

Research on the Fairness Dilemma and Governance Strategies of E-commerce Return Services from the Perspective of Algorithmic Discrimination

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Abstract: *With the widespread application of algorithms in the e-commerce industry, the fairness dilemmas caused by algorithms have become increasingly prominent. This paper analyzes the application, formation reasons, and impacts of algorithmic discrimination in e-commerce return services. The study finds that through functions such as risk prediction and permission control, algorithms generate discriminatory decisions in links including return pricing, user permission management, and after-sales review, posing triple challenges to consumers' legitimate rights and interests, platform trust, and social equity. In response to the above status quo, this paper constructs a governance framework from three dimensions: technological improvement, institutional regulation, and ethical construction, proposing paths such as adopting fair algorithms, establishing algorithmic auditing mechanisms, and improving regulatory accountability systems to jointly promote fair algorithmic decisions in return services.*

Keywords: *Algorithmic Discrimination, E-commerce Platforms, Returns, Fairness Dilemma*

1. Introduction

Against the backdrop of the rapid development of the Internet, algorithmic decision-making has been widely applied in various links of e-commerce. Returns are a crucial part of e-commerce operations. Intelligent return services integrated with algorithms have improved the operational efficiency of e-commerce platforms, but they have also triggered consumers' doubts about fairness. Currently, algorithms participate in determining return permissions and conducting after-sales reviews in the e-commerce return process through technical means such as risk prediction and automated decision-making, and algorithmic technology has long permeated the e-commerce industry.

Existing domestic and foreign studies mainly focus on two aspects: research on e-commerce return management mostly concentrates on improving operational efficiency and controlling costs; on the other hand, research on algorithmic ethics pays more attention to traditional fields such as finance and employment. However, in the specific scenario of e-commerce return services, research on the potential systemic discrimination caused by algorithms is still insufficient. Based on this research background, this paper explores the following issues: 1. The specific application mechanisms of algorithms in e-commerce return services and their potential discriminatory risks; 2. The impacts of algorithmic discrimination on consumers' rights and interests, enterprise operations, and social equity; 3. How to construct an effective systematic governance framework to address these challenges.

The study reveals that algorithmic discrimination in e-commerce return services triggers triple dilemmas: individuals suffer unfair treatment due to algorithmic black boxes; enterprises face decision-making biases that damage brand reputation; and society may consolidate existing inequalities. The complexity of these dilemmas requires the establishment of a systematic governance plan. To this end, this paper constructs a comprehensive governance framework integrating technology, institutions, and ethics, including developing transparent algorithms and establishing auditing mechanisms; improving regulatory frameworks and clarifying powers and responsibilities; and promoting industry self-regulation and user education. This study expands the research boundary of algorithmic ethics in the e-commerce field and provides practical references for platform governance, which holds important theoretical value and practical significance in the context of deepening the digital economy.

2. An Analysis of the Current Situation of Algorithmic Application in E-commerce Return Services

2.1. Functional Evolution of Return Service Algorithms

In the initial stage, algorithms mainly served as executors of process automation. Their functions were primarily to replace manual handling of standardized tasks, such as automatically generating return logistics orders according to preset rules and triggering refund processes automatically after scan signing. The algorithmic logic at this stage was relatively simple and transparent, essentially digitally reconstructing traditional manual operation processes to improve operational efficiency and reduce labor costs. As efficiency-enhancing tools, algorithms were limited to executive-level decision-making and did not involve substantive judgments on users' rights and interests.

With the accumulation of data and the development of machine learning technology, algorithmic functions gradually evolved into the stage of risk prediction and optimal resource allocation. By integrating multi-dimensional data such as users' historical return records and consumption levels, platforms constructed predictive models aiming to accurately identify return risks. At this stage, algorithms shifted from passive execution to active intervention, and their decisions began to exhibit predictive characteristics, but they had not yet directly determined the boundaries of users' rights.

