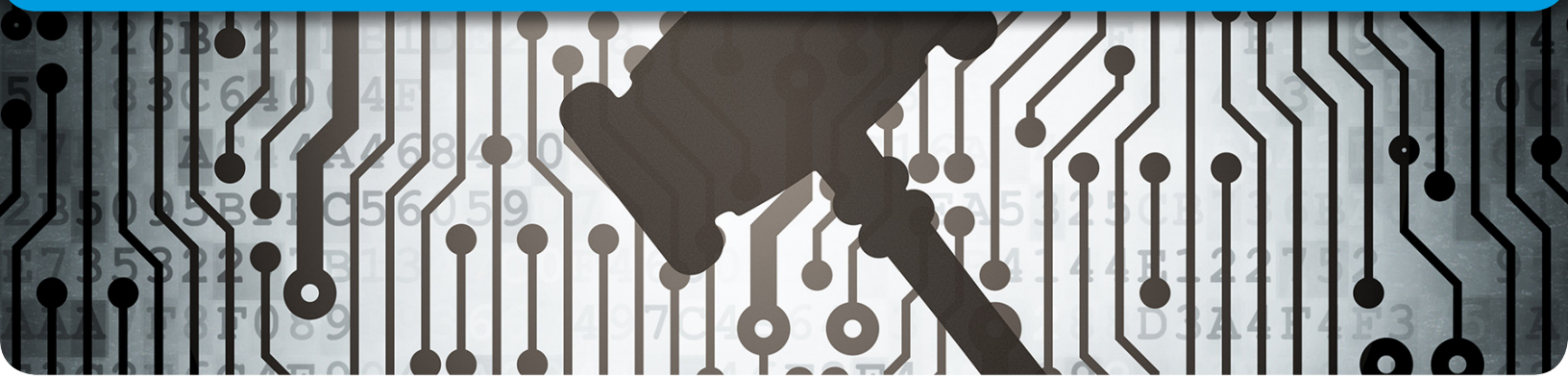
ALGORITHMIC-FACILITATED COORDINATION: MARKET AND LEGAL SOLUTIONS



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I. INTRODUCTION

Technological developments, it was hoped, would bring about more competition. The ability to connect faster and more easily with numerous suppliers on-line through digital platforms, as well as the use of algorithms by consumers in order to compare more offers in a more efficient and sophisticated manner, strengthened pressures on suppliers to provide better and cheaper products and services.[2] These advantages, however, are currently threatened by algorithmic-facilitated coordination.[3]

Algorithms make coordination – both implicit or tacit – much easier and quicker than ever before. Such coordination may bring about many positive effects. For example, they enable suppliers to better coordinate their conduct with the demands of consumers, thereby saving scarce resources, and responding much faster to demand trends. At the same time, and based on similar technological abilities, algorithms ease coordination among competing suppliers. Indeed, coordination no longer requires firms to operate in oligopolistic markets; and firms can more quickly and easily detect and punish deviations from the status-quo, thereby reducing incentives for shirking. As our assumptions about which market conditions must exist for firms to coordinate are altered, the number of red flags that are raised across industries rises. As Ezrachi and Stucke write, this is the end of competition as we know it.[4]

This requires us to explore which tools – either market-based or regulatory – can be used, if at all, in order to reduce the negative welfare effects of algorithmic coordination among competitors. Given that some of the assumptions that stand at the basis of the current rule under which tacit collusion is not considered an "agreement in restraint of trade" do not hold anymore, it is time to determine whether our laws are fit to deal with the digitized world; whether we are looking under the lamp while most of the occurrence in the real world is happening outside its scope of light. In other words, can we widen the scope of the light by simply using a stronger light bulb in the same lamp, or do we need to create a new source of light altogether?

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2 Michal S. Gal and Niva Elkin-Koren, "Algorithmic Consumers," *Harvard Journal of Law and Technology*, (2017).

