

# The Algorithmic Collusion Dilemma in the Framework of Anti-Monopoly Law and Regulatory Strategies

Chen YANG<sup>1</sup>

## Abstract

Tacit collusion refers to the “invisible illegal” behavior of business operators who reach a coordinated agreement without explicitly communicating with their competitors. In the context of the digital economy, algorithmic collusion exhibits four primary characteristics: diversification of collusion forms, universalization of collusion behavior, concealment of collusion intentions, and “dehumanization” of collusion operations. According to its different operating mechanism, algorithmic collusion can be divided into four categories: messenger scenario, convergence collusion, predictable agent category collusion and artificial intelligence and the digital eye collusion. Algorithmic collusion may lead to unreasonable increases in market prices, while suppressing market competition, reducing innovation, and consumer choices. Anti-monopoly law aims to maintain market competition order and consumer interests, and algorithmic collusion is precisely one of the actions that undermines this order. Therefore, regulating algorithmic collusion through anti-monopoly law is a necessary means to protect consumer welfare and market dynamics. From the perspective of anti-monopoly law, the regulation dilemmas of algorithmic collusion include: difficulty in judging the subjective intention of algorithmic collusion, ambiguity in regulating of algorithmic collusion agreement, and need to improve the regulatory system of algorithmic collusion. The regulation path of algorithmic collusion from the anti-monopoly perspective includes: clarifying the subjective intention of algorithmic collusion, clarifying the concept of algorithmic collusion agreement, and strengthening the regulation system of algorithmic collusion. Regulating algorithmic collusion from an anti-monopoly perspective can effectively curb the occurrence of algorithmic collusion, thereby safeguarding fair competition in the market and protecting the legitimate rights and interests of consumers.

## Key words

digital economy; anti-monopoly law; algorithmic collusion; tacit collusion

---

<sup>1</sup> Guangdong University of Finance and Economics. Correspondence Email: 15011934636@163.com.

## Introduction

In 2015, the world's first algorithm collusion case --Topkins case -- occurred on Amazon's e-commerce platform. In this case, the conspirators designed and used the algorithm to automatically track the lowest quotation of competitors in the market, so as to ensure that their products would be displayed in the first place when customers searched for them at the lowest price. The US Department of Justice found that the collusion was in direct violation of Section 1 of the Sherman Act, and the case ended with a plea agreement between the defendants and the US government, in which the co-conspirators were fined more than \$20,000 and sentenced to three months' probation.<sup>2</sup> As the world's first case penalised for using algorithms to manipulate pricing, the Topkins case holds epoch-making significance in the history of anti-monopoly law. In addition, there are numerous cases involving algorithmic collusion. For instance, recently, the Federal Trade Commission (FTC) and the Department of Justice (DOJ) of the United States issued a statement regarding an algorithmic collusion case in the hotel industry. On March 28, 2024, the FTC and DOJ submitted a Statement of Interest to the United States District Court for the District of New Jersey in the case of *Cornish-Adebiyi v. Caesars Entertainment*. The core argument of this statement is that hotels cannot engage in price collusion in setting room rates, nor can they use algorithms to illegally engage in anticompetitive conduct. Nowadays, more and more companies rely on algorithm technology to track and analyze competitors' online price data in order to quickly respond and adjust their market strategies. However, the widespread use of the technology has also potentially increased the risk of collusion, making it easier to carry out and harder to detect. The difficulty in regulating algorithmic collusion compared to traditional collusion is primarily attributed to its concealed nature, difficulty in obtaining evidence, challenges in attributing responsibility to the offending entities, complexity, information asymmetry faced by regulatory authorities, inadequate institutional incentives, and challenges in legal application. These factors collectively contribute to making algorithmic collusion a significant challenge for antitrust law enforcement. The OECD report *Algorithms and Collusion: Competition Policy in the Digital Age*, published in 2017, explored how different types of algorithms, such as signaling algorithms, parallel algorithms, supervised algorithms and self-learning algorithms, facilitate collusion and how these algorithms are implemented, contributing to a wide discussion of algorithmic collusion around the world.<sup>3</sup>

While the international community is addressing algorithmic collusion, China has also prioritised this issue and is actively developing regulatory measures in the field of anti-monopoly law. In February 2021, the Anti-monopoly Commission of The State Council promulgated the "Anti-Monopoly Guidelines in the Field of Platform Economy", which stipulates article 6 "Horizontal monopoly agreement", article 7 "Vertical monopoly agreement" and article 8 "Hub-and-Spoke Collusion", aiming to deal with the challenge of algorithm collusion in the platform economic environment through the monopoly agreement system. Specifically, Article 6 expands the way horizontal monopoly agreements are constituted to include four types of situations: col-

---

<sup>2</sup> *United States of America v. Topkins*, No. 15-00201 WHO (N.D. Cal. Apr. 30, 2015)

<sup>3</sup> Organisation for Economic Co-operation and Development, 'Algorithm sand collusion: competition policy in the digital age' (Organisation for Economic Co-operation and Development, 13 September 2017), <http://www.oecd.org/fr/daf/concurrence/ententes/algorithmscollusion-competition-policy-in-the-digital-age.htm>, accessed 8 August 2024.

