# The Anti-Monopoly Regulation of Hub-and-Spoke Algorithmic Collusion

**Kunquan Li**
*Law School, China Jiliang University, Hangzhou, Zhejiang, China*

**Abstract: In the context of the digital economy, the widespread application of algorithms has given rise to a novel form of monopoly—algorithmic collusion within hub-and-spoke agreements—which has become a focal point of anti-monopoly regulation. Hub-and-spoke agreements break the traditional dichotomy of monopoly agreements, featuring a superimposed horizontal and vertical structure with a hub and spokes. Through algorithms, they enable price coordination among undertakings, characterized by concealment, stability, and the coexistence of explicit and tacit collusion. Although China's current Anti-Monopoly Law and relevant guidelines have responded to this phenomenon, regulatory dilemmas persist, including vague legislative principles, a limited scope of responsible parties confined to "undertakings," and unclear allocation of responsibility. To address these challenges, it is necessary to introduce the principle of rebuttable presumption of illegality, balancing enforcement efficiency with substantive justice. The scope of responsible parties should be expanded to include algorithm designers, providers, and users, with responsibility prioritized based on subjective intent. The determination of illegality should revert to the substantive criteria for monopoly agreements, thereby refining the regulatory pathway. This approach aims to curb the damage to market competition caused by the abuse of algorithms, balance innovation vitality with competitive order, and establish a solid institutional foundation of fair competition for the high-quality development of the digital economy.**

**Keywords: Hub-and-Spoke Agreement; Anti-Monopoly Law; Algorithmic Collusion**

## 1. Introduction

With the continuous advancement of internet information technology, the digital economy has gradually assumed a significant role within China's market economy system, with data becoming the most crucial factor of production. Algorithms, as finite, ordered sets of instructions for solving specific problems, offer substantial advantages in data processing. An increasing number of undertakings design and optimize their algorithms to adapt to market changes and meet consumers' unique demands, thereby gaining a competitive edge. However, driven by profit-seeking motives, the abuse of algorithms has inevitably emerged. Platforms engage in self-preferencing by formulating platform rules or leveraging data and algorithm advantages to treat different undertakings differently [1]. They also implement differential pricing for consumers based on information advantages, commonly known as "big data-enabled price discrimination against existing customers" [2]. This also includes price coordination among platform enterprises achieved through algorithmic interaction, also referred to as "algorithmic collusion." On February 7, 2021, the Anti-Monopoly Guidelines for the Platform Economy Sector were issued. Article 5 identifies "coordinated conduct substantially existing through data, algorithms, platform rules, or other means" as a form of monopoly agreement in the platform economy. Furthermore, Article 8 specifically provides for "hub-and-spoke agreements," a third type of monopoly agreement distinct from the traditional binary classification. Algorithmic collusion within hub-and-spoke structures, as a monopolistic conduct, has become a focal point of anti-monopoly enforcement. However, the Anti-Monopoly Guidelines only provide principled provisions on this matter. How to better identify and specifically regulate this monopolistic conduct poses a significant challenge for current research.

## 2. The Concept and Essential Characteristics of Algorithmic Collusion in Hub-and-Spoke

 

**Agreements**

### 2.1 The Concept of Hub-and-Spoke Agreements

Traditionally, monopoly agreements are classified dichotomously into horizontal and vertical agreements. Horizontal monopoly agreements are those concluded between competing undertakings at the same level of the market, while vertical monopoly agreements are concluded between undertakings and their trading partners at different levels. With the innovative development of business models, agreements among different entities are no longer simply horizontal or vertical but represent a hybrid form, termed "hub-and-spoke agreements." As the name implies, hub-and-spoke agreements analogize the conduct among market players to a bicycle wheel, consisting of a hub and several spokes. The hub and spokes operate at different market levels, typically in an upstream-downstream relationship. The spokes are direct competitors with one another but lack direct communication or contact; their horizontal coordination is mediated through their respective vertical connections with the hub [3]. This typically manifests as a hub undertaking concluding parallel vertical agreements with multiple upstream or downstream undertakings. Among these spokes, a tacit horizontal collusive agreement exists, which can only be proven indirectly [4]. However, some scholars argue that the entity acting as the hub need not necessarily be an undertaking; it could also be a third party not involved in the transaction process that facilitates information exchange among different undertakings, or even an algorithm itself [3]. Nevertheless, the constitutive elements of a hub-and-spoke agreement are clear: the existence of a hub, spoke undertakings, and collusion among these entities.

