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Algorithmic Pricing In Indian E-Commerce Platforms: Competition Law Challenges In The Age Of Artificial Intelligence

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ABSTRACT

The increasing adoption of Artificial Intelligence (AI) and machine learning in digital commerce has transformed pricing strategies through algorithmic pricing systems. These systems enable businesses to analyse consumer behaviour, competitor prices, inventory levels, and market trends in real time. While algorithmic pricing enhances efficiency and market responsiveness, it also raises significant competition law concerns. Algorithms may facilitate anti-competitive outcomes such as price-fixing, tacit collusion, discriminatory pricing, and abuse of market dominance without explicit human coordination.

This paper examines the legal implications of algorithmic pricing in Indian e-commerce platforms and evaluates the adequacy of the Competition Act, 2002 in addressing AI-driven anti-competitive conduct. The study analyses the risks of algorithmic collusion, reviews relevant statutory provisions and judicial precedents, and compares regulatory approaches adopted in the European Union, United States, and United Kingdom. The research finds that traditional competition law concepts based on agreement and human intent are insufficient to regulate autonomous algorithmic conduct. It concludes that India requires AI-specific competition guidelines, algorithmic transparency measures, audit requirements, and a modernized digital competition framework to safeguard competition and consumer welfare in the digital economy.

Keywords: Algorithmic Pricing, Artificial Intelligence, Competition Law, E-Commerce, Digital Markets, Consumer Welfare, Competition Act 2002.

Chapter 1: Introduction

Artificial Intelligence has fundamentally transformed business operations, particularly within digital markets. One of the most significant developments is the emergence of algorithmic pricing, whereby automated systems determine and modify prices based on real-time market information. E-commerce platforms such as Amazon, Flipkart, Myntra, and BigBasket increasingly rely on pricing algorithms to optimize profits and improve competitiveness.

Algorithmic pricing offers substantial benefits, including operational efficiency, dynamic market responsiveness, and enhanced consumer engagement. However, it also creates concerns regarding algorithmic collusion, price discrimination, abuse of dominance, and reduced market competition.

1.1 Research Objectives

1. To examine the concept and operation of algorithmic pricing.
2. To analyse competition law challenges arising from AI-driven pricing.
3. To evaluate the adequacy of the Competition Act, 2002.
4. To compare international regulatory approaches.
5. To propose reforms for regulating algorithmic pricing in India.

1.2 Research Hypothesis

The existing framework under the Competition Act, 2002 is inadequate to effectively regulate autonomous algorithmic pricing practices and requires regulatory reform.

Chapter 2: Conceptual Framework Of Algorithmic Pricing

Algorithmic pricing refers to the use of automated software, artificial intelligence, and machine learning systems to determine and adjust prices in response to market conditions.

AI-driven pricing systems analyse:

Consumer demand

Competitor pricing

Inventory level

Purchasing behaviour

Economic trends

2.1 Types of Pricing Algorithms

1. Rule-Based Algorithms

   Operate through predetermined instructions.

2. Dynamic Pricing Algorithms

   Continuously adjust prices according to market conditions.

3. Machine Learning Algorithms

   Learn from historical and real-time data.

4. Personalized Pricing Algorithms

   Offer different prices to different consumers.

5. Reinforcement Learning Algorithms

   Independently identify profit-maximizing pricing strategies.

While these technologies increase efficiency, they also increase the risk of coordinated pricing behaviour among competitors.

Chapter 3: Algorithmic Pricing In Indian E-Commerce

India's digital economy has expanded rapidly due to increased internet access, smartphone penetration, digital payments, and government initiatives such as Digital India.

3.1 Use of Algorithmic Pricing by Major E-Commerce Platforms

The rapid expansion of India's digital economy has significantly transformed the retail sector. Major e-commerce platforms such as Amazon, Flipkart, Myntra, BigBasket, and Reliance Digital increasingly rely on artificial intelligence (AI) and algorithmic pricing systems to optimize business operations and enhance market competitiveness. These algorithms process vast amounts of real-time data to determine prices dynamically and efficiently.

3.1.1 Monitoring Competitor Prices

One of the primary functions of pricing algorithms is the continuous monitoring of competitors' pricing strategies. Algorithms collect and analyse data from competing platforms and automatically adjust product prices in response to market fluctuations. For example, if a competitor reduces the price of a particular product, the algorithm may immediately lower the firm's price to remain competitive. This enables businesses to respond rapidly to changing market conditions without requiring manual intervention.

