Lomonosov Moscow State University

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Regulation of artificial intelligence in the framework of competition policy: Law and Economics approach

A. Kurdin[1]

О статье

Keywords: Digital economy; artificial intelligence; competition policy; antitrust policy; machine learning; big data; market concentration.

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Abstract

Digital transformation of markets and industries is one of the most difficult challenges for the modern competition policy. The transformation is closely connected to the adoption of artificial intelligence (AI). The authors of the article summarize main issues raised in the process of market behavior qualification and market structure assessment for AI intensive companies. These issues include enhanced market concentration, risks of price discrimination and algorithmic collusion. The specific challenge in that sphere is the dependence of AI efficiency on big-data-based machine learning. This feature causes the increase in market concentration, strengthens the positions of market leaders, and potentially weakens the competitive environment. Antitrust bodies should improve their own digital competences and analytical capacities to prevent the loss of control over the market, as well as the elimination of AI benefits.

[1] Kurdin Alexandr Alexandrovich (aakurdin@gmail.com), Senior Researcher, Department of Competitive and Industrial Policy, Faculty of Economics, Lomonosov Moscow State University, Ph.D.

Одним из наиболее сложных вызовов для современной конкурентной политики является цифровая трансформация отраслей и рынков, тесно связанная с внедрением искусственного интеллекта. Авторы статьи обобщают основные проблемы при квалификации положения и поведения компаний с интенсивным использованием искусственного интеллекта, в том числе повышенную рыночную концентрацию, риски ценовой дискриминации и алгоритмического сговора. Специфическим вызовом в этой сфере является зависимость эффективности искусственного интеллекта от машинного обучения на больших данных. Эта особенность обосновывает рост концентрации, усиливает положение лидеров и потенциально ослабляет конкурентную среду. Антимонопольным органам рекомендовано усиливать собственные цифровые компетенции и аналитические возможности, чтобы не оставить рынок без контроля, но и не элиминировать выгоды от искусственного интеллекта.

1. Introduction

Artificial intelligence is becoming an increasingly important factor for industries' and markets' development. Artificial intelligence systems allow for a significant reduction of both production and transaction costs in the economy. This should have a positive impact on the dynamics of social welfare; however, it also becomes exposed to new risk factors.

Those companies that intensively use artificial intelligence are now holding the leading positions in global business as well as increasing their impact on the state of competition in a wide range of markets. The introduction of systems that use artificial intelligence poses serious challenges to competition policy. To a large extent, these challenges tackle the range of problems discussed in a broader context – the digital economy context. These problems are not artificially made up: several prominent antitrust investigations against global digital leaders such as Google, Facebook, Apple, Microsoft are currently being conducted by antitrust authorities and being considered in courts all around the world with mixed success.

The challenges that the digital economy poses to competition protection and development have been widely discussed in academic literature already in the 2000s; for example, even the special branch of industrial studies – Microsoft Economics – was considered in the context of "Microsoft case" [Etro, 2007]. But the most extensive intervention of digitization into competition studies was observed during the last 5-10 years ([Teece, 2012; Ezrachi, Stucke, 2016; Tsarikovsky et al., 2018; Shastitko, Markova, 2017; Pavlova et al., 2020]). At the same time, there already appears to be some sort of consensus on the key digital economy-related antitrust problems which

include network effects and the significant market power of digital platforms, algorithmic collusion and price discrimination based on big data.

This paper summarizes the above-mentioned problems and institutional alternatives for their solution when applied to artificial intelligence use. Artificial intelligence can be broadly defined – sometimes it is even given such a simple definition as "elementary algorithms using basic computer logical principles". Nonetheless, this paper follows a more relevant approach to artificial intelligence definition (at least, one of three most actual interpretations formulated in [Agrawal et al., 2019]) and interprets it as a set of algorithms capable of machine learning.

Such an approach enables us to complement the traditional analysis of competition policy digital problems: in particular, we highlight that tendency towards high concentration provides not only network effects, but machine learning economies of scale effects as well. The more users train artificial intelligence, the more effective it becomes and the more competitive product it offers as a result. For example, search engine services' consumers, for their part, "feed" these engines not only with personal data but also with requests, providing a kind of training to artificial intelligence.