### 2.2 The Concept of Algorithmic Collusion in Hub-and-Spoke Agreements

With the advancement of algorithmic technology, hub-and-spoke agreements facilitated by algorithms have gradually entered the purview of anti-monopoly law. In 2017, the Organisation for Economic Co-operation and Development (OECD) released the report "Algo and Collusion: Competition Policy in the Digital Age" The report noted that even though algorithms simultaneously alter structural market conditions and supply-side factors, making it difficult to determine whether they increase or decrease the likelihood of collusion, in highly transparent markets where deviations are easily detected and promptly retaliated against, the high-frequency interaction enabled by algorithms promotes collusion [5]. Algorithmic collusion in hub-and-spoke agreements represents a collusion risk potentially arising from the use of parallel algorithms, as mentioned in the report. Undertakings use identical or similar pricing algorithms, enabling information exchange to move beyond traditional oral or written forms, indirectly forming price coordination through algorithms. Hub-and-spoke agreements achieved via algorithms can be further subdivided into two categories.

The first category involves hub-and-spoke agreements with a platform undertaking as the hub. The platform undertaking, as the core of such agreements, possesses advantages in market data and algorithms. Other undertakings within the platform utilize the algorithms provided by the platform for pricing their goods or services and conducting business. Consequently, even without direct horizontal agreements among these undertakings using the same algorithm, their acceptance of the same set of algorithms leads to a certain degree of price coordination for identical or similar goods or services, thereby effectively controlling prices within the platform market. Therefore, the stronger the market power of a platform undertaking providing the algorithm, the more easily it can manipulate pricing methods through algorithms to achieve monopolistic high prices, undermining market competition.

The second category involves hub-and-spoke agreements with an algorithm designer as the core. This type differs from the first and typically consists of horizontally competing undertakings. These competing undertakings set prices based on the algorithm of the same algorithm designer, leading to the effect of monopolistic market pricing. In practice, the algorithm designer at the core can be further divided into two types based on the mode and degree of involvement in collusion: supportive participation in collusion and non-supportive participation in collusion [6]. The former includes providing direct algorithmic assistance for already existing human collusion or indirect

 

algorithmic support where no obvious human collusion exists, but algorithmic support leads to similar decision-making structures. The latter involves situations where competing undertakings have not reached a price collusion agreement, but the algorithm autonomously generates price collusion.

### 2.3 Characteristics of Algorithmic Collusion in Hub-and-Spoke Agreements

After clarifying the concept and types of algorithmic collusion in hub-and-spoke agreements, several characteristics become apparent:

Concealment of Collusive Conduct. Traditional collusive conduct relies on explicit or tacit collusion among undertakings through oral or written forms, often requiring multiple negotiations. Such manifestations of intent are prone to leaving traces, serving as evidence for the existence of a monopoly agreement. Algorithms, however, can transmit consensus through data interaction and code logic, requiring no direct communication of intent among undertakings. Alternatively, after an initial consensus is reached, subsequent conduct relies entirely on algorithms, maintaining price synchronization solely through algorithms and manifesting tacit collusion through indirect means like strategic coordination of undertakings' choices, making it difficult to establish subjective collusive intent.

Stability of Collusive Conduct. Achieving collusion requires stable consensus among undertakings, and the intervention of algorithms fosters this stability. Under the dynamic oligopoly theory, tacit collusion requires three conditions: (1) the existence of infinitely repeated games; (2) the presence of a sequential decision-making mechanism; (3) information transmission mechanisms based on market conduct [7]. Algorithms have inherent advantages in data capture and analysis, enhancing market transparency. Competing undertakings can frequently obtain price information from other undertakings through algorithms and continuously engage in game playing via price signals, increasing the likelihood of collusion. Moreover, the efficiency of algorithms in monitoring market information enables rapid feedback when an undertaking deviates from the price equilibrium to gain market share. Under the decision-making mechanisms embedded in the algorithm design, swift retaliatory measures can be initiated against the deviating undertaking. Therefore, when price strategies yield only short-term gains, most undertakings choose to join the price cartel, ensuring the stability of the collusion.