3 Ariel Ezrachi and Maurice Stucke, *Virtual Competition* (Harvard University Press, 2016).

4 Id.

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Accordingly, this short note focuses on three issues that arise from this technological challenge. First, it explores the effects of algorithms on the ability of suppliers to coordinate their conduct. Second, it explores the ability of existing technological and regulatory tools to deal effectively with algorithmic-facilitated coordination. The final part briefly explores the promises as well as the limits of market solutions to welfare-reducing algorithmic coordination, which can be complementary or provide at least some viable alternative for the possible failure of regulation to deal with algorithmic-facilitated coordination. Issues of vertical integration and coordination, while important, are not addressed in this note.

II. ALGORITHMS AS FACILITATORS OF COORDINATION

A. The Economic Theory at the Basis of Coordination

Competitors have an inherent motivation to coordinate their conduct instead of competing among themselves. Such conduct can significantly increase their welfare and reduce consumers' welfare accordingly. Nobel Laureate economist George Stigler identified three conditions that must exist for such coordination to take place. In this part we briefly explore how meeting these three conditions has become much easier due to the use of a digital hand in market transactions.

Stigler recognized three cumulative conditions that must exist for a supra-competitive equilibrium to be created in the market, which still serve as a basis for much of the economic literature on coordination.[5] These conditions must hold whether coordination is a result of an explicit agreement, or whether it is the result of tacit collusion:

1. *Reaching an understanding* on trade conditions (price, quantity, quality, etc.) which are profitable to all parties to the understanding. This involves resolution of any disagreement between firms as to the "correct" trade terms, and communication of the ultimate decision to all parties. Otherwise, market participants will not be able to create a stable status-quo that is perceived to benefit each and every one of them relative to a situation in which they do not coordinate, and competition will ensue;

2. *Detection of deviations* from the status-quo of other firms. The slower and less completely deviations are detected, the weaker the coordination, as firms have stronger incentives to cheat. Also, if market conditions are not conducive to exposing deviations, firms would have to incur substantial costs to detect deviations, which reduce the overall attractiveness of coordination in the first place;

3. Creating a *credible threat of retaliation* against deviators, in order to discourage such deviations ion the first place.

Economic theory further recognizes a fourth condition which must exist for coordination to take place:

4. *High entry barriers* in the market in which the competitors operate, as otherwise new competitors might easily enter and sweep away the high profits, thereby reducing incentives to set supra-competitive prices in the first place.

The economic literature identifies additional market conditions which help facilitate coordination. Facilitating factors can be grouped into four broad categories: market structure variables (market concentration, entry barriers), the nature of the product (product and cost homogeneity, multiplicity of product variables), the nature of sales (lumpiness and secrecy), and the "personality" of the firms operating in the market.[6] The relevant factors may vary within a market over time and some of them, such as entrepreneurial attitudes towards the engagement in illegal activity, are intrinsically variable. None of the factors are deterministic in their ability to facilitate coordination. Rather, they all reflect general tendencies subject to random deviations. In reality, a combination of market conditions will determine the likelihood of coordination. Some major examples are noted below.[7]

5 George J. Stigler, "Theory of Oligopoly," 72 *Journal of Political Economy* 44 (1964).

6 Michal S. Gal, *Competition Policy in Small Market Economies* (Harvard University Press, 2003), chapter 5.

7 See, e.g. Marc Ivaldi, Bruno Jullien, Patrick Rey, Paul Seabright & Jean Tirole, *The Economics of Tacit Collusion*, Final Report for DG Competition, EC (2003) http://ec.europa.eu/competition/mergers/studies_reports/the_economics_of_tacit_collusion_en.pdf; Sigrid Stroux, US and EC Oligopoly Control (2004); Patrick Rey, "Collective Dominance and the Telecommunication Industry," in The Economics of Antitrust and Regulation in Telecommunication Markets (Pierre A. Buigues and Patrick Rey eds., 2004), 91, 91–102.

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A major structural condition which facilitates coordination is a small number of competitors, i.e. a concentrated market structure. This condition eases all three of Stigler's conditions. Most importantly, reaching an understanding to limit competition is easier and less costly if the number of firms is small; and the detection of chiseling is easier, given that there is a lower number of firms that should be checked for deviating conduct.

