Algorithmic Pricing and the New Face of Price Discrimination

Petre Bianca-Maria[1], Stancu Stefano Andrea[2]

[1] Lucian Blaga University of Sibiu, Faculty of Economic Sciences, Sibiu, Romania, biancamaria.petre@ulbsibiu.ro
[2] Lucian Blaga University of Sibiu, Faculty of Economic Sciences, Sibiu, Romania, stefanoandrea.stancu@ulbsibiu.ro

Abstract: In the evolving digital economy, companies increasingly utilize algorithmic pricing systems to dynamically adjust prices in response to real-time data including browsing history, purchase patterns, device usage, and geographic location. This paper investigates the mechanisms behind algorithmic pricing and its role in facilitating novel forms of price discrimination that disrupt traditional economic models. Employing a qualitative research methodology, the study synthesizes insights from academic literature, industry practices, and regulatory frameworks to assess the ethical, economic, and social ramifications of this pricing approach. It identifies key benefits such as enhanced market efficiency and price flexibility, while highlighting significant risks including privacy invasion, consumer distrust, and potential socioeconomic inequality. Real-world applications from companies like Uber, Amazon, and major airlines demonstrate the practical deployment and covert nature of these practices, often leaving consumers unaware of tailored pricing structures. Ethical dilemmas are examined regarding fairness and transparency, and the paper critiques existing legal protections, emphasizing the need for updated policies that address the specific challenges of algorithmic-driven pricing. The conclusion underscores the dual potential of algorithmic pricing: its capacity to improve market operations and simultaneously create inequities if left unchecked. The study calls for heightened consumer awareness, improved transparency, and comprehensive regulatory reforms. Further research is proposed to explore consumer perceptions of fairness, the balance between efficiency and equity, and mechanisms for ensuring algorithmic accountability in digital markets. This analysis contributes to ongoing debates in economics and policy, offering foundational insights for future investigations into dynamic pricing in data-driven environments.

Key words: Algorithmic Pricing, Price Discrimination, Digital Economy, Consumer Behavior, Data Privacy

JEL classification: D40, L86, D18, K20

1. Introduction

The advent of digital platforms has revolutionized pricing strategies, with firms now leveraging real-time data to personalize offers at an unprecedented scale. These digital infrastructures, encompassing e-commerce websites, mobile applications, and social media marketplaces, have facilitated an environment where pricing no longer remains static or universally applied. Instead, businesses can monitor individual consumer behavior, analyze purchasing patterns, assess browsing histories, and identify specific variables such as the time of access, device type, geographic location, and even purchase urgency to calibrate pricing strategies tailored to individual or segmented consumers.

This paper investigates algorithmic pricing—a modern pricing approach where machine learning models and artificial intelligence (AI) dynamically adjust prices in response to fluctuating data streams. These systems not only respond to conventional market factors such as supply and demand but also consider more personal and contextual data points, like a consumer's digital footprint and socio-economic indicators inferred through online behavior. As a result, pricing decisions occur in milliseconds, reflecting real-time market sentiment, competition, and consumer profile analytics.

The motivation for this study stems from the growing academic and public debate about the fairness and regulatory implications of such sophisticated pricing practices. Policymakers, consumer rights advocates, and scholars have expressed concern that algorithmic pricing might erode traditional principles of fairness and transparency in commercial transactions. The covert nature of price adjustments and the asymmetry of information between businesses and consumers present challenges not only for market integrity but also for ethical governance in the digital economy.

This issue is highly topical, given the surge in consumer data collection, the rapid deployment of AI tools in commerce, and the increasing reliance on algorithmic systems to govern market interactions. From dynamic airline ticket pricing to personalized retail offers and ride-sharing surge charges, algorithmic pricing has become an integral feature of digital marketplaces. Despite its operational efficiencies and market responsiveness, its implications for consumer equity, privacy, and market regulation remain areas of active inquiry.