Coexistence of Explicit and Tacit Collusion. As noted in the concept, this type of hub-and-spoke agreement combines vertical and horizontal monopoly agreements. Using the platform example, the vertical agreement where the leading undertaking provides algorithms to downstream undertakings within the platform is often explicit, while the price coordination resulting from these downstream undertakings accepting algorithmic adjustments is tacit. Similarly, in algorithm-centric hub-and-spoke agreements, the collusion can manifest either as multiple undertakings maintaining their explicit agreement through algorithms or as an autonomous, tacit form of collusion among them. Hence, in determining the nature of algorithmic collusion in hub-and-spoke agreements, it cannot be simply categorized as explicit or tacit algorithmic collusion. The determination of nature and assignment of responsibility should be based on the specific circumstances, with the key factor being the existence of a meeting of minds [8].

## 3. Regulatory Dilemmas of Algorithmic Collusion in Hub-and-Spoke Agreements

### 3.1 Current Legislative Status

On February 7, 2021, the Anti-Monopoly Guidelines for the Platform Economy Sector were issued, providing certain responses to anti-monopoly issues in China's digital economy market. Chapter II explicitly designates hub-and-spoke agreements as a third type of monopoly agreement, alongside horizontal and vertical agreements. It provides criteria for identifying the subjects, including "competing undertakings within the platform" and "platform undertakings," as well as judgment criteria such as "whether technical means, platform rules, data, algorithms, etc., are utilized." This has played a guiding role in regulating algorithmic collusion in hub-and-spoke agreements. However, deficiencies remain, including relatively principled and vague provisions lacking operability, and a low legal hierarchy as it is only a departmental regulatory document [9].

 

In 2022, the Anti-Monopoly Law of the People's Republic of China was revised. Article 9 states, "Undertakings shall not use data, algorithms, technology, capital advantages, and platform rules to engage in monopolistic conducts prohibited by this Law," treating algorithms as a tool relevant to anti-monopoly. Article 17 addresses horizontal monopoly agreements, Article 18 addresses vertical monopoly agreements, but Article 19 does not continue the term "hub-and-spoke agreement" from the Anti-Monopoly Guidelines. Instead, it stipulates, "Undertakings shall not organize other undertakings to reach monopoly agreements or provide substantive assistance for other undertakings to reach monopoly agreements," referring to the organizing or assisting conduct of undertakings. However, academic understanding of the nature of this provision varies. Some scholars view it as a regulation addressing atypical hub-and-spoke agreements that fall outside the traditional dichotomy, representing an independent form of monopoly agreement [10]. Conversely, other scholars argue that the organizing or assisting conduct of undertakings does not constitute an independent type of monopoly agreement and does not depart from the traditional dichotomy; rather, this provision specifies a special means of concluding a monopoly agreement rather than a new type, aiming to expand the scope of responsible parties [11].

The Provisions on Prohibiting Monopoly Agreements issued by the State Administration for Market Regulation in 2023 mention the use of algorithms to conclude horizontal and vertical monopoly agreements in Articles 13 and 15, respectively, but do not mention hub-and-spoke agreements. The Interpretation of the Supreme People's Court on Several Issues Concerning the Application of Law in the Trial of Monopoly Civil Dispute Cases issued in 2024, in Articles 24 and 25, is virtually identical to Articles 13 and 15 of the Provisions on Prohibiting Monopoly Agreements, likewise regulating monopoly agreements reached via algorithms as either horizontal or vertical agreements.

