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Artificial Intelligence and Competitive Dynamics in Downstream Markets

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AI and Competition

Introduction

1. A paper on “AI, algorithms and competition” runs the risk of becoming very technical. The first level of technicality is that AI and algorithms are technical concepts in themselves, requiring some level of knowledge on these specific terms and underlying techniques. The second level of technicality is the economic analysis of relevant aspects. Economic models tend to require a high level of mathematical knowledge. The third level of technicality is the legal analysis of relevant precedent.

2. In recent years, artificial intelligence (**AI**) has emerged as a transformative technology with vast potential to reshape various industries.¹ AI has many different aspects. It is expected that many of these aspects will be beneficial. See, the Furman report (pp.50-51):

3. *Rapid advances in artificial intelligence and machine learning have the potential to transform business models across many sectors, finding better ways of performing complex tasks. New technology has the potential to transform our quality of life, from improvements to the quality of infrastructure that underpins daily life through to faster diagnosis and treatment for medical conditions.*²

4. However, the use of AI also raises potential risks and concerns. These include for example risks to personal privacy and other ethical issues.

5. This paper focusses on the effects of AI in competition in all sectors of the economic in which AI is used by suppliers.³ This can be referred to as downstream markets, i.e. markets whose primary output is not related to AI, but where AI is used as an input.

1. AI and Algorithms

6. What is AI and how can algorithms be defined? IBM defined AI by as the technology that enables computers and machines to simulate human learning, comprehension, problem solving, decision making, creativity and autonomy⁴. An algorithm can be defined as a decision tree or a sequence of instructions. The common-sense decision

¹ <https://www.lexology.com/library/detail.aspx?g=7383d6da-22f4-456e-a074-7ff2f2a0548c>

² In relation to algorithms in general, the UK competition authority concluded that “*algorithms have brought many benefits to consumers and competition in the form of lower costs for suppliers, better service, better product availability, and an improved customer experience*” (UK competition authority, 2018, p.7)

³ “*The opportunities and the risks of big data refer not only to online markets, but also to several offline markets. (...), big data may play an important role in traditional markets (e.g., insurance and healthcare sectors).*” Portuguese competition authority, p.7.

⁴ <https://www.ibm.com/think/topics/artificial-intelligence>

rule “if there is material chance of rain, I will bring an umbrella” is an algorithm. Another algorithm is the rule “if my competitor reduces prices by X, I will reduce my own prices by Y”. As this concerns pricing, this algorithm is called a pricing algorithm.

7. Algorithms are playing an increasingly important role in many markets. In the “E-commerce Sector Inquiry” the European Commission reported that the majority of online retailers track online prices from their competitors, and, in doing so, two thirds use automated software⁵.

8. Initially, in areas such as insurance or credit, the cost to serve customers can vary considerably but can be estimated using observable data. Furthermore, in areas where demand fluctuates rapidly such as taxi fares, airline fares or hotel room pricing, algorithms can be used to react to the changing conditions. Finally, automated pricing is convenient for vendors who have a wide range of products to price.

9. However, by increasing supply side market transparency and the ability of sellers to react to each other’s pricing, automated algorithms can also contribute to equilibria with supra-competitive if they “collude” by aligning prices instead of competing. Algorithms can make collusive agreements more stable and, potentially, easier to initiate in the first place⁶.

10. AI can reduce consumer demand uncertainty, which would expand the scope for collusion in situations where it would not otherwise be sustainable. This is because more accurate data collection and processing would allow companies to better differentiate between low sales volumes from demand shocks and those from firms undercutting an agreed cartel price. However, these methods would also make it easier to identify when there are greater payoffs for defecting. The overall effect on consumer welfare was ambiguous, as there were many instances where collusion was still possible, but companies could no longer sustain monopolistic prices⁷.

11. Algorithmic pricing may also lead to price discrimination in the form of personalized pricing. This is the practice of charging different customers different prices not justified by differences in costs, but instead based on observable features.