This paper is structured to first contextualize the issue through a comprehensive literature review that traces the evolution of price discrimination theories and examines contemporary academic perspectives on data-driven pricing. Following this, the research methodology section outlines the qualitative approach employed, emphasizing secondary data analysis from scholarly sources, corporate reports, and legal frameworks. The core of the paper is contained within the results and discussion section, which explores algorithmic pricing mechanisms, real-world applications, ethical concerns, regulatory shortcomings, and the potential benefits and risks of these practices.

By systematically dissecting each aspect of algorithmic pricing, this paper aims to contribute meaningful insights to the ongoing discourse in economics, policy-making, and consumer rights advocacy. It seeks not only to clarify the operational processes behind algorithmic price discrimination but also to highlight the socio-economic repercussions of this evolving pricing strategy. Ultimately, the paper aspires to inform future policy interventions and

academic research initiatives aimed at balancing market efficiency with consumer protection and ethical integrity in digital economies.

2. Literature review

The concept of price discrimination has been extensively explored within economic literature, traditionally classified into first, second, and third-degree forms (Varian, 1989). First-degree price discrimination involves charging each consumer their maximum willingness to pay, while second-degree pricing differentiates based on quantity purchased or product variation. Third-degree discrimination, often most relevant in digital environments, separates consumers into identifiable groups according to observable characteristics.

The emergence of the digital economy has enabled a more refined and often concealed form of third-degree discrimination. Through sophisticated profiling techniques, companies can segment consumers using data such as device type, browsing history, and real-time online behavior (Chen, Mislove, & Wilson, 2016). Studies by Hannak, Soeller, Lazer, Mislove, and Wilson (2014) and Mikians, Gyarmati, Erramilli, and Laoutaris (2013) revealed substantial pricing differences in online markets, showing that consumers accessing identical products from varying devices or geographic locations might encounter different prices without being informed. This evidence highlights how digital platforms increasingly personalize pricing strategies in ways that are often invisible to users.

Alongside these market dynamics, a growing body of scholarship addresses the ethical implications of algorithmic pricing. Mittelstadt, Allo, Taddeo, Wachter, and Floridi (2016) have raised concerns regarding the fairness and transparency of automated decision-making systems, warning that while personalization can improve consumer experience, it may also compromise market transparency and reinforce socio-economic disparities when misused for discriminatory pricing. Additionally, unresolved issues surrounding data ownership and the adequacy of informed consent remain central to debates over digital commerce practices.

From a regulatory perspective, the European Commission (2020) has identified significant gaps in existing legal frameworks when confronting algorithmic pricing practices, particularly in matters of data privacy, profiling rights, and consumer protection. The Commission has emphasized the need for clear policy guidelines and greater algorithmic transparency to ensure equitable treatment of digital consumers, with special attention to vulnerable and marginalized groups. While emerging research acknowledges that algorithmic pricing can enhance market efficiency, it simultaneously advocates for a careful, ethically guided regulatory approach to guard against exploitation.

3. Research methodology

This paper adopts a qualitative, exploratory research design based on secondary data analysis. The study involves a critical review of existing literature, industry reports, and documented cases of algorithmic pricing in practice. Methodologically, qualitative content analysis was chosen for its suitability in identifying recurring patterns, ethical concerns, and regulatory gaps within narrative data sources. Key academic sources include peer-reviewed journals, legal reports, market analysis papers, and regulatory publications from entities such as the European Commission and U.S. Federal Trade Commission.

In addition to scholarly literature, the study integrates publicly accessible corporate documentation from major digital firms, including terms of service, privacy policies, and algorithm transparency reports where available. These documents provided insights into corporate perspectives on dynamic pricing and data handling practices. Furthermore, industry white papers and media investigations contributed to contextualizing real-world applications of algorithmic pricing.

Content analysis was conducted through a systematic reading and thematic categorization of these materials, focusing on operational mechanisms, consumer outcomes, ethical dilemmas, and regulatory responses. Limitations encountered include restricted access to proprietary algorithmic models and internal consumer profiling methodologies, which remain confidential corporate assets. Consequently, the study relies heavily on documented outcomes, empirical investigations, and regulatory critiques reported in public literature.

