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Algorithmic Collusion and the Limits of Traditional Antitrust Enforcement: A Comparative Study of India and the European Union

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Abstract

The rapid expansion of artificial intelligence and algorithmic pricing systems has fundamentally transformed the functioning of digital markets. Pricing algorithms can automatically monitor competitors' prices and adjust strategies in real time, potentially leading to coordinated pricing outcomes without explicit communication among firms. This phenomenon, commonly referred to as algorithmic collusion, challenges the traditional foundations of competition law that rely on proving agreements or concerted practices between human actors. This paper critically examines whether existing competition law frameworks in India and the European Union are capable of addressing the risks posed by algorithmic collusion. The study analyses the Competition Act, 2002 in India and Articles 101 and 102 of the Treaty on the Functioning of the European Union (TFEU), alongside emerging regulatory instruments such as the EU Digital Markets Act (DMA) and India's proposed Digital Competition Bill. Through a doctrinal and comparative analysis, the paper identifies structural limitations within traditional antitrust enforcement mechanisms when applied to AI-driven markets. The study concludes that algorithmic pricing systems create new forms of tacit coordination that may evade existing legal thresholds for collusion. Consequently, competition authorities may need to adopt hybrid regulatory models combining antitrust enforcement with ex-ante digital market regulation.

Keywords: hybrid, tacit, competition, algorithmic

1. Introduction

Competition law has historically been designed to prevent anti-competitive agreements and monopolistic practices that distort market competition. Traditional antitrust regimes rely heavily on evidence demonstrating communication or coordination among firms engaged in cartel behaviour. However, the emergence of algorithmic pricing technologies has altered the structure of modern markets, particularly in sectors such as e-commerce, online travel, ride-sharing, and digital advertising.

Pricing algorithms can continuously monitor market data and competitors' behaviour and automatically adjust prices in response. While these technologies can enhance efficiency and improve consumer experiences, they also introduce the possibility of coordinated pricing outcomes that resemble cartel behaviour without explicit human agreement. Researchers note that algorithmic systems can facilitate price alignment through autonomous decision-making, allowing firms to achieve supra-competitive prices without direct communication. [1]

This development poses a significant challenge for competition law. Traditional antitrust doctrines assume that collusion requires human communication or explicit agreement between competitors. In algorithm-driven

[1] Matteo Giacalone, *Algorithmic Collusion and Corporate Accountability under Article 101 TFEU* (2025).

markets, however, collusive outcomes may arise from automated decision-making processes rather than deliberate coordination among firms.

Consequently, regulators across the world, including the Competition Commission of India (CCI) and the European Commission,have begun examining the implications of artificial intelligence for competition law enforcement.

2. Concept and Typologies of Algorithmic Collusion

Algorithmic collusion refers to situations where pricing algorithms facilitate coordinated market behaviour among competing firms. Unlike traditional cartels, which involve explicit agreements, algorithmic collusion may occur through automated systems that independently adjust pricing strategies based on market signals.

Scholars and regulators commonly classify algorithmic collusion into several categories:

1. Messenger Algorithms

In this model, algorithms merely implement cartel agreements that have already been established by human actors. For example, competitors may agree on price levels and use automated software to monitor compliance. This scenario resembles traditional cartel behaviour and can easily fall within existing antitrust prohibitions.

2. Hub-and-Spoke Algorithms

Here, multiple firms use a common pricing software provider or digital platform that indirectly coordinates prices among competitors. The software acts as a central hub through which firms adjust pricing strategies. Such structures resemble hub-and-spoke cartels, which are recognized in competition law jurisprudence.

3. Autonomous Self-Learning Algorithms

The most complex form involves algorithms that independently learn to sustain supra-competitive pricing through machine learning techniques. These algorithms may detect patterns in competitors' behaviour and adjust prices accordingly without explicit programming to collude.

Scholars note that such autonomous coordination challenges traditional assumptions about collusion because "parallel pricing behaviour may emerge from independent algorithmic decisions rather than explicit coordination." [2]Moreover, reinforcement-learning algorithms can sometimes produce stable pricing outcomes resembling cartel equilibrium, even when firms act independently. This phenomenon raises fundamental legal questions regarding liability and enforcement under existing competition law frameworks.[3]

3. Algorithmic Pricing and the Structure of Digital Markets

Digital markets exhibit structural characteristics that increase the risk of algorithmic collusion. These include:

- High market transparency
- Real-time data availability
- Low marginal costs of monitoring competitors
- Network effects and data advantages

Algorithms can instantly detect deviations from pricing strategies and adjust prices accordingly, thereby stabilizing coordinated outcomes. Regulators have observed that automated pricing tools enable firms to monitor

[2] Competition Act, No. 12 of 2003, §§3–4 (India).

[3] Treaty on the Functioning of the European Union arts. 101–102, Oct. 26, 2012, 2012 O.J. (C 326) 47.

competitors' prices and respond immediately, potentially facilitating tacit collusion. [4]Because algorithms can analyse large volumes of market data and adjust prices dynamically, the traditional barriers to sustaining collusion, such as the difficulty of detecting cheating firms may be significantly reduced.

4. Legal Framework Governing Collusion in India

India's competition law regime is primarily governed by the Competition Act, 2002, which aims to prevent practices that have an appreciable adverse effect on competition in Indian markets.

Anti-Competitive Agreements

Section 3 of the Competition Act prohibits agreements that cause or are likely to cause an appreciable adverse effect on competition. Horizontal agreements involving price-fixing, market allocation, and bid rigging are presumed to be anti-competitive.