Competition policy traditionally lies at the intersection between legal and economic analysis. On the one hand, it is necessary to fill the regulatory vacuum, which is an especially sensitive subject in the context of markets' digital transformation, as well as to give competition authorities appropriate legal instruments (for example, such developments are made in the recent book [Lundqvist, Gal, 2019]).

On the other hand, these legal instruments should be based on economic analysis, since, as it is shown in this paper, the direct application of the traditionally used instruments may lead to a loss of the artificial intelligence usage benefits. Therefore, concerning all the situations considered in this paper, we use the institutional economics' method based on a comparison of discrete institutional alternatives [Shastitko, 2010].

This paper consists of four sections: the introduction section (section 1) is followed by the study of the major groups of competition policy's problems (sections 2 and 3). First, we address the question of how to qualify companies' positions, namely, we consider the issues related to market concentration in the context of artificial intelligence expansion (section 2). Then we turn to the qualification of companies' behaviour, that is, to the possibility of anti-competitive use of artificial intelligence systems and the economic grounds for such companies' behaviour (section 3). The main findings are presented in the conclusion section (section 4).

2. Artificial Intelligence challenges: qualification of companies' market position

2.1. Background

A tendency for high concentration is one of the most difficult issues that arises in the context of competition protection and development in the digital sector of the economy, in particular when it comes to digital platforms. This tendency is usually attributed to significant network effects, namely, positive relation between benefits from the use of goods or services and the size of their users' network (in other words, number of its participants) [Katz, Shapiro, 1985]. Talking about two-sided markets [Rochet, Tirole, 2003] there are usually two types of network effects to be distinguished: direct and indirect ones. Direct network effects imply that there is a relation between users' benefits on the one side of the market and the number of users on the same side of the market (for example, the greater the number of telephone network subscribers, the more benefits can the subscription bring for each of the users). Indirect network effects imply a relation between two different sides of the market, i.e., between users' benefits on the one side and the number of users on another side. For example, indirect network effects can be illustrated by a taxi-aggregator system where the more drivers use such a system, the more beneficial it becomes for the passengers, and vice versa.

Large-scale network effects suggest that the market is much more effective from a social welfare point of view when there is a small number of large firms (in the extreme case, a single firm) than when many small companies are providing the same services.

In this sense, the result of the network effect is quite similar to the result of the economies of scale effect: the size of the company will naturally tend towards the "minimum effective scale" (MES). Sometimes this size matches the size of the entire market, and consequently, such parameters justify the existence of natural monopolies in traditional industries (with some reservations). Sometimes experts literally extend the same logic to the activity of digital platforms, which, in our opinion, is not quite correct for a number of reasons. One of the obvious reasons is the successful coexistence of several competing platforms (for example, the iOS and Android systems for mobile devices). Nevertheless, parallel comparison with natural monopolies is useful because it helps to understand the logic of regulating authorities: if the market tends towards monopolization, then additional measures of antitrust intervention (including preventive ones) are required.

Not only the existence of the factors that lead to concentration increase but these factors' nature as well determine how the market situation will develop.

Economies of scale are usually caused by the existence of extensive fixed costs (for example, costs of a railway system or pipelines construction), and it is preferable to distribute these

costs over the largest possible number of operations to reduce the value of the average cost per operation. Therefore, it is necessary to concentrate as many operations as possible under control of one company that has incurred these costs.

The network effect itself is linked not to the volume of transactions, but the number of network participants. Also, the network effect is not necessarily associated with high fixed costs. For example, even if the fixed costs of a social network foundation are low, the benefits of using it are much greater for each member in case it is a large social network, rather than there exist many small local social networks. Usually, the crucial parameter is not the number of interactions within the network, but the number of its participants that allows maximizing the range of possible contacts. For example, a social network with a hundred moderately active participants who publish one post per month brings more benefits for its members than a social network with one extremely active participant who publishes a hundred posts per month alone. In such a case the diversity effect has significant importance. No diversity effect is usually observed in traditional natural monopolies sectors (such as gas and electricity supplies, since gas and electricity flows are much more homogeneous than information flows).