The ability to monitor competitors in real time increases market efficiency but also raises concerns regarding coordinated pricing behaviour. When competing firms employ similar algorithms, prices may converge, potentially reducing competition and facilitating tacit collusion.

3.1.2 Dynamic Pricing

Dynamic pricing refers to the practice of adjusting prices in response to demand, supply, consumer behaviour, seasonal trends, and market conditions. E-commerce platforms frequently use dynamic pricing during festive sales, flash sales, and promotional events.

For instance, prices may increase during periods of high demand and decrease when demand declines. Airlines, ride-sharing services, hotel booking platforms, and online retailers extensively utilize dynamic pricing models. While dynamic pricing allows businesses to maximize profits and allocate resources efficiently, excessive fluctuations may create concerns regarding fairness and consumer protection.

3.1.3 Inventory Management

Algorithmic pricing systems also assist businesses in managing inventory effectively. By analysing stock levels and demand forecasts, algorithms can adjust prices to optimize inventory turnover.

When inventory levels are high, algorithms may reduce prices to stimulate sales and prevent stock accumulation. Conversely, limited inventory may result in higher prices to maximize profitability. Effective inventory management reduces storage costs, minimizes wastage, and enhances operational efficiency.

3.1.4 Demand Forecasting

Artificial intelligence enables businesses to predict consumer demand with greater accuracy. Pricing algorithms analyse historical sales data, consumer preferences, purchasing patterns, economic indicators, and seasonal trends to forecast future demand.

Accurate demand forecasting allows businesses to plan production, manage inventories, and establish pricing strategies more effectively. For example, e-commerce platforms can anticipate increased demand during festive seasons such as Diwali and adjust prices accordingly. This predictive capability improves business performance and enhances customer satisfaction by ensuring product availability.

3.1.5 Revenue Maximization

The ultimate objective of algorithmic pricing is revenue optimization. Pricing algorithms continuously evaluate market conditions and consumer behaviour to identify the most profitable pricing strategy.

Through machine learning techniques, algorithms can determine price points that maximize sales volume and profit margins simultaneously. By balancing demand and profitability, businesses can achieve sustained revenue growth. However, the pursuit of revenue maximization may sometimes encourage practices that adversely affect competition and consumer welfare.

3.2 Benefits of Algorithmic Pricing

Algorithmic pricing provides numerous advantages to businesses, consumers, and digital marketplaces. The increasing adoption of AI-driven pricing systems reflects their ability to improve efficiency, reduce costs, and enhance market responsiveness.

3.2.1 Improved Efficiency

Automation significantly reduces the need for manual price monitoring and adjustment. Algorithms can process large volumes of market data within seconds and implement pricing decisions instantaneously. This improves operational efficiency and allows businesses to allocate resources more effectively.

Moreover, automated pricing systems reduce human error and ensure greater consistency in pricing decisions.

3.2.2 Faster Decision-Making

Traditional pricing decisions often require extensive market analysis and managerial approval. Algorithmic pricing eliminates these delays by enabling real-time decision-making based on continuously updated information.

Rapid pricing adjustments help firms respond quickly to market changes, competitor actions, and fluctuations in consumer demand. Faster decision-making enhances competitiveness and market adaptability.

3.2.3 Better Inventory Management

By integrating pricing strategies with inventory levels, businesses can optimize stock management and reduce inefficiencies. Algorithms facilitate quicker inventory turnover, prevent overstocking, and minimize losses arising from unsold goods.

Improved inventory management contributes to cost reduction and enhances overall business performance.

3.2.4 Competitive Pricing

Algorithmic systems enable firms to maintain competitive prices by continuously monitoring market conditions and competitor activities. Consumers often benefit from lower prices and increased access to promotional offers.

In highly competitive digital markets, algorithmic pricing encourages businesses to improve efficiency and offer better value to consumers.

3.2.5 Enhanced Consumer Experience

Consumers benefit from personalized recommendations, targeted discounts, and improved product availability. Pricing algorithms help ensure that products remain competitively priced and readily accessible.

Additionally, consumers can compare prices across multiple platforms, promoting transparency and informed purchasing decisions. As a result, algorithmic pricing contributes to improved customer satisfaction and engagement.