Despite these limitations, the qualitative approach enabled an in-depth examination of trends and controversies surrounding algorithmic pricing, offering a balanced understanding of both its market potential and its socio-economic risks. The methodology also allowed for triangulation by comparing diverse data types, enhancing the reliability of the findings and supporting well-rounded conclusions on this complex, fast-evolving issue. This paper adopts a qualitative, exploratory research design based on secondary data analysis. The study involves a critical review of existing literature, industry reports, and documented cases of algorithmic pricing in practice. Key sources include peer-reviewed journals, regulatory guidelines, and corporate policy documents. Content analysis was conducted to extract recurring themes related to pricing mechanisms, consumer impact, and regulatory concerns. Limitations encountered include restricted access to proprietary algorithmic models and consumer data, which remain confidential corporate assets. As a result, the analysis relies heavily on reported findings and publicly available data.

4. Results and discussions
4.1 What Is Algorithmic Pricing?

Algorithmic pricing involves the use of AI and machine learning to automatically adjust product or service prices in real time. Variables considered include purchase history, browsing patterns, time of day, user device, and location. The objective is to optimize revenue by identifying consumer willingness to pay. These pricing algorithms

continuously process and analyze vast amounts of data, enabling firms to adjust prices dynamically and individually, an advancement far beyond traditional segmentation strategies. This real-time responsiveness allows firms to capitalize on market trends, user behavior, and competitor activity nearly instantaneously, offering a level of pricing agility unattainable through manual methods.

4.2 How It Enables Price Discrimination

Unlike traditional price discrimination, algorithmic pricing facilitates hyper-personalized offers. Wealthier users or those using premium devices might see higher prices, while price-sensitive users receive targeted discounts. These practices fall under an evolved form of third-degree price discrimination but are more covert and data-driven. This approach often bypasses the overt categorizations of classical economics, instead relying on probabilistic models and behavioral indicators to determine individual willingness to pay. Personalization can also influence the consumer decision-making process by shaping perceived value and urgency, contributing to increased profits while often leaving consumers unaware of the practice. As a result, price discrimination becomes embedded in digital experiences, influencing decisions at a subconscious level.

4.3 Real-World Examples

Notable instances include Uber's surge pricing model, which adjusts ride fares based on demand fluctuations and user profiles. Amazon has been found to show different product prices based on browsing history and purchase patterns. Airlines and hotels employ sophisticated pricing engines that modify rates in milliseconds, taking into account user behavior, booking history, and competitive pricing. According to a study by Mikians et al., e-commerce platforms have displayed price differences of up to 166% depending on user profile data and location. Such examples illustrate the expansive reach and flexibility of algorithmic pricing models across industries.

4.4 Ethical and Economic Questions

Key ethical questions arise: Is it fair for two consumers to pay different prices for the same product based on hidden profiles? Economically, while it may enhance efficiency and market responsiveness, it risks exploiting information asymmetry and undermining consumer trust. Ethical scrutiny is heightened when algorithmic pricing strategies capitalize on consumer vulnerabilities or socio-economic disparities, raising concerns about digital fairness and market inclusivity. This becomes particularly problematic when users are unaware of the factors driving price changes, leading to what scholars call "creeping personalization," where decision environments are manipulated without explicit consent.

From a normative standpoint, Kantian ethics would argue that treating consumers merely as data points rather than as ends in themselves is inherently unethical. Conversely, a utilitarian view may justify the practice if it maximizes overall welfare. Rawlsian justice, focused on fairness and protecting the least advantaged, would likely view exploitative pricing as unjust, especially if it deepens socio-economic inequality.

4.5 Regulatory Challenges

Current consumer protection laws often lack provisions for algorithmic pricing practices. There is growing pressure, particularly in the EU and U.S., for greater algorithmic transparency and accountability to ensure fairness and prevent discriminatory practices. Existing legal frameworks are typically designed for traditional forms of price discrimination and do not adequately address the intricacies of algorithmically-driven pricing, necessitating updates and new regulations that prioritize transparency, fairness, and data protection. The EU's Digital Services Act and the proposed AI Act are early steps toward regulatory control, aiming to introduce algorithmic accountability and prevent exploitative practices.

