaging in creating a platform that changes the dynamics of the market.

The **Chair** noted that based on the presentation, Professor Ezrachi did not seem to agree with the written contribution of BIAC which states that *"BIAC is not convinced that there is any enforcement gap in relation to industry practices that may involve pricing algorithms"*. **Professor Ezrachi** argued that the law is designed to capture agreements and not to condemn rational reactions to market characteristics. In case of algorithms, we are faced with the question of the legality of tacit collusion. Apart from the ex-ante merger review of coordinated effects, tacit collusion falls outside the scope of Section 1 of the Sherman Act or Article 101 of the EU Treaty. Hence, the discussion is more on policy; i.e. can algorithms change the characteristics of the market and give rise to competition concerns that are not present today? The essence of the discussion is whether there is an enforcement gap or if we can stretch the concept of the agreement to cover this area. According to Professor Ezrachi, this last option might be harmful to the legal certainty and to economic analysis if we try to cover and capture everything under the existing tools.

BIAC commented that it is difficult to establish whether there is an enforcement gap or not, since we do not know the magnitude of the problem. BIAC asked Professor Ezrachi about the necessary conditions under which companies can price discriminate and collude at the same time and whether companies would use the same algorithms to engage in these activities. **Professor Ezrachi** emphasized that companies do not engage in both strategies for the same user or for the same transaction, but they can apply them on a given market or to existing customer groups. Indeed, different strategies may co-exist as a part of the portfolio of the company's strategy.

Then, **Professor Michal Gal** explained to what extent algorithms may facilitate coordination by focusing on the preconditions for reaching co-ordination. Professor M. Gal referred to the economic theory behind coordination and its necessary conditions, i.e. 1) reaching an agreement, 2) the detection of deviations, 3) punishment (creating an

incredible threat of retaliation), and 4) market conditions (high entry barriers, etc.). In the digital economy, there are many things that affect these conditions. With regard to the reaching of an agreement, Professor M. Gal highlighted that the availability of real-time information on the competitors' digital offers can make it easier to calculate jointly profitable trade terms. The availability of real-time data also facilitates detecting deviations or adjusting to changes in the market, which can shorten the reaction time to create a new stable equilibrium. In an algorithmic world, a collusive equilibrium can be reached more easily because algorithms promote rational decisions and make the decision-making process more transparent. When it comes to detection, algorithms can lower the incentives to deviate. Algorithms can better distinguish between potential deviations from collusion and natural reactions to changes in market conditions or even human mistakes. They can also prevent unnecessary retaliation between firms. All of these elements can increase the risk of tacit collusion without the need for explicit communication or interaction between companies, especially in markets, where the preliminary conditions for stable co-ordination exist (e.g. high entry barriers).

The **Chair** opened the floor for intervention of delegates based on their written contributions and invited them to discuss relevant case examples or findings of sector inquiries. He turned first to the United Kingdom, and then to the United States, the European Commission, Russia, Italy and Singapore.

With regard to agency experiences, the **United Kingdom** pointed out that a lot can be achieved by seeking to understand how algorithmic markets work, how businesses are using algorithms in practice and what effects algorithms may have on competition and on consumers. Market investigations, for example, are particularly useful tools or ways of looking at these markets, since they provide an opportunity to take a more holistic approach at how algorithms may impact markets as a whole, without the constraints of the specific legal characterisation, such as the concept of an agreement, a meeting of minds, or dominance.

The CMA identified four potential theories of harm in relation to algorithms: 1) facilitating collusion, 2) facilitating price discrimination, 3) reinforcing dominance or raising barriers to entry, 4) misleading consumers. An interesting aspect is the relationship between different policies, as algorithms can give rise not just to competition concerns but also to consumer protection concerns. Algorithms raise questions related to data protection, social policy issues and fairness. All these can lead to sub-optimal outcomes if we are focusing solely on competition law, instead of expanding the institutional or policy boundaries of the debate to other policy/enforcement areas. As a good example of international cooperation, the CMA referred to the sales of posters on Amazon UK's marketplace, in which the parties used a price matching algorithm to implement, monitor and enforce the agreement. In that case, the CMA collaborated closely with the United States. The CMA also highlighted the importance of digital evidences in proving an infringement when algorithms are involved.