Indeed, the number of firms is so important, that it is largely assumed that tacit collusion can only be reached in oligopoly markets (hence its alternative name, "oligopolistic coordination"). Oligopoly means few sellers. The main economic characteristic of oligopolistic markets is that each firm's decisions have a noticeable impact on the market and on its rivals. Though each firm may independently decide its strategic moves, any rational decision must take into account the anticipated reaction of its rival firms to its decisions. As Shapiro states, "the hallmark of oligopoly is the presence of strategic interactions among rival firms."[8] An oligopolist's decisions may thus be interdependent though arrived at independently. Such mutual interdependence may forestall rivalrous conduct.

Transparency of transactions also makes it easier to coordinate, since market offers are easier to coordinate, and deviations are easier to detect.

B. Algorithms as Coordination Facilitators

Algorithms operating in the data economy make meeting the conditions for coordinated conduct much easier than ever before.[9]

Reaching an understanding can be much easier for several reasons. The availability of real-time information on other competitors' digital offers, as well as on consumers' preferences, facilitated by technological advances in data collection and data analytics, make it easier than ever to calculate the joint profit-maximizing level. The availability of real-time data also makes it easier to detect and adjust to market changes (such as an increase in the price of a major input of production), thereby shortening the reaction time to changes in market conditions and creating a new status-quo. Of no less importance, algorithms can more quickly and accurately calculate the joint profit-maximizing level among many competitors, thereby overcoming the condition that the market be oligopolistic. Also, the algorithm makes an economic, rational decision, devoid of ego, unless the coder of the algorithm decides otherwise.

Detection of deviations from the status-quo is also made much easier in a world in which data on offers is available online.

Creating a credible threat of retaliation against deviators is also facilitated by algorithms, as they can be coded to react immediately to such deviations. Competitors, acknowledging this fact, have lower incentives to deviate in the first place. Also, algorithms can calculate the risk of being caught and the correct height of sanction to ensure nobody deviates. Also, they may create a higher risk of policing deviations, especially if changing the algorithm's decision tree is not simple (e.g. if it has to go back to the coder). This may make the status-quo more stable.

Interestingly, algorithms also affect entry decisions. Assume that a potential entrant observes that high prices are charged in a certain market with relatively low entry barriers. Its incentives to enter the market are, however, dependent on the profits to be had in the post-entry period. If the algorithmic response to a lower price will be immediate, incentives for new entry will be reduced.

One conclusion from the above is that more transparency in online offers, and in competitors' algorithmic models, while also potentially benefitting consumers, also sustains and strengthens coordination. Indeed, applications for finding cheap gasoline in one's area in fact drove prices to be higher, since each competitor could see in real time when others were changing their price and act accordingly.

Another conclusion is that due to these more efficient ways of fulfilling Stigler's three conditions, coordination can be reached even if the algorithmic market is comprised of many small algorithms, all coded to monitor and police deviations. Indeed, the negligible costs of communicating and processing information make coordination and integration cost-effective in a way that was not available before, enabling large-scale coordination.

8 Carl Shapiro, "Theories of Oligopoly Behavior," in *Handbook of Industrial Organization*, R. Schmalensee and R. Willig eds., Vol. I (Amsterdam: Elselvier Science Publishers, 1989), 329.

9 Salil K. Mehra, *Antitrust and the Robo-Seller Competition in the Time of Algorithms*, 100 Minnesota Law Review 1323 (2016).