### 3.2 Difficulties in Determination under Current Law

3.2.1 Dilemma in determining illegality

Traditional anti-monopoly law classifies monopoly agreements into horizontal and vertical categories. In Chinese judicial practice, the illegality of an agreement is typically assessed by reference to the "per se illegal rule" and the "rule of reason," concepts originating from U.S. economic thought [12]. However, hub-and-spoke agreements are neither purely horizontal nor purely vertical but an integration of both, constituting a single whole. Their complex structure precludes the direct application of either the per se illegal rule or the rule of reason to the agreement as a whole. The per se illegal rule applies to horizontal monopoly agreements, premised on the idea that the degree of competitive harm caused by the agreement cannot be offset by any value it creates. However, in the new economic landscape shaped by algorithms, their efficiency-enhancing effects are also evident. Applying the per se illegal rule directly might contradict its underlying purpose [13]. The rule of reason applies to vertical monopoly agreements, requiring a careful consideration of factors such as the subjects' subjective intent, conduct, and anticompetitive effects to determine illegality. However, the rule of reason entails high evidentiary burdens. In algorithmic collusion, establishing subjective intent is particularly challenging, potentially allowing hub entities to evade responsibility.

3.2.2 Loopholes in the scope of colluding parties

Current legislation still centers on "undertakings" and "competing undertakings" when imposing penalties for monopoly agreements. However, this traditional standard for colluding parties does not fully align with the new realities of algorithmic collusion. In algorithmic collusion within hub-and-spoke structures, the hub entity may include not only undertakings but also algorithm designers, algorithm providers, algorithm users, and potentially even algorithms themselves. All these entities could potentially facilitate algorithmic collusion. Therefore, even though Article 19 of the current Anti-Monopoly Law appears to cover atypical hub-and-spoke agreements, it is not entirely a relationship of inclusion, as this article also limits the subjects to "undertakings." Furthermore, when designed algorithms overlap—for instance, when hub-and-spoke type algorithms overlap with predictive or learning algorithms—they may react to market conditions without human intervention. Whether the algorithm itself can

 

be considered a colluding party in such cases, and whether the designer of such strong AI should be held responsible as a colluding party to some extent, currently lacks clear provisions [14].

3.2.3 Disputes over allocation of responsibility among parties in hub-and-spoke agreements

As mentioned above, the parties involved in algorithmic collusion within hub-and-spoke agreements include, beyond undertakings, algorithm designers, providers, and users. Algorithm providers may possess market dominance, corresponding to the first category with the platform undertaking as the hub. Such entities leverage their market dominance to acquire substantial market data and independently develop algorithms to support users or undertakings on their platform. When such entities use algorithms as tools to manipulate market prices and achieve monopoly, they should naturally bear monopoly liability. Platform undertakings typically possess strong bargaining power, while undertakings within the platform (algorithm users) often occupy a disproportionately weak position. The series of vertical agreements collectively produce the effect of a horizontal agreement. These undertakings might join the agreement to maximize profits, or they might be compelled to agree as a precondition for accessing the market. Should these undertakings bear corresponding liability? Many current theories treat algorithmic collusion in hub-and-spoke agreements as a form of horizontal monopoly agreement. From this perspective, these undertakings cannot claim exemption under the safety harbor rules applicable only to vertical monopoly agreements [15]. Algorithm designers, in this context, refer to parties whose role does not overlap with that of the algorithm provider. They are commissioned by algorithm providers or users to design algorithms and do not have a competitive relationship with them. They may design algorithms unaware of the clients' monopolistic intent, or they may collude with the clients to achieve monopoly. Determining the liability of such parties and the rules governing subject responsibility are pressing issues requiring resolution.