lecting sensitive data with the help of a platform, communicating intentions with the help of technology, reaching a monopoly agreement with the help of an algorithmic platform, and other modes of collaborative behavior. In addition, in June 2022, the Anti-Monopoly Law of the People's Republic of China added Article 19, which clearly stipulates that "a business operator shall not organize another business operator to form a monopoly agreement, or provide material assistance for another business operator to reach a monopoly agreement."<sup>4</sup> These regulatory additions can be seen as a positive response to the issue of "algorithmic collusion", which has garnered academic attention. However, when there is no clear written agreement between enterprises, it becomes extremely difficult to determine the intentional contact and collusion intention through data, algorithms and other means, which undoubtedly brings great challenges to law enforcement practice and law application. Next, this paper will start from the perspective of anti-monopoly law, conduct an in-depth analysis of the legal nature of algorithmic collusion, explore various types of algorithmic collusion and their operating mechanism, and propose corresponding solutions to the regulatory problems of algorithmic collusion under the perspective of anti-monopoly law, in order to provide some help for the future regulatory work of algorithmic collusion.

### 1. Defining Algorithmic Collusion

"Collusion" is a way for companies to gain higher profits and reduce market competitiveness at the expense of consumers. There are two types of collusion: explicit collusion and tacit collusion. The current international mainstream view holds that tacit collusion is different from unconscious concurrent behavior. The prohibition of monopoly agreement and collusion is one of the core contents of the anti-monopoly laws in the world. Combining the opinions of domestic scholars, the author summarizes the characteristics of algorithmic collusion from the perspective of digital economy into four points: diversification of collusion forms, generalization of collusion behaviors, concealment of collusion intentions, and "decentering of humanity" of collusion operations.

"Collusion" is a way for companies to gain higher profits and reduce market competitiveness at the expense of consumers.<sup>5</sup> Collusion can take different forms, including explicit collusion, tacit collusion, and the varying degrees of combination of the two.<sup>6</sup> Explicit collusion refers to anti-competitive conduct reached on the basis of mutual agreement and communication of intent among two or more parties. Tacit collusion, on the other hand, is inferred from the actual behavior of the firm in the absence of an explicit agreement.<sup>7</sup> Tacit collusion is often paid more attention than explicit collusion, which is "explicitly illegal". Tacit collusion refers to the "hidden illegal" behavior that the operators reach a concerted agreement without explicit communication with the competitors. Some scholars have pointed out that there is a clear difference between tacit collusion and unconscious parallel behavior. In tacit collusion, the con-

---

<sup>4</sup> Jiancheng Gao, 'Challenges and Countermeasures for the Regulation of Algorithmic Collusion under Antitrust Law (算法共谋的反垄断法规制挑战与对策)' (2024) 45 Journal of Dalian University of Technology (Social Sciences) (大连理工大学学报 (社会科学版)) 90.

<sup>5</sup> Yu Donghua, *Antitrust Economics*. (Beijing: Economic Science Press, 2017).

<sup>6</sup> Yongwei Chen, 'The Challenge of Algorithmic Collusion in Artificial Intelligence (人工智能的算法共谋挑战)' (2019) 4 Journal of Internet Economy (互联网经济) 43.

<sup>7</sup> Yifan Guo, 'A Study on the Legal Issues of Algorithmic Collusion from the Perspective of Antitrust (反垄断视域下算法共谋的法律问题研究)' (2021) 3 Journal of Price Theory and Practice (价格理论与实践) 26.

duct of the business reveals the intent and expression of intent to conspire despite the absence of an explicit written or oral agreement; In contrast, the unconscious parallel behavior lacks any intention or expression of collusion at all, so it cannot be classified as tacit collusion.

At present, the international consensus on the illegality of algorithmic collusion has been gradually reached, and it is generally believed that the unconscious behavior and the unconscious parallel behavior should be clearly distinguished. Take the Las Vegas hotel collusion case in 2023 as an example, the court clearly pointed out in the trial that the existence of unconscious parallel behavior alone, without the support of other additional factors, is not enough to infer the existence of collusion agreement. In the end, the court dismissed the indictment due to the lack of an explicit collusion agreement between the defendants. This case reinforces the legal boundary between unconscious concurrent conduct and conscious collusion.<sup>8</sup> When discussing the definition of collaborative behavior in the antitrust domain, the EU and the US show similar judicial positions. Both sides admit that although the unconscious parallel market behavior may induce market synergy, it should not be directly classified as the category of collaborative behavior if the enterprise can fully and reasonably explain the independence and non-coordination of such behavior. The judgment of whether unconscious parallel behavior constitutes collaborative behavior needs to be more careful, and other auxiliary evidence, such as communication records, market reactions and behavioral consequences, must be comprehensively considered, so as to ensure the precision and fairness of anti-monopoly enforcement.<sup>9</sup>

## 2. Characteristics of Algorithmic Collusion from the Perspective of Digital Economy

As a new form of collusion, algorithmic collusion in digital economy presents new characteristics compared with collusion in traditional economy. The academic circles have different opinions on the identification of the characteristics of algorithmic collusion. Some scholars argue that the essential characteristics of algorithmic collusion include three points: the high degree of concealment in reaching the collusion, the large number of algorithmic participants involved, and the high level of algorithmic intelligence.<sup>10</sup> Some scholars have analyzed the mechanism by which algorithms facilitate collusion, arguing that algorithms enhance the concealment, stability, and generalization of collusion.<sup>11</sup> Some scholars have compared algorithmic collusion in the digital economy to traditional economic collusion, identifying four distinguishing

---

<sup>8</sup> Joe Achneider and Michael Leonard, 'Vegas Visitors Sue Big Names on the Strip Over Hotel Room Prices' (BLOOMBERGL, 2023), <https://news.bloomberglaw.com/antitrust/vegas-visitors-sue-big-names-on-the-strip-over-hotel-room-prices>, accessed 8 November 2024.