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So far we have assumed that competitors set similar although supra-competitive trade terms to consumers, so that consumers have no real choice among competitors. But in the digital world another factor comes into play: information about each and every consumer's elasticity of demand. As more information is gathered about each consumer's preferences, a consumer's "digital profile" can be used by suppliers to increase their profits even further, if they can price-differentiate between the offers they make to different consumers. This, in turn, implies that setting one price for the whole market is welfare-reducing for suppliers and that more factors enter into the coordinated equilibrium, thereby making coordination more complicated.[10]

How is coordination affected by this tendency? Much depends on the type of coordination reached between algorithms and on the information each firm has about consumer preferences. Should firms not share such information, they would have a tendency to reach a market-division agreement, in which each does not enter the market segment of the other, and each can exploit information regarding consumer preferences in its designated market, and even engage in perfect price discrimination. Another possibility is that firms share such information, whether because it is easily calculated by each of them alone, or because they all refer to a common database and use similar data analytical tools. If so, they can coordinate with regard to the price charged from each and every consumer, rather than in the market as a whole. While such coordination would be almost impossible for humans, it can be facilitated by algorithms.

C. Algorithms Increase Harm to Welfare

The effects of algorithms as coordination-facilitators increases the harms of coordinated conduct among potential competitors. Indeed, in the data-driven economy, these harms are more significant than ever before.

To understand the size of this threat, take as a baseline the current harm created by cartels.[11] By assisting competitors to overcome what was assumed to be the inherent limitations of coordination, algorithms strengthen both the ability to reach as well as the duration of coordinated conduct. Accordingly, the potential for harm is much larger. Indeed, the threat is so important that the OECD, as well as other international bodies, have recently put it on their agenda. Should this technological change not be recognized and dealt with, its effects on our marketplace and on our social fabric might well be significant.

Let me offer a final observation: if many markets are coordinated, and firms can indeed price-discriminate, this might reduce the incentives of consumers to work and earn more, thereby completely changing the dynamics in the market.

So how do we ensure that consumers enjoy the benefits of the data-driven digital economy? The next two parts briefly explore two potential solutions: market-based ones, and competition law ones.

III. MARKET-BASED SOLUTIONS?

Can the market devise its own solutions to algorithmic coordination? The answer is a partial yes. As shown by Gal and Elkin-Koren, the use of algorithms by consumers can counteract at least some of the increased market power of suppliers.[12]

Algorithmic consumers ("digital butlers") are algorithms that are employed by consumers, which make and execute decisions for the consumer by directly communicating with other systems through the Internet. The algorithm automatically identifies a need, searches for an optimal purchase, and executes the transaction on behalf of the consumer. As elaborated elsewhere,[13] algorithmic consumers offer many benefits to consumers as they can significantly reduce search and transaction costs, and help consumers overcome biases and enable more rational and sophisticated choices.

Most importantly for our purposes, they can counteract at least some of the negative welfare effects of algorithms used by suppliers, creating algorithmic wars. How can they do so? Algorithmic consumers can create buyer power, if an algorithmic consumer has a sufficiently large number of users, or if it coordinates its conduct with other algorithmic consumers. This, in turn, may allow consumers to counteract suppliers' buyer power. Indeed, the algorithm can be coded not to buy a certain good if price is above a certain level. The aggregation of buyers can also make transactions less frequent and small, thereby increasing incentives of suppliers to deviate from the status-quo.

10 See also Nicolas Petit, "Antitrust and Artificial Intelligence: A Research Agenda," *JECLAP* (2017).

11 See, e.g. John M. Connor and Robert H. Lande, *Cartels as Rational Business Strategy: Crime Pays* 34 Cardozo Law Review 427 (2012).

12 Gal and Elkin-Koren, supra.

13 Id.

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Furthermore, algorithmic consumers can be coded to include decisional parameters designed to eliminate or at least reduce some market failures in the long run. Algorithms are sufficiently flexible to include considerations such as long-run effects on market structures that might harm consumers. For example, an algorithm might be able to recognize the coordination, and refrain from doing business with those suppliers until prices are lowered. Or it might always buy some portion of its goods from at least one new source, to strengthen incentives for new suppliers to enter the market. Of course, including such decisional parameters requires more sophisticated modeling and analysis of market conditions and their effect on welfare, but given advances in economics and in data science, they are becoming easier.