Other jurisdictions have adopted different approaches. In China, regulatory bodies like the State Administration for Market Regulation have issued warnings against AI-enabled price discrimination targeting returning customers. Canada has not yet enacted specific laws, but policy discussions are underway on AI fairness under the Digital Charter. Developing nations often lack specific regulation, raising concerns about imported pricing algorithms exacerbating inequality.

Table 1. Comparative Legal Approaches to Algorithmic Pricing

Jurisdiction	Legal Status	Key Provisions
EU	Proposed AI Act	Algorithmic transparency, human oversight
China	Enforced warning (2021)	Prohibits price hikes targeting repeat customers
Canada	Under development	AI ethics under Digital Charter principles

Source: EU Digital Services Act; China Algorithm Regulation (CAC); Canada AIDA.

4.6 Potential Benefits

When applied responsibly, algorithmic pricing can improve market efficiency, optimize inventory management, and enable price flexibility for low-income users. By dynamically adjusting prices based on demand and consumer behavior, businesses can reduce waste, manage peak demand, and offer personalized promotions that benefit both consumers and firms. It can also foster competitive pricing environments where firms are incentivized to offer fairer deals to retain consumer loyalty. Moreover, in sectors like transportation and utilities, real-time pricing can help distribute demand more evenly, leading to broader social benefits such as reduced congestion and energy conservation.

4.7 Risks and Downsides
Risks include privacy invasion, reduced consumer trust, and potential reinforcement of socio-economic inequalities as wealthier consumers may be targeted for higher pricing. Algorithmic opacity and lack of consumer awareness exacerbate these risks, as individuals are often unaware of how their data is used in pricing decisions. Additionally, reliance on predictive algorithms raises concerns about reinforcing existing biases and market segmentation that may disproportionately disadvantage vulnerable groups. In particular, marginalized users may face digital exclusion, whereby opaque pricing models unintentionally penalize those with limited digital literacy or access to price comparison tools.

Furthermore, as shown by a 2015 ProPublica investigation, even well-known platforms like Amazon and Staples were found to vary prices based on zip code, indirectly linking pricing to race and income levels. According to a 2019 Deloitte study, 66% of online shoppers are unaware that prices may vary for the same item depending on personal data, while research by Hannak et al. observed a 20–30% price variance between Android and iOS users for identical products.

4.7.1 Consumer Psychology Perspective
Consumers' perceptions of fairness heavily influence their emotional response to algorithmic pricing. Behavioral economics highlights phenomena like loss aversion—where perceived overpayment leads to disproportionately negative reactions—and price anchoring, where initial price exposure frames future judgments. Fairness heuristics also play a key role; if consumers sense manipulation or hidden motives, brand trust may deteriorate significantly. These psychological responses shape both immediate purchasing decisions and long-term brand loyalty. As a result, even algorithmically 'efficient' prices may provoke backlash if perceived as unfair or deceptive.

4.7.2 Stakeholder Impact Matrix
Table 2. Stakeholder Impact Matrix

Stakeholder	Benefits	Risks	Policy Needs
Consumers	Personalized discounts, better availability	Privacy loss, opaque pricing, digital inequality	Transparency rights, access to price tracking tools
Low-income Users	Occasional targeted offers	Higher vulnerability, lack of digital literacy	Subsidized access, protective regulation
Firms	Revenue maximization, inventory efficiency	Reputational damage, legal exposure	Compliance standards, ethical auditing
Regulators	Market modernization	Enforcement complexity, tech lag	Updated laws, AI literacy in policy frameworks

Source: Adapted from Yeung (2018), Regulation & Governance.

4.8 Circumvention Strategies: The Role of VPNs
One of the most accessible tools consumers use to counter algorithmic price discrimination is the Virtual Private Network (VPN). By masking the user's IP address and simulating access from different geographic locations, VPNs can obscure or alter the data that pricing algorithms use, such as location, browsing history, or even perceived purchasing power.