The intervention of the Department of Justice of the **United States** (DOJ) focused mainly on the Amazon poster case discussed also by the UK CMA. In this case, the algorithm was actually used to assist the firms in setting their prices. According to the DOJ, the traditional antitrust tools can work to address this sort of conduct, especially because it is not necessary to rely on direct evidences, and circumstantial evidences or plus factors can be enough to prove an infringement. Concerning the question of liability, the purveyor, the creator, the seller and the user(s) of the algorithm can also be held responsible for the conduct. According to the US Federal Trade Commission (FTC) it is not the algorithm in

itself that raises concerns, but the human decisions to use algorithm to restrain the competitive process. The algorithm serves as an implementing mechanism. Many antitrust concerns with algorithms are related to core traditional antitrust concerns that would be identified regardless of algorithms. The FTC also pointed out that algorithms are not inherently anticompetitive; the question is whether firms are designing algorithms to remove or to soften competition. The FTC concurred that antitrust laws are flexible enough and capable to capture any possible restriction of competition through algorithms.

The **Chair** asked the US how they would handle situations in which companies would rely on an algorithm service provider to maximise their profit as intelligently as possible by looking at what the competitors are doing, which can possibly lead to some kind of collusive outcome. The **DOJ** replied that the case-law tends to approach this as a conscious commitment to a common scheme. Therefore, one might look at, for example, contemporaneous documents to see whether companies are aware of the fact that their algorithms is being used by at least one of their competitors or whether another competitor or group of competitors is using a similar algorithm that can result in a softening of price competition. The DOJ highlighted that at the moment we do not have any information on how many cases would fall into this so-called gap and that one has to consider that there are many benefits from algorithms that can result in competitive pricing. With regard to the DOJ reply, **Professor Ezrachi** argued that there might be a gap in the legal framework. If we just think of a scenario in which a service provider offers the best dynamic pricing algorithm, advertises it everywhere, all companies are aware of it, so it would be a rational behaviour for them to use it. The legal framework was designed for a human environment and humanlike decision-making, not for an algorithm-driven environment.

According to the **European Commission,** it is worth considering how algorithms and data fit in the broader framework of the digital economy, when it comes, for example, to designing products or services or how to price services. In the E-Commerce sector inquiry, half of the retailers reported tracking prices of online competitors and most of them (about 70%) acknowledged doing so through software. Moreover, a large majority of respondents are using software to re-price accordingly. The European Commission pointed out that we can rely on traditional antitrust notions and principles, but at the same time, we may need to adjust them to the new market realities. According to the Commission, what is illegal offline is likely to be illegal online.

The European Commission described the possible competitive concerns in vertical and horizontal context. In a vertical context, for example, a producer can use algorithms to monitor the enforcement of an RPM arrangement by retailers. In a horizontal context, there could be many scenarios ranging from the monitoring of explicit collusion to implementing an existing collusive agreement through an algorithm. Another traditional scenario is outsourcing pricing to a common agent (e.g. to a service provider). Algorithms could also be used for signalling in order to understand the future behaviour of the competitors. The European Commission also highlighted that agreeing on pricing parameters or on a pricing formula through an algorithm can also amount to a breach of Article 101 TFEU. Finally, algorithms can autonomously reach explicit collusion without explicit instructions from the user. Although tacit collusion is not in the scope of antitrust rules, agencies might need to consider new types of communication through algorithms, which could perhaps be used to turn tacit collusion into explicit collusion.

Russia presented their ongoing work related on algorithms. Some Russian companies, producers, distributors and resellers, make often use of very specific products to

determine their retail price. These software products can be divided into four groups, based on their functionality:

1. Products that collect and/or analyse information on the prices of competitors, on product ranges and other commercial information;
2. Products that automatically calculate prices based on the data uploaded by user;
3. Products that collect and/or analyse information on the prices of competitors, product range and other commercial information and automatically set prices based on the automated data mining activities;
4. Products that collect and/or analyse information on the prices of resellers set for specific brand products, automatically compare retail prices with recommended/minimum prices (in contrast to the above, these software products are used by vendors for controlling retail prices for brand products of resellers).