Finally, Algorithmic buying groups may reduce the ability of suppliers to learn about, or to use to their advantage, information regarding each user's preferences by aggregating the choices of different consumers into one virtual buyer (what might be called anonymization-through-aggregation). Indeed, once consumers are aggregated into sufficiently large consumer groups, suppliers will lose the ability to collect information on consumers' individual preferences with regard to products bought through the group, and to discriminate among them based on each consumer's elasticity of demand.[14] For instance, a seller might price discriminate by charging a law professor more for the same law book than a student, given that the former generally has greater financial means with which to buy law books. The loss of this ability, in turn, could increase consumers' welfare, if suppliers are forced to set a lower price for all. However, in some situations it might also affect welfare negatively, by limiting the ability of some flexible-demand consumers to enjoy lower prices, or by limiting consumers' exposure to personalized offers.

Algorithmic consumers can therefore improve market dynamics and limit coordination without need of legal intervention. Rather, its regulating power resides in the reaction of consumers to the change in market conditions created by suppliers through their algorithms. It is sufficiently wide to capture tacit coordination.

This market-based solution is not, however, without limitations. One limitation may be regulatory: the use of algorithmic consumers might infringe competition laws, should they be considered to engage in anti-competitive agreements or to abuse their market power. Another concern is that the market for algorithmic consumers will be dominated by digital butlers who are not benign, but rather serve their suppliers' purposes (such as Amazon's Alexa).

Finally, another potential market solution, that may enable suppliers to reduce prices, is to make offers directly to consumers, and not through a digital medium. This, in turn, might reduce – although not completely eliminate- the ability of other algorithms to learn about such transactions, thereby reducing detection of shirking.

IV. LEGAL SOLUTIONS: IS COMPETITION LAW WORKING FOR US?

"Smart coordination" by suppliers requires "smart regulation." The question is whether competition law is up to the task. Indeed, current legal tools were designed to deal with human facilitation of parallel conduct. New ways to coordinate, as well as the potential scale and scope of the resulting parallel conduct, were not envisioned at the time when competition law prohibitions were fashioned.

The main problem in applying competition law prohibitions is that for liability to arise from coordinated conduct, an "agreement" must be found to exist among those engaged in the anti-competitive conduct. Undoubtedly, some types of coordination among algorithmic consumers satisfy this condition. A relatively simple scenario involves the use of algorithms to implement, monitor, police or strengthen an anti-competitive agreement among users or providers of algorithms. In such a situation a clear agreement exists.[15]

A more complicated scenario involves tacit collusion among algorithms, reached without the need for a preliminary agreement among them. Rather, a stable status quo is achieved when each algorithm is coded to make its decisions based on its predictions of the best responses and dominant strategies of other parties in the market. This leads to coordination without prior agreement, which could be facilitated automatically. In another scenario, the algorithms are designed to achieve a given target, such as price reduction. The algorithms determine independently the means to reach that target, through self-learning and feedback collected from the market. Therefore, coordination is not the fruit of explicit human design but rather the outcome of evolution, self-learning and independent machine execution. Ezrachi and Stucke argue that parallel conduct that results from the last two scenarios does not constitute an

14. See, e.g. Samuel B. Hwang & Sungho Kim, *Dynamic Pricing Algorithm for E-Commerce*, *in* Advances in Systems, Computing Sciences and Software Engineering 149 (Tarek Sobh & Khaled Elleithy eds., 2006). For a discussion of the welfare effects of price discrimination, see, e.g. R. Preston McAfee, Price Discrimination, in Issues in Competition Law and Policy 465, 480–83 (ABA Section of Antitrust Law 2008).

15 For four main scenarios, see Ezrachi and Stucke, supra.

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"agreement" for the purpose of competition law and therefore is not prohibited.[16]

Gal and Elkin-Koren offer a different view.[17] One of the exceptions to the rule that exempts tacit collusion from competition law liability is the existence of "plus factors."[18] These are positive actions, engaged in by market players, which depart from the market's natural conditions and allow firms to better achieve coordination. In both cases it can be argued that the algorithm, or rather its design, constitutes a plus factor. Algorithms include in their decision trees elements that not only scan and compare the available options as a basis for consumption decisions, but also change suppliers' decision parameters to include reactions to offers made by suppliers to other consumers, thereby also changing suppliers' incentives. Arguably, therefore, the algorithm constitutes a plus factor to an agreement among the operators of such algorithms, and possibly also among their users.