## 4. Improving the Regulatory Path for Algorithmic Collusion in Hub-and-Spoke Agreements

### 4.1 Principle for Determining Illegality: Introducing the Rebuttable Presumption of Illegality

Applying the per se illegal rule to horizontal agreements and the rule of reason to vertical agreements was originally intended to enhance judicial efficiency. However, this approach faces difficulties when applied to novel agreements like algorithmic collusion in hub-and-spoke structures. In reality, vertically related undertakings might share a common anticompetitive purpose, enabling them, like horizontal competitors, to develop business arrangements that exclude or restrict competition. This insight suggests that determining the illegality of hub-and-spoke agreements should not be constrained by type-based classification but should revert to the substantive assessment of illegality for monopoly agreements [4]. Therefore, it is necessary to introduce the rebuttable per se illegal rule [16]. The rebuttable per se illegal rule occupies a middle ground between the per se illegal rule and the rule of reason. It means that upon establishing the fact of central hub-and-spoke algorithmic collusion, the conduct is presumed to violate the Anti-Monopoly Law. The burden of proof, which under the rule of reason lies with the plaintiff to demonstrate the absence of anticompetitive effects or the presence of pro-competitive effects outweighing the competitive harm, is shifted to the defendant. Adopting the rebuttable presumption of illegality offers several advantages: First, it inherits the enforcement efficiency of the per se illegal rule, reducing enforcement costs. Second, it alleviates the plaintiff's evidentiary burden, shifting the burden of proving (or rebutting) anticompetitive effects to the defendant, which often possesses market dominance. Simultaneously, it allows the defendant to rebut the presumption. By examining the actual competitive effects of the agreement, its true nature can be accurately identified, aligning with the legislative purpose of anti-monopoly law.

### 4.2 Clarifying the Scope of Responsible Parties and Allocation of Responsibility

Regarding the parties involved in algorithmic collusion within hub-and-spoke agreements, the scope should not be limited to "undertakings." It should be expanded to include "algorithm

 

providers," "algorithm designers," and "algorithm users" as potential responsible parties under anti-monopoly law. Within the overarching framework of the hub-and-spoke agreement, the extent of their responsibility should be determined based on their respective contributions. Algorithms are more often tools used by responsible parties to maintain monopolies. Even in cases of algorithmic overlap where algorithms autonomously coordinate prices, holding the algorithm itself—an inanimate object—liable is meaningless. Doing so would instead allow the algorithm providers, designers, and users who bear the obligation to control and monitor it to evade responsibility.

Based on the characteristics of hub-and-spoke agreements, the determination of responsibility should center on subjective intent. In the first category, platform undertakings (or algorithm providers) typically possess market dominance, and the algorithms they provide often play a crucial role in the market. Therefore, their subjective intent warrants particular scrutiny. If the platform undertaking (algorithm provider) acts as the hub and other undertakings within the platform actively promote the hub-and-spoke agreement, both should bear anti-monopoly liability. The platform undertaking or algorithm provider, as the primary force facilitating the agreement, should bear primary responsibility. However, if the hub entity requires undertakings within the platform to join the agreement, making it a de facto market access condition, the hub should remain the primary bearer of responsibility, while liability for the spoke undertakings might be mitigated or exempted, as they lack the capacity to resist the agreement. If the hub undertaking conceals the true meaning of the agreement from the spokes, the spoke undertakings lack any collusive intent whatsoever and should not be held liable.

For algorithm designers, a differentiated analysis is similarly required. If the algorithm designer and the commissioning party share collusive intent, the designer should naturally bear responsibility. Conversely, if the algorithm designer could not reasonably foresee the hub-and-spoke agreement or the monopolistic functionality of the designed algorithm, they should not be held liable. Furthermore, if the algorithm designer is also responsible for subsequent algorithm maintenance and updates, their involvement in adding elements that restrict market competition during later algorithm development must be considered to determine the existence of collusive intent or the intent to aid collusion. Regarding the specific apportionment of responsibility, it should be allocated by referencing each party's degree of control over the algorithm and their benefits derived from the monopoly agreement.