3.3 Challenges Associated with Algorithmic Pricing

Despite its numerous benefits, algorithmic pricing presents significant legal, economic, and ethical challenges. These concerns have attracted increasing attention from competition authorities and policymakers worldwide.

3.3.1 Price Volatility

One of the major drawbacks of algorithmic pricing is excessive price volatility. Because algorithms respond instantly to market conditions, prices may fluctuate frequently within short periods.

Such volatility can create uncertainty for consumers and undermine confidence in digital markets. In some cases, rapid price increases during emergencies or periods of high demand may be perceived as unfair or exploitative.

3.3.2 Personalized Price Discrimination

Advanced algorithms can analyse individual consumer behaviour, purchasing history, geographic location, and browsing patterns to determine willingness to pay. This enables firms to charge different prices to different consumers for the same product.

Although personalized pricing may increase efficiency, it raises concerns regarding fairness, transparency, and consumer exploitation. Consumers are often unaware that prices are being customized based on personal data.

3.3.3 Entry Barriers for Smaller Firms

Large digital platforms possess significant advantages in terms of data access, technological infrastructure, and financial resources. Small and medium-sized enterprises often lack the capacity to develop sophisticated pricing algorithms.

As a result, algorithmic pricing may strengthen the competitive position of dominant firms and create barriers to market entry. This can reduce competition and limit opportunities for smaller businesses.

3.3.4 Increased Market Concentration

The extensive use of AI and algorithmic pricing may contribute to market concentration by reinforcing the dominance of large platforms. Firms with access to superior data and advanced technologies can achieve significant competitive advantages.

Over time, these advantages may result in reduced competition, increased market power, and diminished consumer choice. Competition authorities therefore closely monitor the impact of digital technologies on market structures.

3.3.5 Potential Algorithmic Collusion

Perhaps the most significant competition law concern associated with algorithmic pricing is the risk of algorithmic collusion. Pricing algorithms may independently learn that maintaining higher prices is more profitable than engaging in aggressive price competition.

Even in the absence of explicit communication or agreement among competitors, algorithms may generate coordinated pricing outcomes similar to traditional cartels. Such conduct challenges conventional competition law principles because proving the existence of an agreement becomes increasingly difficult.

Consequently, algorithmic collusion has emerged as one of the most pressing regulatory challenges in the digital economy and highlights the need for updated competition law frameworks capable of addressing AI-driven market behaviour.

The growing dependence on automated pricing systems requires closer competition law scrutiny.

Chapter 4: Competition Law And Algorithmic Collusion

4.1 Concept of Competition Law

Competition law seeks to preserve competitive market structures, protect consumer welfare, and prevent market distortions. The Competition Act, 2002 was enacted to prevent practices having an appreciable adverse effect on competition, promote economic efficiency, and safeguard consumer interests. In digital markets, competition law has acquired greater significance because data, algorithms, and network effects increasingly determine market power.

4.2 Anti-Competitive Agreements under Section 3[1]

Section 3 of the Competition Act prohibits agreements that directly or indirectly determine purchase or sale prices. Traditional cartelization generally requires evidence of communication and coordination among competitors. However, algorithmic pricing challenges this requirement because algorithms can independently arrive at similar pricing strategies.

4.3 Algorithmic Collusion

Algorithmic collusion refers to a situation where competing firms employ algorithms that result in coordinated pricing outcomes. Scholars have identified four models:[2]

- Messenger Model
- Hub-and-Spoke Model
- Predictable Agent Model
- Autonomous AI Collusion

The most concerning model is autonomous collusion, where machine-learning systems independently learn that maintaining higher prices maximizes profits.[3]

4.4 Consumer Welfare Implications

Algorithmic collusion may increase prices, reduce innovation, and diminish consumer choice. Since consumer welfare is the central objective of competition law, algorithmic conduct resulting in artificial price increases should attract regulatory scrutiny.

4.5 Need for Reinterpretation of Competition Law

Existing legal concepts such as agreement, intent, and concerted practice were developed in an era of human decision-making. Courts may need to adopt a broader interpretation capable of addressing autonomous coordination facilitated by artificial intelligence.