The inclusion of artificial intelligence in this discourse once again modifies the logic of market concentration growth. The large scale of systems using artificial intelligence is an important factor from the perspective of opportunities that it provides for machine learning enhancement rather than the range of contacts maximization. As [Goldfarb, Trefler, 2019] rightly point out in their paper, training which involves "big data" makes it possible to substantially enhance the capabilities (including the predictive ones) of an intellectual system learning and therefore improve such system's quality.

The more data enters the system, the better it works, and the more beneficial joining exactly this system becomes for a random user. A good example is an Internet search algorithm: the more requests are addressed to this system, the more trained it becomes. In fact, users provide training services with each search query they make and each reaction to the search results give. The effectiveness of this training increases under the following conditions:

- sufficient variety of user requests;
- possibility of collecting additional information about the parameters of these requests (users' personal data, time and place of the request, etc.).

The interim results show that in the era of machine learning-based artificial intelligence development, the advantage is given not only to those who can reduce average costs via increasing the volume of supplies, and not only to those who can provide the most extensive interaction

opportunities but also to those who have the most trained algorithms. The latter condition, as well as the former two, depends on the scope of companies work, primarily because of the access to "big data" [Ezrachi, Stucke, 2016]. At the same time, a trained algorithm can both reduce average costs and improve the quality of interactions, when its role is not limited to being just a mechanistic platform that brings participants together, but when it also performs the role of an aggregator that provides more complex services for mutual selection and coordination of participants' interests [Shastitko, Markova, 2017].

2.2. Consequences

Growth of the service providers' optimal scale of work which happens in particular due to the extension of artificial intelligence training opportunities leads to several consequences for competition policy in those situations when defining market players' position is crucial.

First, new questions concerning control of concentrations between undertakings – mergers and acquisitions – arise. They traditionally represent one of the spheres that are subject to competition control, and one of the criteria that is important to take into consideration when analysing such a sphere consists in companies' market shares: increased market concentration forces competition authorities to adopt a more careful approach towards approving mergers and acquisitions. Accordingly, in cases when the merger takes place between two AI-intensive companies, it might be preferable to strengthen the approval criteria.

However, there is also a counterargument: if concentration increase in the industry under consideration is a natural process and it leads to better product quality owing to machine learning development, then, on the contrary, a friendly tradition in antitrust should be developed as an approach towards mergers and acquisitions evaluation.

Secondly, if only large undertakings with large-scale machine learning opportunities are able to operate successfully in the market, this is the evidence of high barriers to entry.

For instance, it is difficult for a new search machine to enter the market and evolve unless it processes a certain number of search queries and trains through this. Nevertheless, without achieving a certain development level the machine will not be able to attract a sufficient number of users. Such a vicious circle can be broken only with the help of special solutions aimed at attracting users – for example, the anonymity of the searching process, absence of advertising or special innovative search technologies.

In such a situation a competition authority that commonly seeks to lower entry barriers and sees it as the most liberal and the least distorting way of competition maintenance may face the inability to use the traditional mechanisms of barriers reduction. Neither licensing can be

abolished, nor infrastructure access can be ensured. Divestiture of the existing companies can be considered as a drastic measure to provide competitiveness of the market new entrants, but taking into account the loss of the benefits derived from high market concentration the above-mentioned measure could have a devastating effect on social welfare.

Possible steps to reduce such barriers could be measures aimed at ensuring that "newcomers" have access to the already existing companies' "big data" for training, or to the results of such training which represent knowledge about the structure of queries and users' reactions, or even to elements of search algorithms based on this knowledge. The first measure (using the "big data" of the already existing companies for training) may lead to the problem of unauthorized access to users' personal data if "big data" is used carelessly. The second measure can be interpreted as a violation of the existing companies' intellectual rights.

Some sort of compromise has been found within the framework of recently elaborated European law, namely The Digital Markets Act.[2] This law obliges large digital platforms owners to provide access to personal data that they generate themselves. At the same time, these owners should not prevent users from conducting business on other platforms. In this case, a new digital platform can obtain access to "big data" if it is able to ensure large business-users migration to it along with these users' data.