2. The importance of algorithms

12. Why the current concerns with algorithms? In our opinion, the reason is threefold:

- The **first reason** is big data and digital transformation. As a result of KSAs digital revolution, KSA is facing a “Data Explosion”. The Data Explosion is defined as the “*rapid or exponential increase in the amount of data that is generated and stored in the computing systems, that reaches level where data management becomes difficult*”⁸. Many companies believe that information is a valuable

⁶ [An Empirical Analysis of Algorithmic Pricing on Amazon Marketplace | Proceedings of the 25th International Conference on World Wide Web](#)

⁶ [Algorithms & Antitrust: An overview of EU and national case law - Concurrences](#)

⁷ Jason O’Connor & Nathan E. Wilson, Reduced Demand Uncertainty and the Sustainability of Collusion: How AI Could Affect Competition, 54 INFORMATION ECON.&POL’Y (2021).

⁸ <https://www.geeksforgeeks.org/what-is-data-explosion/>

commodity, and one worth hoarding: the more we have of it, the more we can learn from it, and make changes that will drive business success.⁹

- The **second reason** is the automation of pricing algorithms.
- The **third reason** is AI. With the Data Explosion and automated algorithms, the limits of the human capacity to keep an overview of all the signals and interactions are being reached. In other words, humans reach the limits of being able to improve on the pricing algorithms and their interactions. AI - or rather machine learning - is a way to make the process of controlling for mistakes and learning from the data and the outcomes automated. IBM defined Machine learning as “*a branch of artificial intelligence (AI) and computer science that focuses on the using data and algorithms to enable AI to imitate the way that humans learn, gradually improving its accuracy.*”¹⁰

3. Selected economic concerns with AI

13. The rise of AI in markets has raised potential significant competition concerns due to its ability to process complex data and implement decision-making strategies beyond human capabilities. Unlike traditional manual analysis, AI thrives on large datasets, making data a critical asset that can enhance market power.

14. Dominant platforms may use AI algorithms to favor their own products and exclude rivals, as seen in cases involving Google and Amazon, prompting enforcement actions by the European Commission. AI may also enable anti-competitive coordination—sometimes without direct human involvement.

15. Competition authorities in the EU, UK, and US have identified two core risks: a) the potential for algorithms to facilitate collusion. b) the use of AI for unfair pricing strategies. We will discuss these concerns in a bit more detail.

3.1. Facilitating collusion

16. In economic literature, "collusion" typically describes any coordinated effort or agreement among competing firms aimed at increasing prices—and consequently profits—beyond what would occur in a non-cooperative environment. Essentially, collusion is a collective strategy for maximizing profits among rivals. To establish and maintain collusion, the involved parties must (1) agree on a unified approach, (2) monitor compliance with that approach, and (3) enforce it by penalizing any deviations (OECD 2017, p.19).

17. The literature research has highlighted various factors on which there is broad consensus that these (can) promote (explicit) collusion among competitors, such as a high market concentration, barriers to entry, a low demand elasticity, stability of demand, links among competitors, market symmetry, multi-market contacts, the frequency of orders, buyer power, and product homogeneity.

⁹ <https://www.forbes.com/sites/bernardmarr/2016/04/28/big-data-overload-most-companies-cant-deal-with-the-data-explosion/>

¹⁰ <https://www.ibm.com/topics/machine-learning>

18. This section explores whether, and if so: how, eight factors that facilitate collusion (the number of firms, barriers to entry, interaction frequency, market transparency for companies and consumers, asymmetry among firms, product differentiation, and innovation) have been affected by the rise of AI, comparing the dynamics before and after AI.

19. Table 1 displays a list of these eight market characteristics. The second column provide the assumed factor on cartel stability. The factor that increase the stability of a cartel (i.e. that is a risk for the economy) are marked in red. The third column provided the assumed impact of algorithms on collusion in relation to this specific factor. If the impact of AI on the stability of a cartel is positive (i.e. a risk for the economy) are marked in red. For example, if the factor “number of companies” increases (i.e. a greater number of firms participate in the cartel) this decreases the stability of the cartel (i.e. a lower risk for the economy), but AI is assumed to make this relation less obvious and hence facilitate the stability of a cartel even with a large number of companies (i.e. a higher risk to the economy).

Table 1.