However, algorithmic collusion creates difficulties for enforcement because the statutory framework requires evidence of an "agreement" or "concerted practice." While regulators could interpret algorithm-driven coordination as a form of tacit agreement, establishing such proof remains challenging.[5]Scholars have argued that a broad interpretation of Section 3 could allow the Competition Commission of India to address certain forms of algorithmic collusion, though self-learning algorithms present greater difficulties.

Abuse of Dominant Position

Section 4 of the Competition Act prohibits enterprises from abusing their dominant position within the market. Algorithmic pricing could potentially constitute abusive conduct if used by dominant digital platforms to exclude competitors or manipulate market outcomes.

Emerging Regulatory Developments

The Competition Commission of India has recently undertaken a market study on artificial intelligence and competition, recognizing that AI systems may influence pricing behaviour and market structure.

Furthermore, the Indian government has proposed a Digital Competition Bill to regulate large digital platforms through an ex-ante regulatory framework similar to the European Union's Digital Markets Act. [6] These developments indicate that India is gradually adapting its competition law framework to address digital market challenges.[7]

5. European Union Competition Law and Algorithmic Collusion

The European Union operates one of the most sophisticated competition law regimes globally. Antitrust enforcement within the EU is primarily based on Articles 101 and 102 of the TFEU.

Article 101 TFEU

Article 101 prohibits agreements and concerted practices that restrict or distort competition. Scholars have debated whether algorithmic pricing strategies could fall within the scope of Article 101, particularly when algorithms

[4] CMA Working Paper, *Pricing Algorithms and Collusion in Online Markets*.
[5] *Algorithmic Collusion: Can the Competition Act Protect Against Self-Learning Algorithms?*, IndiaCorpLaw (2022).
[6] *Algorithmic Collusion: Can the Competition Act Protect Against Self-Learning Algorithms?*, IndiaCorpLaw (2022).
[7] PRS Legislative Research, *Report of the Committee on Digital Competition Law* (2024).

facilitate coordinated behaviour among firms. [8]EU competition authorities have recognized that shared algorithms or pricing software could potentially serve as mechanisms for anti-competitive coordination.

Article 102 TFEU

Article 102 addresses abuse of dominant position. If dominant firms deploy algorithms that manipulate market prices or exclude competitors, such conduct may be treated as abusive behaviour. [9]

Digital Markets Act (DMA)

The European Union has also introduced the **Digital Markets Act**, which imposes obligations on large digital platforms designated as "gatekeepers."

The DMA seeks to prevent anti-competitive behaviour by large technology firms and ensure fair competition within digital markets. This ex-ante regulatory approach supplements traditional antitrust enforcement mechanisms.

6. Comparative Analysis: India and the European Union

A comparative analysis of India and the European Union reveals several important differences in their approaches to regulating algorithmic collusion.

1. Scope of Antitrust Enforcement

The European Union adopts a broader interpretation of "concerted practices," enabling competition authorities to address coordinated market behaviour even without explicit agreements.In contrast, Indian competition law still relies heavily on proving agreements between competitors, making enforcement more difficult in cases involving autonomous algorithms.

2. Regulatory Innovation

The EU has adopted proactive regulatory instruments such as the Digital Markets Act to regulate digital platforms before anti-competitive harm occurs.India, by comparison, is still in the process of developing similar regulatory frameworks through the proposed Digital Competition Bill.

3. Institutional Experience

The European Commission has decades of experience investigating complex cartel cases and regulating digital markets. India's competition law regime, though increasingly sophisticated, is relatively young.

7. Key Challenges in Regulating Algorithmic Collusion

Several challenges complicate the enforcement of competition law in algorithm-driven markets.

Difficulty in Proving Collusion

Traditional antitrust frameworks require proof of agreement or communication between competitors. Algorithmic coordination may occur without such evidence.

Attribution of Liability

Determining liability in algorithmic collusion cases is complex. Responsibility may lie with firms deploying algorithms, software developers, or even platform operators.

[8] European Commission, *Horizontal Cooperation Guidelines* (2023).
[9] Alejandro Guerrero Perez et al., *Algorithmic Pricing and EU Competition Law*, Global Competition Review (2025).

Algorithmic Transparency

Many machine-learning systems operate as "black boxes," making it difficult for regulators to determine how pricing decisions are generated.

Rapid Technological Evolution

Technological innovation often outpaces regulatory frameworks, creating gaps between legal standards and market practices.

8. Recommendations

To address these challenges, competition authorities may consider several reforms:

1. Introducing statutory recognition of algorithmic collusion within competition laws.
2. Developing algorithm-auditing mechanisms for regulatory investigations.
3. Enhancing cooperation between competition regulators and AI experts.
4. Strengthening ex-ante digital market regulation for dominant platforms.
5. Promoting international cooperation between competition authorities.

9. Conclusion

Algorithmic collusion represents a significant challenge for contemporary competition law regimes. As pricing algorithms become increasingly sophisticated, traditional legal frameworks designed to regulate human conspiracies may struggle to address automated coordination among firms.

The comparative analysis of India and the European Union demonstrates that while both jurisdictions recognize the risks posed by algorithmic pricing systems, regulatory responses remain evolving. The European Union has begun adopting proactive regulatory frameworks, whereas India is still developing mechanisms to address digital market competition.

Ultimately, effective regulation of algorithmic collusion will require modernized antitrust doctrines, technological expertise, and proactive regulatory strategies capable of addressing the complexities of AI-driven markets.