3. Artificial Intelligence challenges: qualification of companies' behaviour

3.1. Background

The use of artificial intelligence can pose a difficult task for a regulator when trying to qualify companies' behaviour. Within this task, the competition authority will have to make a distinction between unplanned actions of algorithms that lead to anti-competitive consequences due to errors or accidents, and conscious anti-competitive steps laid down by the authors or users in the structure of algorithms.

What attracts the attention first are price algorithms which automatically realize pricing processes not only on stock exchanges but also on consumer markets [Varian, 2019; Ezrachi, Stucke, 2016].

Systems using artificial intelligence, no matter how complex and developed they may be, should have an explicit target function and a set of restrictions while solving each task. In the case of pricing, the target function should apparently be the profit function, but strict adherence to the goal of increasing profit implies committing actions that violate competition law, including price

[2] https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/digital-markets-act-ensuring-fair-and-open-digital-markets_en

collusion and/or price discrimination since they lead to higher profits. Accordingly, the system should include antimonopoly limitations on the freedom of action in order to prevent the above-mentioned violations and avoid sanctions related to them. However, a lot of lengthy antitrust proceedings, including judicial ones, show that the formalization of such limitations is an extremely difficult task.

The situation is aggravated by the fact that the use of artificial intelligence potentially reduces the transaction costs of antitrust violations.

Thus, pricing collusion is hampered not only due to legal limitations but due to the difficulties related to price negotiating and subsequent mutual price control by cartel participants. Nonetheless, these difficulties are drastically reduced by artificial intelligence that is capable of working with arrays of price information in real-time and compile predictive price analytics. At the same time, no evidence of price collusion is left outside the virtual environment, and it will be necessary to analyse information systems performance in order to prove the collusion existence.

Mass consumers price discrimination is complicated by the necessity of consumers segmentation which allows setting different prices for different groups of consumers. However, this challenge is addressed by artificial intelligence that is capable of analysing behaviour of numerous consumers, especially when it has access to personal data.

Thus, the introduction of artificial intelligence systems creates an environment in which the use of anti-competitive pricing mechanisms becomes much easier, while the identification and punishment of such antitrust violators, on the contrary, becomes more complicated.

3.2. Consequences

Price collusion which is carried out with the help of algorithms of companies concerned has long been considered as one of the future challenges for competition authorities, although so far this challenge is regarded mostly from a theoretical point of view. There have been quite a lot of situations (precedents) when participants of cartel agreements used one or another type of software for price monitoring (including the use of auction robots), but competition authorities in their decisions on such cases usually point out only a preliminary conclusion of companies' officials [EEC, 2021; Tarkhova et al., 2020]. Such an approach requires modernization of the existing market monitoring instruments rather than application of any new approach to collusion prevention or suppression. Such work is already being carried out by several competition authorities, including the Russian one [FAS, 2018].

The conceptual issue is related to the prosecution of violations that are not directly related to the will of the conspiracy participants, violations that are committed by algorithms entering into

agreement regardless of their owners' will. This problem goes beyond competition policy, because the development of AI raises the question of AI's liability in general (for example, on the roads) – this issue in the legal context is elaborated, for example, in [Kingston, 2016].

It is necessary to set an antitrust standard in order to answer the following question: should the existence of algorithmic collusion be considered as a sufficient condition for penalizing those market participants that use them? On the one hand, such collusion might be the result of market participants' indirect intention when they have not prevented the possible anticompetitive effects even though they should have foreseen these effects. Antitrust regulators face the issue of "computer engineers' liability for the programming of machines self-educated to coordinate pricing" [Tsarikovsky et al., 2018, p. 167]. On the other hand, market participants' liability is called into question because of the absence of apparent orders from authorized officials to form a cartel. The second approach to this question is more in line with the presumption of innocence – that is why collusion becomes more preferable from a legal point of view unless it is subject to criminal prosecution in the country of violation commitment (as it is in Russia, see article 178 of the Russian Criminal code). In such cases the burden of proof related to algorithmic collusion actually rests solely on competition authorities.