Chapter 5: Legal Framework In India

5.1 Applicability of Competition Act, 2002[4]

[1] Competition Act, 2002, s. 3.
[2] Ariel Ezrachi & Maurice Stucke, *Virtual Competition* (Harvard University Press, 2016).
[3] Ariel Ezrachi & Maurice E. Stucke, "Artificial Intelligence and Collusion" (2017) University of Illinois Law Review 1775.
[4] Competition Act, 2002, s. 4.

Although the Competition Act does not explicitly mention algorithms or artificial intelligence, several provisions can be applied to AI-driven conduct.

Section 3: Anti-Competitive Agreements[5]

Section 3 may apply where firms intentionally deploy algorithms to facilitate price coordination. However, proving an "agreement" becomes difficult when collusive outcomes arise through machine-learning interactions.

Section 4: Abuse of Dominant Position

Large digital platforms possess significant advantages arising from network effects, consumer data, and technological capabilities. Algorithmic pricing may strengthen dominance through discriminatory pricing and exclusionary conduct.

5.2 Role of Competition Commission of India

The Competition Commission of India (CCI) is responsible for preventing anti-competitive agreements and abuse of dominance. The Commission has increasingly focused on digital markets and technology platforms.

In algorithmic pricing investigations, the CCI may need to examine:

- Source codes
- Pricing software
- Data-sharing arrangements
- Machine-learning systems
- Platform algorithms

5.3 Relevant Judicial Decisions

CCI v. Steel Authority of India Ltd. (2010)[6]

The Supreme Court emphasized the broad investigative powers of the CCI and recognized its role in maintaining competitive markets.

Excel Crop Care Ltd. v. CCI (2017)[7]

The Court reiterated that cartel behaviour represents one of the most serious violations of competition law.

Rajasthan Cylinders and Containers Ltd. v. Union of India (2018)[8]

The Court clarified that parallel pricing alone cannot establish cartelization unless evidence of coordination exists.

These decisions highlight the evidentiary challenges that would arise in algorithmic collusion cases.

5.4 Regulatory Gaps

Major deficiencies include:

[5] Competition (Amendment) Act, 2023.

[6] Competition Commission of India v. Steel Authority of India Ltd., (2010) 10 SCC 744.
[7] Excel Crop Care Ltd. v. Competition Commission of India, (2017) 8 SCC 47.
[8] Rajasthan Cylinders and Containers Ltd. v. Union of India, (2018) 13 SCC 563.

- Absence of AI-specific provisions.
- No statutory definition of algorithmic collusion.
- Lack of mandatory algorithm audits.
- Limited technical expertise within enforcement agencies.
- Fragmented regulation involving competition, consumer protection, and data governance.

Chapter 6: Comparative Analysis Of Regulatory Approaches To Algorithmic Pricing

6.1 European Union

The European Union (EU) has emerged as one of the most proactive jurisdictions in addressing the competition law challenges posed by artificial intelligence, algorithmic pricing, and digital markets. The EU's regulatory framework combines traditional competition law with specialized legislation aimed at ensuring fairness, transparency, and accountability in digital markets.

Article 101 of the Treaty on the Functioning of the European Union (TFEU)

Article 101 prohibits agreements, decisions, and concerted practices that prevent, restrict, or distort competition within the internal market. The provision is particularly relevant in cases involving algorithmic collusion because it targets anti-competitive coordination among market participants. Traditional price-fixing arrangements are clearly prohibited under Article 101; however, the increasing use of pricing algorithms has raised concerns regarding tacit coordination facilitated by artificial intelligence.

Algorithms can continuously monitor competitors' prices and instantly adjust pricing strategies, thereby reducing incentives for price competition. Even in the absence of direct communication between firms, algorithmic systems may generate outcomes similar to cartel behaviour. Consequently, European competition authorities have emphasized the need to interpret Article 101 broadly to address emerging forms of digital collusion.

Article 102 TFEU

Article 102 prohibits the abuse of a dominant position within the internal market. Digital platforms often possess significant market power due to network effects, access to large volumes of consumer data, and technological advantages. Algorithmic pricing may strengthen such dominance by enabling firms to engage in discriminatory pricing, exploit consumer data, or exclude competitors from the market.

For example, dominant platforms may use sophisticated algorithms to identify consumer willingness to pay and charge different prices to different consumers. Such conduct raises concerns regarding exploitation, market foreclosure, and consumer welfare.