Parameter (market characteristic)	Potential effect of an increase in this parameter on the stability of collusion	Impact of AI on the stability of collusion via this parameter
Number of companies	Decreasing	Positive
Barriers to entry	Increasing	Ambiguous, depending on the market
Frequency of interactions	Increasing	Positive
Market transparency for companies	Increasing	Positive
Market transparency for consumers	Ambiguous, depending on the market	Ambiguous, depending on the market
Asymmetry between companies	Decreasing	Ambiguous, depending on the market
Product differentiation	Decreasing	Ambiguous, depending on the market
Innovation	Decreasing	Negative or ambiguous, depending on the market

Note: Effects of various market characteristics on stability of collusion and resulting impact of algorithms on collusion stability¹¹

3.2. Personalized pricing

20. The UK competition authority¹² defined personalized pricing as “the practice where businesses may use information that is observed, volunteered, inferred, or collected about individuals’ conduct or characteristics, to set different prices to different consumers (whether on an individual or group basis), based on what the business thinks they are willing to pay.” In its narrowest interpretation, it is the first-degree (perfect) price discrimination, which is the setting of individual prices for each consumer.¹³

21. Personalized pricing is covered in Article 5 of the Competition Law (2019): “Practices which deliberately or inadvertently prejudice competition (..)shall be prohibited, particularly (..) dividing markets for the sale or purchase of goods and services, or

¹¹ See also OECD, Algorithms and Collusion, 2017 (<http://www.oecd.org/competition/algorithms-collusion-competition-policy-in-the-digital-age.htm>).

¹² UK competition authority, 2018, 7.2, p.35.

¹³ Japanese competition authority, p.44.

designating them according to any specific criteria, particularly: a) geographical areas, b) distribution centers, c) customer type and d) seasons and time periods.”

22. Price discrimination can be applied on various levels. The traditional classification of the forms of price discrimination is by Pigou (The Economics of Welfare, 1920). Below is the summary by Varian¹⁴:

Table 2.

First-degree	involves the seller charging a different price for each unit of the good in such a way that the price charged for each unit is equal to the maximum willingness to pay for that unit.
Second-degree	occurs when prices differ depending on the number of units of the good bought, but not across consumers. That is, each consumer faces the same price schedule, but the schedule involves different prices for different amounts of the good purchased.
Third-degree	meaning that the different purchasers are charged different prices, but each purchaser pays a constant amount for each unit of the good bought.

23. This paper will only discuss 3rd and 1st degree price discrimination.

24. A (hypothetical) monopolist that does not have access to information on each individual consumer sets its price at a level where any change to this uniform price would result in a net loss of profit. Even in the absence of other suppliers, one can argue that there are competitive constraints. The monopoly price is observed by potential competitors. That means that potential entrants with a superior product or that are more efficient would be able to assess the scope for entering the market. The government would observe the monopoly price. If the prices are deemed excessive, governments could intervene by regulation.¹⁵ Customers would observe the monopoly price and could contemplate jointly creating (a counterbalancing level of) purchasing power on the demand side. In short. The price signal would clearly indicate the potential issue and allow tracking over time.

25. With price discrimination the situation changes. For example:

- Potential entrants are likely to have much less information on prices and therefore may be less able to consider the scope for profitable entry.
- Governments and competition authorities have much less information on prices and therefore may be less able to consider the need for intervention.
- A customer has less information on prices charges to other customers and therefore cannot easily assess the potential scope for joint purchasing.¹⁶

26. Traditionally, it is assumed that the following four conditions are relevant for price discrimination:

1. Firms have some degree of market power.

¹⁴ Varian, p.600.

¹⁵ Note that excessive pricing is an abuse of a dominant position in competition law. However, competition authorities are generally reluctant to apply this prohibition to static situations, i.e. where a monopolist charges a fixed price P. This is because transparency on the competition rules require that the competition authority is able to specify which price P-x would be deemed acceptable. This would turn a competition authority into a de facto regulator of all undertakings that have a dominant position in an economy and could create many additional issues in an international context.

¹⁶ It is noted that many b2b contracts have a statement that the prices listed in the contract are confidential. This may hinder the scope for joint purchasing.

2. There is observable heterogeneity among consumers.
3. Firms are able to fine-tune prices according to this heterogeneity.
4. There is no arbitrage among consumers.¹⁷

3.2.1. Price discrimination

27. Third-degree price discrimination means that different purchasers are charged different prices, but each purchaser pays a constant amount for each unit of the good bought. This is perhaps the most common form of price discrimination; examples are, student discounts or charging different prices on different days of the week: If a hairdresser offers a 10% discount to students, this is a form of third level price discrimination. However, it is not always required for the supplier to check whether the criteria are met.