However, the application of the second approach without any reservations does not create the right incentives for algorithms configuring and seems to be controversial from an economic point of view. One of the possible solutions could be making pricing algorithms sufficiently transparent at least for competition authorities – this would ensure control of pricing algorithms collusions in the situation when market participants have no incentives to prevent these collusions.

It implies that in case a competition authority reaches a reasonable conclusion about implicit or explicit collusion between algorithms, their owners are not immediately held prosecuted but a competition authority releases them notice of the violation discontinuance.

The concentration of users' "big data" under control of the largest digital platforms and further transformation of this data into the knowledge about users via artificial intelligence translates into an increased risk of price discrimination, meaning that different groups of consumers will be charged different prices.

The effect of price discrimination on social welfare is ambiguous. The negative perception of price discrimination is widespread as it lowers consumer surplus and redistributes it in favour of the producer. Nonetheless, two criteria are to be met in order to achieve such a redistribution. First, the producer should be able to segment consumers properly, in particular by their income level. Secondly, the producer is supposed to be a monopolist or have a dominant market position

so that consumers have no opportunity to switch their consumption to other goods/services. It is exactly the above-mentioned second criterion that is the prerequisite for competition authorities to prosecute price discrimination.

Artificial intelligence implementation makes it possible to meet both mentioned criteria. Users' data processing mechanism that is quite flawless is able to intensively evolve with the help of machine learning and allows not only to distinguish consumers groups by income (that corresponds to third-degree price discrimination) but, also, approach individual pricing based on consumers' preferences.

This creates potential grounds for the first-degree or perfect price discrimination that used to be considered unfeasible. In this case, the producer is able to extract all the consumer surplus, i.e., charge the maximum price that every consumer is willing to pay. Also, as it has already been mentioned, the highly evolved artificial intelligence is not only becoming a competitive advantage for individual companies, but it is promoting concentration increase due to the fact that large companies own more efficient machine learning technologies.

At the same time, consumers segmentation with the help of artificial intelligence has certain positive consequences even for the consumers themselves. These positive consequences are embodied in offers customization which involves individualization of not only price but also other parameters of a product or service.

In fact, artificial intelligence reduces transaction costs for both producers and consumers, who are limited in their capacity of rational thinking and have difficulties in optimizing even their own consumer choice, in particular when they choose between different complex services [Shastitko, Pavlova, 2019]. Various tariff calculators can be taken as an example – these calculators are used within the telecommunications framework and allow customers to select an optimal portfolio of services, even when their choice restrictions are set by the owner of artificial intelligence – by an operator in this case.

Also, price discrimination itself allows for cross-subsidization of poor consumer groups at the expense of the rich ones. In theory, statistic analysis shows that such subsidizing leads to deviation from the social optimum. However, the presence of network effects can change the situation as the value of the service depends on the number of its users. For example, the mass expansion of cellular communications due to cross-subsidizing of low-income groups is quite capable of covering the additional costs that rich users bear, because otherwise, cellular communications can remain only an exclusive service with a narrow circle of subscribers.

There is a risk that facing price differentiation and offers customization, competition authorities will choose an "hostile" approach to such pricing qualifying it as price discrimination or even as monopoly pricing, but this may lead to a situation when users lose potential dividends from artificial intelligence systems.

At the same time a full exemption of AI-intense companies' pricing policy from competition authorities' control under the pretext that artificial intelligence is too sophisticated, and regulators cannot catch up with its development seems to be a questionable idea. Opportunities for abuse of dominance increase significantly and the deterrent nature of antitrust control remains relevant.

A more promising, though more costly, scenario for competition authorities is regulation sophistication, so that the use of their own antimonopoly information systems and their own artificial intelligence will allow conducting a multi-criteria analysis of goods' (services') quality and price parameters.

The mission here consists in preserving wide opportunities of price differentiation when goods that differ are sold and excluding discrimination when the same goods are sold to different consumer segments. Of course, such restrictions apply only if the company under consideration has a dominant market position. If competition is preserved on the market despite the above-mentioned barriers to entry and concentration tendencies, then such restrictions are excessive because consumers always have an opportunity to switch their demand from one good to another.