<sup>9</sup> Yifan Guo, 'A Study on the Legal Issues of Algorithmic Collusion from the Perspective of Antitrust (反垄断视域下算法共谋的法律问题研究)' (2021) 3 Journal of Price Theory and Practice (价格理论与实践) 26.

<sup>10</sup> Xu Liu, 'The Legal Dilemma and Logical Basis of Antitrust Regulation on Algorithmic Collusion in the Age of Artificial Intelligence (人工智能时代算法共谋反垄断的适法困境与逻辑依归)' (2022) 1 Journal of Northwest University for Nationalities (Philosophy and Social Sciences) (西北民族大学学报 (哲学社会科学版)) 89.

<sup>11</sup> Yongzhen Huang, 'Antitrust Regulation of Algorithmic Collusion in the Digital Economy Era (数字经济时代算法共谋的反垄断法规制)' (2023) 21 Journal of Northeast Agricultural University (Social Sciences) (东北农业大学学报 (社会科学版)) 60.

characteristics: diversified forms, stabilised structures, concealed actions, and intelligent operations.<sup>12</sup> Drawing on the insights of various domestic scholars, the author have summarized the characteristics of algorithmic collusion in the context of the digital economy into four specific points:

Firstly, the forms of collusion are diversified. Besides traditional explicit agreements, algorithms have emerged as a new medium for transmitting collusive signals. Through subtle interactions between algorithms, enterprises achieve indirect communication. This indirect form of collusion blurs the line between legitimate competition and illegal collusion, posing new challenges to theoretical research and judicial practice in the field of antitrust law.<sup>13</sup> Secondly, the behavior of collusion has become universalized. By reducing the influence of market concentration, the algorithm essentially broadens the scope of collusion formation and further promotes the generalization of collusion.<sup>14</sup> Thirdly, the intention of collusion has become concealed. Collusion now takes the form of tacit, non-explicit cooperation, and compared to overt collusive behavior, its intention is more concealed, making the underlying conscious contact more difficult to detect and prove.<sup>15</sup> Fourthly, “decentering of humanity” of collusion operations. When algorithms are combined with artificial intelligence technology, they can design intelligent agents capable of handling complex market competition issues. This combination completely reverses the dominant position of operators in market competition.<sup>16</sup>

To sum up, the algorithm collusion under the digital economy vision has four characteristics: the forms of collusion are diversified, the behavior of collusion has become universalized, the intention of collusion has become concealed and “decentering of humanity” of collusion operations. Compared to collusive behaviors in the traditional economy, algorithmic collusion in the digital economy poses broader harm, is more difficult to detect, and more challenging to regulate. Therefore, it is necessary to conduct a further analysis of the various types of algorithmic collusion and their operational mechanisms, in order to improve the anti-monopoly regulation framework for algorithmic collusion.

### 3. Types and Operating Mechanisms of Algorithm Collusion

Algorithm collusion can be divided into four categories: messenger scenario, convergence collusion, predictable agent collusion, and artificial intelligence and digital eye

---

<sup>12</sup> Xuerong Zhou, ‘Regulatory Dilemmas and Path Choices for Antitrust in the Context of Algorithmic Collusion (算法共谋下反垄断的规制困境与路径选择)’ (2024) 31 Journal of Administrative Tribune (行政论坛) 116.

<sup>13</sup> Xuerong Zhou, ‘Regulatory Dilemmas and Path Choices for Antitrust in the Context of Algorithmic Collusion (算法共谋下反垄断的规制困境与路径选择)’ (2024) 31 Journal of Administrative Tribune (行政论坛) 116, 118.

<sup>14</sup> Yongzhen Huang, ‘Antitrust Regulation of Algorithmic Collusion in the Digital Economy Era (数字经济时代算法共谋的反垄断法规制)’ (2023) 21 Journal of Northeast Agricultural University (Social Sciences) (东北农业大学学报 (社会科学版)) 61.

<sup>15</sup> Xuerong Zhou, ‘Regulatory Dilemmas and Path Choices for Antitrust in the Context of Algorithmic Collusion (算法共谋下反垄断的规制困境与路径选择)’ (2024) 31 Journal of Administrative Tribune (行政论坛) 116, 118.