28. The scope to have material third level price discrimination may have increased with the availability of big data and AI. Based on the information collected, it may be possible to direct potential customers to specific price offerings and increase overall profits. The autosuggestion function of search engines may influence consumer perception of the market and factually limit the number of alternatives that are available.

29. Big data and automation have resulted in a slightly different version of price discrimination. Prices are very quickly adapted to changing market conditions. For example, the prices that Uber charges respond quickly to congestion. This is not price discrimination as such as all prices for all customers are changed at the same time. However, a higher price would result in potential customers on the right-hand side of the demand curve (with a higher price elasticity) forfeit their purchase and finding alternative solutions, where customers on the left-hand side of the demand curve (with a lower price elasticity) continue to purchase at the higher price. This is normal supply and demand, however, the information that is available because of the high frequency of interactions may allow the supplier to test the willingness to pay of individual customers and in particular situations. This can in turn increase price differentiation and reduce transparency for customers.

30. First level price discrimination is where each customer is faced with a price that is set on an individual level: This is quite common when customers have easily observed characteristics. In a slightly more permissive setting, the pricing is not on an individual level by segment: suppliers segment their customers according to their willingness to pay on the basis of characteristics observable by firms. In a perfect situation, every customer is offered an individual price equal to their maximum willingness to pay.¹⁸ These algorithms may be associated with techniques such as yield management or revenue management, often used, for example, in the air transport and hospitality industries.¹⁹ The more characteristics are available and identified as being relevant, the more segments are created and the closer the result comes to individual prices.

31. The negative effects of price discrimination will only occur if there is a lack of competition: if a customer with a highly inelastic individual demand curve can choose from various suppliers, competition can drive the prices down even if each of these suppliers are aware of the specific inelastic individual demand curve. If there is competition for customers in a segment, competition will drive the prices down and the theoretical ability

¹⁷ Portuguese competition authority, p.55. The Japanese competition authority (p.45) appears to combine 2 and 3.

¹⁸ CMA, 7.5

¹⁹ Portuguese competition authority, p.54

to apply personal pricing – based on knowledge of the customers – should not significantly change the competitive conditions and outcome in a market.²⁰

32. Therefore, personalized pricing could be defined as **“the practice where businesses may use information that is observed, volunteered, inferred, or collected about individuals’ conduct or characteristics, to set different prices to different consumers (whether on an individual or group basis), based on what the business thinks they are willing to pay and where additional information on the customers would not result in increased differentiation of prices. “**

33. One can conclude that third degree price discrimination can result in two different outcomes:

- If the producer can supply an additional segment of customers that are not supplied in the situation without price discrimination, the result is an overall increase in welfare.
- If the producer can differentiate between segments of customers that are already supplied in the situation without price discrimination, the result is limited to a transfer of welfare from customers to the producer.

34. The collection and storage of information has increased at an unprecedented pace. The application of artificial intelligence has resulted in the ability to process these vast amounts of data. AI thus increased the scope for first degree price discrimination. Note that there is no welfare loss as a result of market power if the monopoly supplier applies perfect price discrimination. On the other hand, as the producer sets the price equal (marginally below) the willingness to pay for each individual customer, there is no consumer surplus and all welfare is producer surplus.

35. If there is no effect on overall welfare, does this imply that there is no effect on competition? No - one can identify various potential effects on competition:

- If the customers are not final consumers but intermediate companies, perfect price discrimination reduces the incentives to be economically active. If the benefits of production of products and services are reduced, this may in turn affect the range of products and the incentives to innovate.
- If the customers are not final consumers but intermediate companies, perfect price discrimination may affect the competition between suppliers in this downstream market.
- If the customers are final consumers, perfect price discrimination will reduce their purchasing power. This income effect may also affect the markets for other products and services.
- If the customers are final consumers, and these consumers also provide labor, perfect price discrimination may affect their incentives to be economically active. If an increase in salary will result in an equal increase in prices to reflect the additional willingness to pay, there is an incentive to reduce the supply of labor.
- A supplier with the ability to apply perfect price discrimination will make high profits even compared to a monopoly supplier that does not apply price discrimination. These high profits may provide a war chest that deters entry: it may provide a credible threat to reduce prices in response to any entry into the market.