VPNs allow consumers to:
- Compare regional price differences by virtually relocating to different countries or cities.
- Avoid location-based pricing where users in wealthier regions may see higher prices.
- Disrupt digital profiling, especially when used in incognito mode or combined with privacy-oriented browsers.

However, while VPNs empower consumers to reclaim some control, they present ethical and legal grey zones. Companies may restrict access or ban users detected using VPNs, arguing that such tools distort market segmentation strategies designed for logistical or taxation reasons. Furthermore, VPN use is a reactive solution that benefits tech-savvy consumers, which could deepen the digital divide. Less-informed or less-resourced individuals remain more vulnerable to exploitative pricing, exacerbating socio-economic inequalities.

4.9 Future Technologies and Trends

Looking forward, algorithmic pricing will likely be shaped by technological advancements such as voice commerce and IoT-based pricing, where smart devices negotiate prices on behalf of users. Reinforcement learning algorithms may further refine real-time adjustments based on continuous feedback loops, potentially increasing both efficiency and complexity. At the same time, privacy-enhancing technologies, including differential privacy and federated learning, could mitigate data abuse while maintaining pricing effectiveness. The interplay between these trends will define the ethical, economic, and legal contours of the next generation of dynamic pricing.

5. Conclusions

The paper concludes that while algorithmic pricing offers notable benefits in market efficiency and resource allocation, it also raises serious ethical and regulatory concerns. Its ability to personalize prices in real time has transformed traditional pricing models into dynamic, data-driven systems that can respond swiftly to market signals. However, the covert nature of modern price discrimination demands updated legal frameworks and increased transparency from firms. Without clear disclosure and oversight, such practices risk eroding consumer trust and exacerbating existing socio-economic divides. Future research should focus on consumer perceptions of fairness in dynamic pricing and the potential for algorithmic systems to enhance market inclusivity rather than deepen inequalities. Exploring how algorithmic tools can be designed with fairness, explainability, and accessibility in mind will be essential for ensuring that innovation in pricing serves the broader public interest.

6. Acknowledgement

References

- Chen, L., Mislove, A., & Wilson, C. (2016). An empirical analysis of algorithmic pricing on Amazon Marketplace. *Proceedings of the 25th International Conference on World Wide Web*, 1339-1349.
- European Commission. (2020). White Paper on Artificial Intelligence: A European approach to excellence and trust. Available online: https://ec.europa.eu/info/publications/white-paper-artificial-intelligence-european-approach-excellence-and-trust_en (accessed on 10 May 2025).
- Hannak, A., et al. (2014). Measuring price discrimination and steering on e-commerce web sites. *Proceedings of the 2014 Conference on Internet Measurement*, 305-318.
- Mikians, J., et al. (2013). Detecting price and search discrimination on the Internet. *Proceedings of the 11th ACM Workshop on Hot Topics in Networks*, 79-84.
- Mittelstadt, B.D., et al. (2016). The ethics of algorithms: Mapping the debate. *Big Data & Society*, 3(2).
- Varian, H.R. (1989). Price discrimination. In *Handbook of Industrial Organization* (Vol. 1, pp. 597-654). Elsevier.
- Mikians, J., Gyarmati, L., Erramilli, V., & Laoutaris, N. (2012). *Detecting price and search discrimination on the Internet*. arXiv preprint arXiv:1211.5729.
- Yeung, K. (2018). *Algorithmic regulation: A critical interrogation*. Regulation & Governance, 12(4), 505–523.
- European Commission. (2022). *Digital Services Act package*. Retrieved from https://digital-strategy.ec.europa.eu/en/policies/digital-services-act-package
- Angwin, J., Mattu, S., Larson, J., & Kirchner, L. (2015). *How We Analyzed the Staples Data*. ProPublica. Retrieved from https://www.propublica.org/article/how-we-analyzed-the-staples-data
- Deloitte. (2019). *The Deloitte Consumer Review: Digital Predictions 2019*.
- Hannak, A., Soeller, G., Lazer, D., Mislove, A., & Wilson, C. (2014). *Measuring price discrimination and steering on e-commerce web sites*. In Proceedings of the 2014 conference on Internet measurement conference (pp. 305–318).