## 5. Conclusion

The vigorous development of the digital economy has propelled algorithms to become core tools for market competition, yet it has also spawned a novel form of monopoly—algorithmic collusion within hub-and-spoke agreements—posing severe challenges to the traditional anti-monopoly regulatory system. Such collusion, using algorithms as a link, combines the characteristics of horizontal and vertical monopoly agreements. Leveraging concealment, stability, and multiplicity of parties, it evades regulation and undermines market competition, harming both the fair competition rights of undertakings and the legitimate rights and interests of consumers. Although China's current anti-monopoly legal system has provided preliminary responses through the Anti-Monopoly Guidelines for the Platform Economy Sector and the revised Anti-Monopoly Law, legislative ambiguities and practical difficulties persist regarding standards for determining illegality, defining the scope of responsible parties, and allocating responsibility. The regulatory pathways proposed in this paper—introducing the rebuttable presumption of illegality, expanding the scope of responsible parties, and prioritizing responsibility based on subjective intent—revert to the substantive determination of illegality for monopoly agreements, balancing enforcement efficiency with fairness and justice. In the future, it is necessary to continuously promote the refinement of the anti-monopoly legal system, strengthen compliance reviews of algorithm technology and the application of regulatory technology, while simultaneously balancing market innovation vitality with the maintenance of competitive order. Only then can the monopoly risks arising from algorithm abuse be effectively curbed, achieving a win-win outcome.

 

**References**

[1] Zou Kailiang & Wang Xindi. Research on Anti-monopoly Law Regulation of Self-preferential Treatment of Digital Platform. Price:Theory & Practice, 2023(09): 62–67.

[2] Zhou Xuerong. The Regulatory Dilemma and Path Selection of Anti-monopoly under Algorithmic Collusion. Administrative Tribune, 2024, 31(01): 116–124.

[3] Jiao Haitao. The Legal Nature of Hub-and-Spoke Conspiracies in AML. Journal of University of Chinese Academy of Social Sciences, 2020(01): 25–36, 2.

[4] Zhang Chenying. Review on the Dichotomy of Monopoly Agreements and Reconstruction of Prohibition Rules—From the Perspective of Hub-and-spoke Agreements. Studies in Law and Business, 2018, 35(02): 102–113.

[5] Han Wei. Antitrust Regulation of Algorithmic Collusion——Analysis of OECD Report on Algorithms and Collusion (Part 1). Competition Policy Research, 2017(05): 112–121.

[6] Gao Qing & Peng Yu. Antitrust Regulation of Algorithm Suppliers' Participation in Algorithmic Price Collusion. Journal of Nankai University (Philosophy, Literature and Social), 2025(06): 95–107.

[7] Zhan Shifu. On the Antitrust Regulation of Algorithmic Tacit Collusion. Journal of Beijing Institute of Technology (Social Sciences Edition), 1–15 (2026-01-02).

[8] Gao Jiansheng. Countermeasures to the Challenges of Anti-monopoly Law on Algorithmic Collusion. Journal of Dalian University of Technology (Social Sciences), 2024, 45(04): 90–100.

[9] Cheng Zengwen. Autonomous Algorithm Abuse and Antitrust Regulation in the Field of Platform Economy. South China Finance, 2021(10): 87–96.

[10] Hao Junqi. On the Legislative Perfection of the Normative Categories of Monopoly Agreements in China. Journal of CUPL, 2022(01): 201–216.

[11] Lei Haoran. The Behaviour and Responsibility Admission on Operator Organizing or Helping Reach Monopoly Agreements. Research on China Market Regulation, 2023(05): 53–57.

[12] Hong Yingying. Systematic Interpretation and Improvement of China's Resale Price Maintenance System. ECUPL Journal, 2015, 18(04): 49–60.

[13] Luo Xin. Collusion Regulation of Hub-and-spoke Algorithm in Internet Economy. Journal of Wuhan Technical College of Communications, 2023, 25(04): 47–53.

[14] Li Haoting. Anti-Monopoly Regulation of Hub-and-Spoke Algorithmic Tacit Collusion. Journal of Western, 2025(03): 69–72.

[15] Nie Xinyu. Dilemma and Solution to the Regulation of Platform Hub-and-spoke Algorithm Collusion—From the Perspective of Power Imbalance. In Emerging Rights (Vol.1, 2025). East China University of Political Science and Law Press, 2025: 373–384.

[16] Tan Nana. Theoretical Logic and System Construction of Anti-monopoly Regulation to the Hub and Spoke Algorithm Conspiracy. Competition Policy Research, 2022(04): 34–43.

 