²⁰ See e.g. Portuguese competition authority, p.57.

- A supplier with the ability to apply perfect price discrimination may have an incentive to oversupply the market. In order to show the beneficial effects, the supplier provide the products to customers with a willingness to pay that is below the market price. In effect, the supplier provides cross subsidization, removing wealth from customers with a high willingness to pay to customers with an ability to pay that is below the production costs. Such welfare reducing incentives may be supported by the government as they may increase local employment and increase supply to economically deprived groups in the society. In addition to the allocative inefficiencies, this expanding application of perfect price discrimination will further reduce the opportunities for entry.

3.3. Striking the right balance

36. Both as a jurisdiction and as a regulator, one has to consider the optimal timing for any potential intervention. AI is relatively new and, whereas there are many predictions, the effects are still largely unforeseen. This creates a particular challenge. On the one hand, – and despite the noted attention for the subject -traditional regulatory tools may be too slow to protect competition effectively. On the other hand, here is a risk that intervening before building up sufficient understanding reduces innovation and healthy competition.²¹ It may be helpful to recall that a truly innovative company will have a 100% market share for the new product, however, this does not imply that innovation is a cause for concern for competition authorities.

37. We note that generic competition law appears to be well placed to deal with many of the current potential concerns that are identified in relation to AI. The prohibitions contained in competition law are based on a case-by-case ex post assessment. Given the uncertainties inherent in new development such as AI, ex post regulation may be superior to specific ex ante regulation (in a narrow sense): it may simple be impossible to predict the potential outcome of AI on the economy and whether prohibiting or requiring certain actions will result in an overall increase or decrease of welfare. The exemption procedure included in KSA competition legislation offers a balancing of negative effects on competition with offsetting benefits.

3.4. KSA competition law

38. Whereas we consider that KSA competition law is generally well equipped to deal with new markets and new technologies such as AI, the application of the competition law and guidance to such new markets and new technologies may not always be self-evident to all third parties.

39. Competition law is the codification of certain lessons draws from economics. In other words, competition law focusses on combatting – and thereby preventing – certain conduct by undertakings that has a negative effect on competition.

²¹ https://www.mayerbrown.com/-/media/files/perspectives-events/publications/2024/04/ai-challenges-in-competition-law_mar24.pdf%3Frev=55168f8e10a64e458c3fc1ac7af179df

Article 5 of the KSA competition law prohibits arrangements between undertakings that have the object or effect of hindering competition. This distinction should not be interpreted that the prohibition also captures arrangement that have no effect on competition. Rather, the correct interpretation is that for some categories of agreements – such as hardcore cartels in which competitors jointly set prices or a market sharing agreement where competitors promise not to offer their products or services in areas allocated to a competitor – there is no need to determine the effect on a case-by-case bases as economic science has convincingly evidenced that these types of arrangements always have a negative effect on competition. For other arrangements, the negative effect on competition has to be proven on a case-by-case basis.

40. AI offers new challenges to society. Whereas there are many predictions on the effects of AI on societies and economies. This applies to the economic analysis of AI on competition. As we have previously seen, the economic research is far from reaching consensus on the effects of AI on competition in relation to collusion and personal pricing, let alone on reaching firm conclusion on the impact of AI on specific markets. To address these challenges, regulators must adapt their approaches, incorporating new technologies and methodologies to detect and prevent them in the digital age. The creation of the digital unit within the GAC reflects its ability to adapt to the new challenges.

41. Development in existing markets and new markets created by AI call for a pragmatic approach to the enforcement of competition law. As competition law is the codification of lessons from economics, the competition authorities should aim to keep this connection between the law and its economic underpinnings intact. This calls for caution with and good communication on the application of the prohibitions in competition law in markets affected by AI. An overly dogmatic application may result in interventions that defy economic logic and common sense. This can result in legitimacy concerns. The economic approach started in the mid-nineties in the EU to address precisely such legitimacy concerns.

42. There is a balance to be struck between legal certainty (predictability) and flexibility. If there is too much stress on legal certainty, competition law may be unable to address competition concerns in new markets or with new technologies that require a reinterpretation of the rules. If there is too much flexibility, compliance for companies becomes unduly burdensome and this may even have a negative effect on investment.