<sup>16</sup> Wei Zhou, ‘Antitrust Regulation of Algorithmic Collusion (算法共谋的反垄断法规制)’ (2020) 1 Journal of Law (法学) 46.

collusion. If the types of algorithm collusion are divided according to express collusion and tacit collusion, then messenger scenario and convergence collusion conform to the characteristics of express collusion, and predictable agent category collusion and artificial intelligence and the digital eye collusion conform to the characteristics of tacit collusion. The first collusion scenario is called “Messenger Scenario” or “Messenger Collusion” for short.<sup>17</sup> From the essence level, the clear collusion agreement and the algorithm-assisted pricing mechanism that messenger scenario relies on together constitute a typical cartel agreement form. Its complexity and secrecy put forward higher requirements for the supervision in the field of economic law. Therefore, the relevant participants should be regarded as the participants of the price manipulation collusion, and bear the corresponding responsibility.<sup>18</sup> The second collusion scenario: hub and spoke cartels, also known as convergence collusion, are characterized by their multiple levels of participation, which span different levels of the industrial chain and form cross-level cooperative relationships. In predictable agent category collusion, market entities do not need to sign monopoly agreements with other competitors. Instead, they rely on algorithms to conduct real-time monitoring and collect market price information independently. Based on price fluctuations, they autonomously follow or adjust their pricing, consciously maintaining parallelism with other market entities.<sup>19</sup> In an oligopolistic market, when such conscious parallel pricing behavior occurs, the pricing set by industry-leading enterprises often becomes the benchmark for other enterprises to follow, which further elevates the risk of excessive pricing in the market.<sup>20</sup> Artificial intelligence and the digital eye collusion refers to the phenomenon of price convergence within the relevant market after the algorithm automatically adjusts the price according to the principle of maximizing the interests of the enterprise after deep learning. It is worth noting that in this collusion, there is no explicit collaboration or agreement between companies. Some firms are not even aware that they have developed highly consistent pricing strategies with other competitors, because the actual enforcer of this collusion is the algorithm itself.<sup>21</sup> Compared with the traditional algorithm model, the core difference of the artificial intelligence and the digital eye collusion algorithm is its unobservability, that is, the internal logic and decision-making process therein are hardly directly discernible through external coding. This inherent opacity not only reshapes the definition of algorithmic responsibility, but also brings unprecedented complexity and challenges to the field of antitrust regulation.

---

<sup>17</sup> Ariel Ezrachi and Maurice EStucke, ‘Artificial Intelligence and Collusion: When Computers Inhibit Competition’(2017) *University of Illinois Law Review* 1775.

<sup>18</sup> Xu Liu, ‘The Legal Dilemma and Logical Basis of Antitrust Regulation on Algorithmic Collusion in the Age of Artificial Intelligence (人工智能时代算法合谋反垄断的适法困境与逻辑依归)’ (2022) 1 *Journal of Northwest University for Nationalities (Philosophy and Social Sciences)* (西北民族大学学报 (哲学社会科学版)) 89.

<sup>19</sup> Jiancheng Gao, ‘Challenges and Countermeasures for the Regulation of Algorithmic Collusion under Antitrust Law (算法共谋的反垄断法规制挑战与对策)’ (2024) 45 *Journal of Dalian University of Technology (Social Sciences)* (大连理工大学学报 (社会科学版)) 91.

<sup>20</sup> Jiancheng Gao, ‘Challenges and Countermeasures for the Regulation of Algorithmic Collusion under Antitrust Law (算法共谋的反垄断法规制挑战与对策)’ (2024) 45 *Journal of Dalian University of Technology (Social Sciences)* (大连理工大学学报 (社会科学版)) 91.

<sup>21</sup> Li Dan, ‘Algorithmic Collusion: Determination of Boundaries and Its Antitrust Regulation (算法共谋: 边界的确定及其反垄断法规制)’ (2020) 35 *Journal of Guangdong University of Finance and Economics (广东财经大学学报)* 107.

To sum up, algorithmic collusion can be divided into four categories: messenger scenario, convergence collusion, predictive agent collusion, and artificial intelligence and the digital eye collusion. The aforementioned explicit collusion refers to the case where enterprises have collusive behavior under a clear agreement. Implicit collusion, on the contrary, is presumed based on the behavior patterns of enterprises in the absence of a clear agreement.

If the algorithm is divided according to express collusion and tacit collusion, the messenger scenario and convergence collusion conform to the characteristics of express collusion, and the predictive agent collusion and artificial intelligence and the digital eye collusion conform to the characteristics of tacit collusion. The tacit collusion has attracted much attention in the academic field because of its complexity and difficulty in regulation. From the perspective of antitrust law, the following will discuss the regulatory dilemma of algorithmic collusion from the perspective of anti-monopoly law, especially the problems in the current legislation and regulation of tacit collusion, and explore the corresponding regulatory path, hoping to be helpful in regulating algorithmic collusion.

#### **4. The Dilemma of Algorithmic Collusion Regulation from the Perspective of Anti-monopoly Law**

The regulatory dilemmas of algorithmic collusion from the perspective of anti-monopoly law encompass the difficulty in determining the subjective intent of algorithmic collusion, Ambiguity in Provisions on Algorithmic Collusion Agreements, and the necessity to refine the regulatory system for algorithmic collusion.