Digital Markets Act (DMA)

Recognizing the limitations of traditional competition law in regulating digital markets, the European Union enacted the Digital Markets Act (DMA) in 2022. The DMA introduces a preventive regulatory framework targeting large digital platforms designated as "gatekeepers."

The DMA imposes obligations on gatekeepers to ensure fair competition and prevent anti-competitive conduct before it occurs. Key obligations include:

- Prohibiting self-preferencing practices.
- Ensuring interoperability between digital services.
- Restricting unfair use of business-user data.
- Promoting transparency in platform operations.

- Preventing exclusionary conduct that harms competition.

The DMA represents a significant shift from ex-post enforcement to ex-ante regulation and serves as a model for digital market governance worldwide.

Artificial Intelligence Act (AI Act)

The European Union's Artificial Intelligence Act represents the world's first comprehensive legal framework governing AI systems. The Act adopts a risk-based approach and imposes transparency, accountability, and compliance requirements on high-risk AI systems.

Although the AI Act is not specifically designed as competition legislation, its provisions are relevant to algorithmic pricing because they require:

- Transparency regarding AI decision-making processes.
- Human oversight mechanisms.
- Risk assessment procedures.
- Accountability for AI-generated outcomes.

The AI Act complements competition law by addressing concerns associated with opaque algorithmic systems and enhancing regulatory oversight.

Evaluation of the EU Approach

The European Union provides the most comprehensive framework for regulating algorithmic pricing because it integrates competition law, digital market regulation, and AI governance. By combining Articles 101 and 102 TFEU with the DMA and AI Act, the EU has developed a multidimensional regulatory strategy capable of addressing both traditional and emerging forms of anti-competitive conduct.

6.2 United States

The United States has traditionally relied upon antitrust law to regulate anti-competitive conduct. Unlike the European Union, the United States has not adopted a comprehensive legislative framework specifically addressing artificial intelligence or algorithmic pricing. Nevertheless, American competition authorities have increasingly recognized the challenges posed by digital markets and AI-driven pricing systems.

Sherman Antitrust Act, 1890

The Sherman Act remains the cornerstone of American antitrust regulation. Section 1 prohibits contracts, combinations, or conspiracies that unreasonably restrain trade, while Section 2 addresses monopolization and abuse of market power.

Algorithmic pricing presents unique challenges under the Sherman Act because traditional antitrust enforcement generally requires evidence of an agreement among competitors. Where autonomous algorithms independently generate collusive outcomes, proving the existence of an agreement becomes considerably more difficult.

Role of the Federal Trade Commission (FTC)

The Federal Trade Commission (FTC) plays a central role in investigating anti-competitive conduct in digital markets. The FTC has expressed growing concern regarding the use of pricing algorithms and artificial intelligence in e-commerce.

Recent FTC initiatives have focused on:

- Data-driven market power.

- Digital platform dominance.
- Consumer protection in algorithmic decision-making.
- AI accountability and transparency.

Although the United States currently lacks dedicated AI legislation comparable to the EU AI Act, regulatory agencies increasingly scrutinize algorithmic conduct that may harm competition or consumers.

Evaluation of the US Approach

The American approach remains heavily dependent on traditional antitrust principles and case-by-case enforcement. While this framework provides flexibility, critics argue that existing laws may be insufficient to address autonomous algorithmic collusion and rapidly evolving digital markets. Consequently, scholars and policymakers continue to debate the need for AI-specific competition regulations.

6.3 United Kingdom

The United Kingdom has adopted a balanced approach that combines competition law enforcement with proactive market research and technological expertise.

Competition and Markets Authority (CMA)

The Competition and Markets Authority (CMA) has emerged as a leading authority in studying algorithmic pricing and digital competition. Through various reports and market investigations, the CMA has examined the impact of algorithms on competition and consumer welfare.

The CMA acknowledges that algorithms offer significant benefits, including:

- Greater pricing efficiency.
- Enhanced market responsiveness.
- Reduced transaction costs.
- Increased transparency.

However, the authority also recognizes that algorithms may facilitate tacit coordination and reduce competitive pressure.

Digital Markets Regulation

The UK has increasingly focused on regulating digital platforms through specialized institutions and market investigations. Regulatory efforts emphasize:

- Fair competition.
- Consumer protection.
- Transparency in algorithmic decision-making.
- Accountability of digital platforms.