Observe that to apply such rules in practice, competition authorities might need to strengthen their technological expertise, by either creating an internal "algorithmic police" or by employing outside talent to detect algorithmic conduct that constitutes a plus factor. Also observe that the regulatory net should not be cast too widely, as otherwise we might prohibit conduct which is welfare-enhancing. Therefore we need to devise "reasonableness tests" that are based on understanding on how algorithms work in the digital environment, while exploring the quality of the data and its analysis which serve as inputs into the algorithm, the model used to make the decision, the way the decision is communicated in the market, and the anticipated reaction to this decision by other market players. Indeed, while some algorithms can be treated as "coordination by design," a paraphrase on "privacy by design" which is an approach to systems engineering which takes privacy into account throughout the whole engineering process, others may only inadvertently facilitate coordination. These issues are explored in detail by Gal and Petit.[19]

Alternatively, legislators and courts might need to reevaluate the current policy of exempting tacit collusion from the prohibition against anti-competitive agreements. This is because some of the factors underlying the decision not to regulate tacit coordination—principally that such coordination affects only a small number of markets—may no longer be true. Indeed, this justification was based on assumptions of limited human capacity that no longer hold. Once we introduce algorithms, not only does oligopolistic coordination become more durable, but it may also actually be facilitated in non-oligopolistic markets, in which many competitors operate. Moreover, detection and reaction are almost immediate. The requirement that a prior agreement exist among market players therefore does not fit the algorithmic world. The major problem with limiting tacit coordination by algorithms is similar to the one raised by Donald Turner with regard to non-algorithmic-enhanced oligopolistic coordination: how should the remedy be structured?[20] Should the algorithm be mandated to ignore its competitors' potential moves? Such a requirement may well undermine competition. Therefore, the issue of remedy should be well thought through before the law is changed.

Another regulatory issue involves the level of transparency and explainability which is legally required from coders of algorithms. Transparency enables consumers and regulators to detect coordination as well as other types of conduct such as discrimination. Yet even if we create user or regulatory literacy of algorithmic decision-making, the issue still remains what exactly is prohibited. Furthermore, transparency can help facilitate coordination by exposing the considerations that one's rivals take into account, including the weight given to different parameters. Finally, the benefits of transparency and explainability fall short when the algorithm employs machine learning based on neural networks, that is, it teaches itself the best way to behave in the market even if the coder did not model such conduct.

A final challenge is that regulatory tools, while talking into account competition-related considerations, should not disregard other factors which affect welfare such as privacy, right to identity, the protection of business secrets in order to ensure incentives to innovate, and cyber security.

16 Ibid.

17 Gal and Elkin-Koren, supra.

18 See, e.g. William E Kovacic, Robert C. Marshall, Leslie M. Marx, & Halbert L. White, *Plus Factors and Agreement in Antitrust Law*, 110 Mich. L. Rev. 393 (2011).

19 Gal and Petit, *Algorithms as Plus Factors*, forthcoming.

20 Donald F. Turner, *The Definition of Agreement Under the Sherman Act: Conscious Parallelism and Refusals to Deal*, 75 Harv. L. Rev. 655 (1962).

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V. CONCLUSION

The brave new world in which algorithms make many decisions challenges some of our most basic assumptions about how markets operate. Indeed, as shown, algorithms make coordination easier and quicker than ever, thereby reducing incentives to compete. This, in turn, increases the importance of market or legal reactions to reduce potential welfare-reducing effects, while ensuring that the consumer can enjoy the benefits that the digital world offers. This short note attempted to briefly explore some of the basic challenges to competition which are created by algorithms used by suppliers, as well as some potential market-based and legal counter-measures.

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