##### **Challenges in Determining Subjective Intent in Algorithmic Collusion**

Algorithmic collusion is divided into express collusion and tacit collusion, express collusion implies that there is explicit communication and consensus reached among individuals regarding collusion through oral or written forms. This type of algorithmic collusion is less challenging to identify as evidence is more readily obtainable. For example, there was a case in Spain involving real estate agents and their multiple Listing services (MLS). The MLS in question is an algorithmic platform used by real estate agents and brokers to share information about properties for sale and find available listings for potential buyers. The competing real estate agents, together with software developers, designed the MLS to prevent secret discounting. To limit competition, the MLS has a number of regulations. For example, real estate agents can only upload properties to the platform if they disclose a commission, which is at least 4 percent. If real estate agents attempt to acquire a competitive edge by offering discounts, this software will prevent them from uploading their property information onto the MLS. In the end, Spain's market surveillance authority penalized both the offending real estate franchisee and the IT company overseeing the cartel's software, in accordance with a monopoly agreement between the conspirators.<sup>22</sup> In this case, competing enterprises jointly formulated an algorithm that implemented a fixed price in accordance with the agreement. This belongs to an explicit agreement and can be

---

<sup>22</sup> Organisation for Economic Co-operation and Development, 'Algorithmic Competition - Note by Spain' (*Organisation for Economic Co-operation and Development*, 19 May 2023), [https://ne.oecd.org/document/DAF/COMP/WD\(2023\)16/en/pdf](https://ne.oecd.org/document/DAF/COMP/WD(2023)16/en/pdf), accessed 18 October 2024.

regulated quite easily in accordance with relevant anti-monopoly laws.

For tacit agreement, besides confirming the existence of price parallel behavior, it is also necessary to judge the expression of human collusion intention and whether there is intentional contact or information exchange. The case of the United States v. Airline Tariff Publishing Company is a typical case of tacit collusion. In this case, the cartel participants within the US aviation industry employed a variety of complex signals and mechanisms to fulfill their collusive aims through tacit collusion. Due to the hidden and complex communication process involved in the case, and the absence of explicit prohibition of tacit collusion in the competition law, it is impossible to prove that the cartel participants really have intentional contact or information exchange, and it is difficult for the judicial authorities to impose sanctions on them.<sup>23</sup> This case profoundly reveals that algorithmic collusion is not only difficult to detect, but also challenging to regulate. With the rapid development of algorithmic technology, companies have developed the ability to design and deploy complex “algorithmic mechanisms” that can quietly achieve a state of “tacitly collusive equilibrium” even in the absence of communication or information sharing between direct competitors. In particular, both predictive agent category collusion and artificial intelligence and the digital eye collusion show potential trends in such latent synergy. With their superior predictive and analytical capabilities, these algorithms achieve instant response and self-optimization to market dynamics by continuously observing and deeply learning from the behavior patterns of other participants in the market, thus demonstrating a potential risk that collusion can be triggered without direct human control. This may indirectly contribute to the formation of tacit collusion, in which there is no explicit agreement between market players, but their behavior shows a high degree of consistency.<sup>24</sup> Therefore, in the face of this emerging challenge brought by algorithm technology, it is urgent for the field of economic law to reconsider the definition of collusion and regulatory strategies, so as to cope with the new market ecology driven by algorithm and ensure that the fairness and efficiency of market competition are not eroded. How to accurately judge the subjective intention of algorithmic collusion is the next problem to be solved.

### **Ambiguity in Provisions on Algorithmic Collusion Agreements**

As one of the key elements of the formation of collusion, the clarity of the agreement is crucial to the implementation of collusion. Express collusion requires specific and explicit agreement between operators. The concept of “monopoly agreement” in China’s current Anti-monopoly Law is based on three pillars: first, the common intention or will formed between the operators; Second, the interactive mode of consultation or coordination adopted; Third, the content directly points to the substantial restrictions on market competition. With the deep integration of algorithm technology into collusive practice, the structure of collusive behavior has become intricate, and the interaction mode among operators has also shown unprecedented diversity. Algorithm can not only be an auxiliary tool, but also play a dominant role, playing a key role in the planning, execution and other links of collusion. This puts forward higher require-

<sup>23</sup> United States v. Airline Tariff Pub. Co., 836 F. Supp. 9 (D.D.C. 1993).

<sup>24</sup> Ayue Zang, ‘Antitrust Regulation of Algorithmic Collusion in the Big Data Era(大数据时代下算法合谋的反垄断规制)’ (2019) 16 Journal of Hubei University of Economics (Humanities and Social Sciences) (湖北经济学院学报 (人文社会科学版)) 73.

ments for the legislative improvement of the anti-monopoly law.

Algorithmic collusion agreement has different effects on different types of algorithmic collusion behavior. Specifically, messenger scenario and convergence collusion are often based on explicit algorithm collusion protocol, which makes the regulation difficulty of these two types of collusion relatively low. In messenger scenario, the subject of manipulation collusion is human, while the algorithm only exists as a media tool to reach collusion. In contrast, in the convergence collusion, operators of different levels are involved, and the enterprise forms a vertical monopoly agreement with a certain center as the medium, so as to avoid the supervision of anti-monopoly law. These two types of collusion are based on the express monopoly agreement and easy to regulate. However, for the two new types of collusion, predictive agent collusion and artificial intelligence and the digital eye collusion, the traditional concept of monopoly agreement is too limited to form an effective restriction on them. In order to effectively deal with the new challenges brought by algorithmic collusion, it is urgent to reinterpret the core legal concept of “agreement” in the Anti-monopoly Law, so that it can flexibly adapt to and effectively cover all kinds of collusion behavior patterns driven by algorithms.<sup>25</sup>