The establishment of the Digital Markets Unit (DMU) demonstrates the UK's commitment to addressing competition issues in technology-driven markets.

Evaluation of the UK Approach

The UK model highlights the importance of integrating legal expertise with technological understanding. Rather than relying solely on traditional competition law, the UK emphasizes research, monitoring, and

specialized institutional capacity. This approach may be particularly useful for emerging economies seeking to regulate AI-driven markets.

6.4 Lessons for India

The comparative analysis reveals that no jurisdiction has fully resolved the challenges associated with algorithmic pricing. Nevertheless, valuable lessons can be drawn from international experiences.

India should consider adopting the following measures:

1. Development of AI-specific competition guidelines addressing algorithmic collusion and automated pricing systems.
2. Introduction of transparency obligations requiring businesses to disclose significant algorithmic pricing practices.
3. Establishment of mandatory algorithm audits for dominant digital platforms and large e-commerce operators.
4. Creation of specialized technical units within the Competition Commission of India (CCI) to investigate algorithmic conduct and AI-driven market behaviour.
5. Adoption of a Digital Markets framework similar to the European Union's Digital Markets Act to address gatekeeper platforms and prevent anti-competitive practices.
6. Enhanced cooperation among competition authorities, consumer protection agencies, and data protection regulators.

Critical Comparative Observation

Among the jurisdictions examined, the European Union offers the most comprehensive regulatory model because it integrates competition law, digital market regulation, and AI governance within a unified framework. The United States provides valuable experience in antitrust enforcement, while the United Kingdom demonstrates the importance of specialized regulatory expertise. India can benefit from these approaches by developing a hybrid framework that preserves innovation while ensuring fair competition and consumer welfare in the digital economy.

Chapter 7: Challenges In Regulating Ai-Driven Pricing

1. Transparency Challenges
   Machine-learning systems often operate as black boxes, making regulatory oversight difficult.
2. Accountability Issues
   Determining responsibility among developers, platforms, and businesses remains complex.
3. Detection Difficulties
   Algorithms can coordinate pricing faster and more effectively than human actors.
4. Innovation vs Regulation
   Regulators must balance technological innovation with competition protection.
5. An excessively restrictive framework may discourage innovation, while inadequate regulation may permit anti-competitive conduct.

Chapter 8: Findings And Recommendations

8.1 Major Findings

1. Algorithmic pricing is increasingly prevalent in Indian e-commerce.
2. It generates significant efficiency gains.
3. Algorithmic collusion presents serious competition risks.

4. Existing competition law is not fully equipped to address autonomous AI conduct.
5. Transparency and accountability remain major concerns.
6. India lacks a dedicated regulatory framework for AI-driven competition issues.

8.2 Recommendations

1. Develop AI-specific competition guidelines.
2. Strengthen technical capacity within the CCI.
3. Introduce algorithmic transparency requirements.
4. Establish mandatory algorithm audits.
5. Improve consumer disclosures regarding dynamic pricing.
6. Promote inter-agency regulatory coordination.
7. Encourage ethical AI governance frameworks.

8.3 Proposed Legal Reforms

- Statutory recognition of algorithmic collusion.
- Expansion of the concept of agreement.
- Algorithm accountability provisions.
- Mandatory competition risk assessments.
- Digital competition legislation.
- Independent algorithm audit regulations.

Chapter 9: Conclusion

Algorithmic pricing has transformed digital commerce by enabling real-time pricing decisions based on sophisticated data analytics and artificial intelligence. Although these technologies improve efficiency and competitiveness, they also generate new risks for market competition and consumer welfare.

The study demonstrates that the Competition Act, 2002 provides a useful foundation for regulating anti-competitive conduct but remains inadequately equipped to address autonomous algorithmic behaviour. Traditional concepts of agreement, intent, and collusion require reinterpretation in the context of AI-driven markets.

India must adopt a future-oriented regulatory framework that combines competition law, digital market governance, and AI accountability mechanisms. By introducing transparency requirements, algorithm audits, AI-specific competition guidelines, and stronger institutional capacity, India can encourage innovation while preserving fair competition and consumer welfare.

The future of digital commerce depends not only on technological advancement but also on the ability of legal institutions to adapt effectively to emerging forms of algorithmic market conduct.

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