3.3. Acquisition of potential competitors

The importance of maintaining the competitive character of the market as an environment of competition between of several firms becomes particularly important when AI-intense companies interact with each other. The potential of such an environment development is reduced by the fact that markets under consideration objectively tend towards increasing concentration and significant entry barriers.

At the same time, market leaders within digital platforms (or at least their leading services) succeed one another from time to time that is evidence of the competitive character of the market environment and that means that some players can be defeated in the fight where the main prize is users. Network effects and economies of scale with respect to machine learning impede leaders' replacement, however, the fight can be intensified by the introduction of completely new or considerably modified services (such as Instagram or TikTok social networks following Facebook in their prominent market paths, or WhatsApp and Telegram messengers).

Advanced artificial intelligence systems controlled by market leaders may also have a deterrent effect: big data-based predictive analytics makes it easier to forecast further development of one or another service, identify the most dangerous potential competitors in advance and then acquire them. This way Facebook acquired Instagram and WhatsApp, and their market shares' growth relative to Facebook's market share does not actually mean competition intensification for the company as a whole. At the same time, potential competitors acquisition and their integration into large companies' ecosystems at a relatively early stage can considerable simplify the process of merger approval by competition authorities.

Setting more stringent requirements to economic concentration between AI-intense companies is a straightforward solution that does not seem to be an obvious idea. One of the important incentives for innovation-based start-ups to develop is exactly the prospect of being bought by digital giants, so imposing restrictions on such acquisitions may slow down innovations.

A better elaborated (yet more complicated from a technical point of view) solution consists in developing rules of market competition analysis. The developed rules would include the evaluation of the prospects that target companies could have as potential competitors of the acquirers, and such an evaluation should be based at least on the analysis of target companies growth perspectives and the perspectives of them substituting or complementing the existing services. Nonetheless, this kind of predictive analytics also requires competition authorities to use artificial intelligence.

4. Conclusion

Artificial intelligence systems make a significant contribution to the digital transformation of industries and markets, as well as to competition policy problems associated with such transformation.

Machine learning algorithms contribute to the growth of concentration in industries where artificial intelligence is used, since the increasing scale of learning provides better training of artificial intelligence, and therefore a higher quality of services provided, which in turn attracts additional users and contributes to a new level of quality increase. This mechanism can overlap with the network effect and ultimately lead to even greater dominance of the well-known “digital giants”. To an even larger extent, the dominance can be strengthened by artificial intelligence through the analysis of promising competitors and their early acquisitions. Dominance is not an antitrust violation itself, but it can lead to such violations, in particular to price discrimination.

Artificial intelligence can further contribute to price discrimination because users' big data processing enables to segment them effectively and eventually move towards perfect price

discrimination. Another antitrust risk of using artificial intelligence is represented by algorithmic collusions, including those that happen against the will of these algorithms' owners. A company's profit maximization task calls for cartel creation and such a decision can be taken by either human intelligence with the help of artificial intelligence that is used to create and control collusion, or (at least theoretically) by artificial intelligence alone. This inevitably raises questions about the culpability of the people involved in the cartel and the mechanisms of their punishment.

In such a situation competition authorities face a dilemma: which approach – "hostile" or "friendly" one – should be adopted when dealing with the new phenomena.

The first of the two alternative approaches implies using stricter requirements for merger approvals between AI-intense companies, applying punitive mechanisms to the owners of algorithms that are involved in price collusions, qualifying price differentiation from a price discrimination point of view.

In contrast, the second approach implies mitigating antitrust control of the above-mentioned companies as these companies make an undeniable contribution to the economy's development and applying restrictive measures to such undertakings threatens to eliminate the benefits of artificial intelligence use.

The most promising option that can be chosen to solve this dilemma is reaching a compromise between the already mentioned polarized alternatives which entails an intensified adoption of artificial intelligence on the part of competition authorities themselves as well as achieving greater transparency of companies' algorithms. That kind of policies may require a more intensive participation of market leaders in the process of regulation development due to their digital competences and capacities [Cath, 2018]. Such a solution would make it possible to draw a line between fair offers customization and price discrimination, track and prevent potentially anticompetitive algorithmic decisions beforehand, set only local limitations on mergers and acquisitions in case such transactions do seriously threaten potential competition.

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