### 5. The Necessity to Refine the Regulatory System for Algorithmic Collusion

Some scholars propose that an effective algorithmic collusion regulatory system should follow a chronological sequence of three steps: prior prevention, concurrent control, and post-event resolution. This approach supports a comprehensive regulatory framework.<sup>26</sup> Prior prevention means that the design and development of algorithms with the risk of collusion are strictly prohibited through legal provisions. Concurrent control means that anti-monopoly regulators can specially supervise the behavior of algorithms in the market through the development of monitoring algorithms. Post-event liquidation refers to the means of imposing sanctions on operators who collude with algorithms for illegal facts. The author believes that we can draw lessons from the above ideas to analyze the difficulties faced by the regulatory system of algorithm collusion, including:

First, the ability of anti-monopoly law enforcement agencies to use digital regulatory technology needs to be strengthened. In the face of rapidly iterating scientific and technological environment and emerging business forms, the regulatory concepts of some regulatory agencies are still lagging behind and fail to fully match the pace of technological progress, which undoubtedly weakens the effectiveness and quality of supervision, resulting in unsatisfactory regulatory results. Besides that, the difficulty of algorithm collusion discovery and regulation is relatively high. In the in-depth analysis of the core problems in the field of algorithm supervision, the lack of transparency of the “Algorithmic Black Box” phenomenon is a major problem that attracts

---

<sup>25</sup> Xu Liu, ‘The Legal Dilemma and Logical Basis of Antitrust Regulation on Algorithmic Collusion in the Age of Artificial Intelligence (人工智能时代算法合谋反垄断的适法困境与逻辑依归)’ (2022) 1 Journal of Northwest University for Nationalities (Philosophy and Social Sciences) (西北民族大学学报 (哲学社会科学版)) 89.

<sup>26</sup> Yifan Guo, ‘A Study on the Legal Issues of Algorithmic Collusion from the Perspective of Antitrust (反垄断视域下算法共谋的法律问题研究)’ (2021) 3 Journal of Price Theory and Practice (价格理论与实践) 30.

attention.<sup>27</sup> The operation of algorithms involves lots of data that is difficult to comprehend, particularly in the case of autonomous learning algorithms, whose computational processes are even more complex and whose programmatic environments are constantly evolving. Beyond the input data and output results, the processes themselves are unknowable. Law enforcement agencies have yet to comprehend the operational and decision-making mechanisms of algorithms, and they are also not well-equipped to identify signs of collusion or algorithmic code that serves as evidence of collusion itself.<sup>28</sup> Apart from reinforcing external regulatory measures, how to effectively enhance enterprises' emphasis on data security construction and guide them to consciously refrain from engaging in illegal activities such as algorithmic collusion by establishing diverse incentive mechanisms is equally deserving of profound consideration.

Through the examination of the aforementioned cases, it is evident that the United States, the European Union, and China each possess distinct characteristics in their enforcement frameworks for algorithmic collusion. The United States primarily relies on the Sherman Act, utilizing both direct and indirect evidence to identify collusion, yet faces challenges in obtaining evidence due to the concealed nature of algorithms. The European Union emphasizes economic ties and market structure, allowing for the inference of collusive intent through indirect evidence while also utilizing the system of collective dominance in the market for regulation. However, it similarly encounters difficulties in identifying tacit collusion. China's Anti-Monopoly Law and its accompanying guidelines explicitly prohibit algorithmic collusion, but due to the scarcity of mature cases, law enforcement agencies confront challenges in identification and evidence collection. Globally, the concealed and complex nature of algorithmic collusion renders traditional antitrust laws difficult to apply, necessitating increased cooperation among countries to strike a balance between market competition and technological innovation.

## **6. The Regulatory Approaches of Algorithmic Collusion from the Perspective of Anti-Monopoly**

The regulatory approaches of algorithmic collusion includes clarifying the subjective intention of algorithmic collusion, define the concept of algorithmic collusion agreement and reinforce the regulatory system of algorithmic collusion.

### **Clarifying the Subjective Intention of Algorithmic Collusion**

Given these emerging forms of collusion, a thorough investigation into the subjective intentions and objective behaviour of enterprises is necessary, incorporating various relevant factors to assess the presence of algorithmic collusion. Specifically, it includes the following aspects:

First of all, for the identification of algorithm collusion, one can commence with circumstantial evidence, that is, by examining market price fluctuations and conducting

---

<sup>27</sup> Yifan Guo, 'A Study on the Legal Issues of Algorithmic Collusion from the Perspective of Antitrust (反垄断视域下算法共谋的法律问题研究)' (2021) 3 Journal of Price Theory and Practice (价格理论与实践) 29.