According to FAS, the use of last type of software products represents the greatest concern for competition at the moment, since they compare prices of different resellers, and punish resellers who do not comply with recommended and minimum price maintenance rules. FAS also mentioned the use of algorithms as a tool for implementing a bid-rigging scheme, when algorithms allow bidders to collect and analyse prices, tender information or imitate price competition or detect price variations. The use of algorithms raises the problem of liability of computer engineers and of users for possible violations made via algorithms.

The **Italian** delegation presented two investigations concerning online comparison tools. Since the agency has a dual competence (on both competition and consumer protection) it decided to approach these issues under the unfair practices rules. Since the website directed consumers towards specific insurance products and services, the first aspect of the investigation concerned the alleged lack of transparency of the comparison websites, in relation to the number and the identity of the insurance companies, their representativeness, the process of sale and the sources of instruments. In April 2015, the agency accepted binding commitments offered by the parties. Commitments provided for the inclusion of clear and up-to-date information, (i) on the functioning of the comparison mechanism, (ii) on the commissions paid by the insurance companies to the comparator, (iii) on the market share of the companies being compared. The commitments also included the possibility for consumers to "opt-in" (instead of the previous "opt-out" option) in relation to accessory services.

To conclude this part of the roundtable discussion, **Singapore** presented the finding from its study on E-Commerce, which revealed that algorithms have efficiency-enhancing effects but can also facilitate tacit collusion. Singapore pointed out that data, data analytics and their implications on competition policy remains a topic at the centre of the agency's attention.

3. Possible solutions from law enforcement and regulatory perspective

The final part of the discussion dealt with possible solutions to the concerns that algorithms may raise for competition law enforcement and market regulation. The **Chair** gave the floor to the experts, first to Professor Michal Gal, then to Professor Ariel Ezrachi and finally to Professor Avigdor Gal.

Professor M. Gal discussed the concept of algorithmic consumers, whereby algorithms can learn about the preferences of the consumers, and help consumers reduce search and transaction costs, analyse and compare different offers and switch suppliers. Algorithmic consumers can also increase buyer power by aggregating consumers' demand and counteract risks of suppliers' discrimination, collusion and concentration. On possible legal solutions, the main question whether algorithm-facilitated coordination fulfils the legal requirement of an "agreement" under competition law. According to Professor M. Gal, it would be useful to look at the concept of facilitating practices (or positive avoidable actions) that allow firms to achieve coordination quickly and easily by overcoming impediments to the conditions for reaching an agreement. Professor M. Gal concluded that it is also worth considering interactions of completion policy with other regulations.

Professor Ezrachi suggested that agencies could audit algorithms, allowing the competition agency to check if the algorithm can lead to collaborative outcomes or to price alignments. Another approach he suggested would be to use an algorithm collusion incubator, whereby the competition agency can use an algorithm of its own and try to imitate the results that we see on the market and based on that try to assess what actually is the type of instructions that you require in order to reach that. Other possible counter-measures he discussed included: 1) de-acceleration, or semi-deceleration, preventing algorithms from instantaneously adjusting prices to competitors' prices; 2) disruptive or consumer algorithms; and 3) sponsored entry to destabilise the algorithmic collusive market. Professor Ezrachi also suggested an ex-ante perspective. Instead of dealing with whether companies have done something right or wrong, it is better to explore the structure of the market. It is also worth considering smart regulation by defining certain boundaries of what algorithms can and cannot do, rather than designing regulations based on strict rules.

Finally, **Professor A. Gal** highlighted the benefits of the involvement of data scientists by providing the necessary technological insight into algorithms and algorithmic solutions. Regarding to the question of auditing algorithms, Professor A. Gal explained that instead of auditing the algorithm, it would be preferable to audit the data used by the algorithm. Replicability is also an important factor to consider. For example in determining the price, when algorithms get the same results, we can look at the dominant features they relied on. One can then decide if these features are acceptable from a legal perspective or not.

The **Chair** concluded the roundtable by summarising some of the main points that emerged from the discussion. He noted that the roundtable demonstrated that we are still at a very exploratory stage of the issue, and that the Committee may want to come back to it later in time when experiences will be more consolidated.