<sup>28</sup> Jiancheng Gao, 'Challenges and Countermeasures for the Regulation of Algorithmic Collusion under Antitrust Law (算法共谋的反垄断法规制挑战与对策)' (2024) 45 Journal of Dalian University of Technology (Social Sciences) (大连理工大学学报 (社会科学版)) 91.

market surveys to determine the existence of parallel pricing behavior. When pricing algorithms are widely adopted by many competitive enterprises and price parallelism occurs in the market, it may imply the existence of algorithmic collusion. Secondly, we can infer whether there is collusion agreement by observing the behavior of competing firms. In the MLS case mentioned earlier, for example, Spain's market surveillance authority relied on monopolistic agreements among the conspirators to punish both the offending real estate franchisee and the IT company that provided the software that monitored the cartel. In such cases, the confirmation process of the collusion agreement exhibits a high degree of immediacy and clarity. If each enterprise adopts the same algorithm technology, or realizes that its algorithm system shares the core database resources with its competitors, the hypothesis of collusion intention among these enterprises can be deduced based on reasonable logic. This inference is rooted in the centralization of the algorithmic services market. Finally, for those algorithmic collusion behaviors that lack clear traces of agreement or communication, it is necessary to deeply analyze the specific behavior patterns of enterprises to indirectly infer whether there is subjective intention of collusion. Furthermore, the standard of "high probability" can also be established for presumption, among other methods. Taking predictive agent collusion and artificial intelligence and the digital eye collusion as typical cases, the core of evaluating such collusion intention is to examine the behavior logic of algorithm users, rather than whether the algorithm program itself has the "autonomy" of collusion. From the perspective of algorithm users, the key is to examine whether the enterprise, as the actual operator of the algorithm, chooses to accept and maintain the collusion result when the enterprise uses predictive agent or artificial intelligence and the digital eye collusion to generate collusion result. If the enterprise knows that the algorithm behavior may constitute collusion, but deliberately allow its operation, and does not take any effective intervention or preventive measures to prevent the realization of the collusion results, then even in the form of the lack of direct collusion agreement or communication evidence, it can still be based on the reasonable inference of the enterprise behavior, the existence of the subjective intention of collusion.

#### Define the Concept of Algorithmic Collusion Agreement

When exploring the issue of business operators constituting collusion through a series of acts, it is essential to explicitly expound the specific content and nature of the collusion agreement, clearly demarcate the boundaries between legal and illegal collusion behavior, and precisely grasp the connotation of the agreement. In the academic context, Article 16 of China's Anti-Monopoly Law does not offer a definitive and exhaustive elucidation of the specific connotation of the core concept of "agreement". This principle-based legislative formulation, devoid of a clear delineation of specific constituent elements, poses difficulties in the direct and effective enforcement of legal regulations when confronted with emerging forms of monopolistic behavior, such as algorithmic collusion. Thus, it is essential to moderately expand the boundaries of "agreement" to encompass a wider range of behaviours that may indicate cooperative intent between enterprises.

As for how to expand the boundaries of the concept of "agreement", the relevant experience of countries outside the region is worth learning. The definition of the concepts of "agreement" and "concerted action" in Article 101 (1) of the Treaty on the Functioning of the European Union shows a high degree of foresight and inclusiveness. Through broad and flexible interpretation, all acts that constitute collusion in

essence and have the same effect of disrupting market competition order are included in the scope of regulation. This not only reflects the firm determination to maintain market competition order, but also demonstrates the adaptability and flexibility of the law in the face of complex and changing economic environment. Expanding the scope of “agreement” will support more effective regulation of algorithmic collusion, thereby helping to maintain fair competition in the market. In view of this, the Anti-Monopoly Law can deeply discuss the phenomenon of algorithmic collusion, which goes beyond the traditional explicit collusion category, into two main types. The first category can be described as algorithmic collusion involving mutual consent, where such collusion may be facilitated through ambiguous and indirect arrangements. Consequently, a broadened interpretation of the concept of “collusion agreement” becomes particularly necessary. Specifically, whenever robust evidence substantiates a tacit understanding among the operators and establishes a clear causal linkage between the deployment of algorithms and subsequent market actions, it may be considered as constituting an “agreement” in accordance with the regulatory framework of the Anti-Monopoly Law. The second type is the algorithm collusion with consent but without direct negotiation, which may be realized by the autonomous decision-making ability of artificial intelligence technology. The second category is algorithmic collusion with mutual consent but without direct negotiation, which may be facilitated by the autonomous decision-making capabilities of artificial intelligence technology. In this scenario, operators may not have undergone an explicit negotiation process but, instead, based on factors such as interdependencies in the market and shared interests, have independently converged on similar market strategies. Given the potential threats and even severe detrimental impacts that such conduct may pose to market competition order, legal regulation should transcend the traditional formal requirements of an "agreement." Instead, it should uphold the principle that substance outweighs form, and deem such conduct, which lacks direct negotiation but substantially constitutes a conspiracy, as a conspiracy agreement, thereby encompassing it within the regulatory ambit of the Anti-Monopoly Law.

#### **7. Reinforce the Regulatory System of Algorithmic Collusion**

In terms of algorithm supervision, we should pay attention to prevention in advance, control in the event, and liquidation after the event, and establish a supervision system for the whole process, supplemented by technical supervision. Suggestions for strengthening the algorithm collusion supervision system include:

Firstly, strengthen the supervision of algorithm development and the ability of anti-monopoly law enforcement agencies to use digital regulatory technologies. In terms of algorithm development supervision, to supervise algorithm development beforehand and avoid designing algorithms that favor collusion, a pre-stage can be added with the introduction of a compliance review process. Companies are required to report the use of specific algorithms under certain market conditions, and the design and development of algorithms posing a risk of collusion are prohibited. In addition, anti-trust enforcement agencies can strengthen the supervision of algorithmic collusion by attracting professionals in the field of technology, adopting advanced commodity price monitoring and backtracking techniques, and establishing a negative list system for algorithmic usage patterns with significant competitive harm characteristics. It is worth noting that in view of the lack of transparency of “black box algorithm”, some scholars have proposed the innovative idea of embedding “algorithm recorder” in algorithm design. This strategy not only reflects the positive response to the challenges

of emerging technologies, but also points out the direction for the modernization of anti-monopoly law enforcement.<sup>29</sup> Moreover, further guide the operators involved in the case to apply the leniency system. Article 56 of China's Anti-Monopoly Law only states that "if an operator takes the initiative to report to the anti-monopoly law enforcement agency the relevant situation of reaching a monopoly agreement...The anti-monopoly law enforcement agency may reduce or exempt the operator from punishment according to the circumstances", and does not provide clear guidance for law enforcement agencies and operators in terms of liability reduction, applicable conditions and procedural norms. Therefore, the regulatory authorities should uphold the basic regulation concept of "human-centered doctrine" and conduct systematic publicity and psychological counseling to the implement or of the algorithm in a timely manner, which will help reduce the cost of law enforcement and improve the efficiency of handling related cases. Lastly, pilot the implementation of a Data Protection Officer (DPO) system within enterprises. In establishing a Data Protection Officer (DPO) system, the structure outlined in Chapter IV, Section 4 of the General Data Protection Regulation (GDPR) can serve as a useful model. Specifically, DPO are given a high degree of professionalism and need to possess deep theoretical knowledge and practical experience in data protection to ensure that they can accurately identify and assess potential data protection risks when performing their duties. In addition, independence is one of the core characteristics of the DPO position. In order to maintain the continuity and effectiveness of a DPO's duties, the GDPR also stipulates strict clauses that companies must not dismiss a DPO without cause. So, when setting up a DPO system, the above provisions on DPO in the GDPR can be incorporated to build a monitoring system that effectively safeguards data security.

## Conclusion

In the backdrop of the vigorous development of the digital economy, algorithmic collusion, as a covert and complex market competition behavior, has witnessed an escalating degree of harmfulness and has presented a stern challenge to the implementation of anti-monopoly laws. This article delves deeply into the predicaments and regulatory strategies of algorithmic collusion. Firstly, regarding the challenges in determining subjective intent in algorithmic collusion, the author puts forward a distinct regulatory approach. Regarding explicit collusion, such as messenger collusion and convergence collusion, the presence of clear algorithmic collusion agreements makes regulatory efforts relatively straightforward. However, with tacit collusion, such as predictable agent category collusion and artificial intelligence and the digital eye collusion, the subjective intent is more concealed, resulting in greater difficulty in assessment. Therefore, I recommend adopting a multifaceted approach that considers market price fluctuations, competitive behavior patterns among enterprises, and the behavioral logic of algorithm users to comprehensively evaluate whether algorithmic collusion exists. This approach will aid in addressing the challenges associated with discerning subjective intent behind algorithmic collusion and ensure both precision and fairness in antitrust enforcement. Secondly, in addressing the ambiguity in provisions on algorithmic collusion agreements, the author advocates for a clear definition of this term. In China's anti-monopoly, there is no explicit interpretation of the core concept of "agreement," which complicates the direct and effective implementation

---

<sup>29</sup> Wenjun Wu, Tiejun Huang, Ke Gong, 'Ethical Principles and Governance Technology Development of AI in China' (*Connecting People Understanding the World*, 15 March 2020), <https://en.igcu.pku.edu.cn/info/1132/2498.htm>, accessed 1 November 2024.

of legal regulations when confronted with new forms of monopolistic behavior such as algorithmic collusion. Therefore, it is essential to appropriately expand the boundaries of the “agreement” concept to encompass various behavioral patterns that reflect collaborative intentions among enterprises. This approach will facilitate a clearer distinction between lawful and unlawful collusive behaviors, enabling a more accurate understanding of what constitutes an agreement and thereby enhancing regulatory effectiveness against algorithmic collusion. Finally, in addressing the necessity to refine the regulatory system for algorithmic collusion, it is essential to emphasize prior prevention, concurrent control, and post-event resolution. A comprehensive regulatory system should be established throughout the entire process, complemented by technological oversight. By enhancing the capacity of antitrust enforcement agencies to utilize digital regulatory technologies, guiding involved operators towards leniency provisions, and implementing a system of data compliance officers within enterprises, we can significantly enhance the effectiveness of regulation against algorithmic collusion.

In conclusion, this paper conducts an in-depth analysis of the dilemmas and regulatory strategies surrounding algorithmic collusion, and proposes clear regulatory pathways. These suggestions are aimed at addressing specific issues such as challenges in determining subjective intent in algorithmic collusion, ambiguity in provisions on algorithmic collusion agreements, and the incompleteness of the regulatory system, providing useful references for antitrust practices. However, with the continuous advancement of technology and constant changes in the market, the forms and means of algorithmic collusion will continue to evolve. In order to promptly respond to the challenges posed by new technologies, besides the above-mentioned regulatory pathways, it is also possible to strengthen cooperation and exchanges within the international community to jointly address cross-border competition issues such as algorithmic collusion and maintain a fair competition order in the global market. In the future, we look forward to building a fairer, more transparent, and efficient competitive environment in the digital economy.