Currently, algorithmic functions are moving towards an advanced stage of global intelligent decision-making and permission control. At this stage, algorithmic systems are no longer limited to optimizing individual links but have become the decision-making core throughout the entire return process. By integrating multi-source data and complex models, algorithms directly participate in determining users' return permissions, classifying service levels, and judging the attribution of dispute liabilities. Platforms realize dynamic evaluation and classification of user behaviors through algorithms and automatically allocate differentiated service rights and interests based on evaluation results. Algorithmic decisions at this stage are characterized by significant opacity^[1] and finality, and the complexity of their internal logic exceeds the cognitive scope of ordinary users, thereby laying the groundwork for potential fairness risks.

2.2. Specific Application Scenarios of Algorithmic Decision-Making

In the specific practice of e-commerce return services, algorithmic decision-making has penetrated into multiple key links, and its wide range of application scenarios further highlights the necessity of researching algorithmic fairness.

The differentiated pricing mechanism of return insurance is a typical application scenario of algorithmic decision-making. In this scenario, algorithms analyze multi-dimensional user characteristic data, including historical return records and consumption levels, to construct personalized risk assessment models. Based on the output results of these models, the system implements different premium standards for different user groups. While this pricing mechanism reflects the concept of precise risk management, it may lead to pricing discrimination based on indirectly relevant factors.

Automated management of users' return permissions is another key scenario. In this context, algorithmic systems dynamically adjust the scope of users' return permissions by continuously monitoring and analyzing user behavior data. Specifically, users identified as having excellent credit by algorithms are granted privileges such as fast refund channels and extended return periods; in contrast, users labeled as high-risk may face restrictions on their return permissions. Although this management mechanism improves platform operational efficiency, its decision-making process lacks transparency, and users find it difficult to know the specific evaluation criteria. When algorithms make judgments based on biased data or flawed models, users' legitimate rights and interests may be infringed^[2].

Intelligent judgment in after-sales review processes is also widely adopted. Modern e-commerce platforms generally use natural language processing and computer vision technologies to automatically review return applications and relevant evidence submitted by users. By comparing historical data, identifying text emotional tendencies, and analyzing image features, algorithms make preliminary judgments on the rationality of return applications. While this intelligent review mechanism improves processing efficiency, it also has certain limitations.

2.3. Conceptual Definition of Algorithmic Fairness

Algorithmic discrimination refers to the systematic and repeatable unfair treatment of specific groups resulting from data analysis^[3]. In the specific context of e-commerce return services, algorithmic fairness is a composite concept involving multiple dimensions, which needs to be comprehensively understood from both technical characteristics and social values. From a technical implementation perspective, the design and training processes of algorithms are influenced by multiple factors such as developers' subjective choices, training data, and goal settings. These technical decisions are essentially manifestations of value judgments, determining the standards by which algorithms distinguish and treat different user groups. In the e-commerce return scenario, when algorithms incorporate indirectly relevant factors such as users' geographical locations and consumption capabilities into decision-making criteria, they embed specific value judgments into the technical system. The concealment of this value-laden nature allows algorithmic discrimination to present itself under the guise of technical neutrality, increasing the difficulty of identification and governance.

Algorithmic fairness in the e-commerce context needs to be analyzed in combination with specific business operations. In this field, algorithmic fairness includes at least three core dimensions: process fairness, outcome fairness, and procedural fairness. Process fairness requires that the logic of algorithmic decision-making is consistent with the goals of return services, avoiding differential treatment based on irrelevant characteristics; outcome fairness focuses on the differentiated impacts of algorithmic decisions on different user groups, requiring an assessment of whether they will cause systematic adverse consequences for specific groups; procedural fairness emphasizes the transparency and contestability of the decision-making process, ensuring that users enjoy necessary rights to information and appeal channels. These three dimensions together constitute the complete connotation of algorithmic fairness in the e-commerce return scenario and provide a theoretical framework for identifying and resolving fairness dilemmas.

The realization of algorithmic fairness does not pursue absolute equality of outcomes but seeks a balance between efficiency, personalization, fairness, and non-discrimination. In the specific practice of e-commerce return services, it is necessary to establish a scientific evaluation standard that not only respects the rationality of commercial operations but also protects users' basic rights and interests. Meanwhile, the realization of algorithmic fairness is a dynamic process that needs to be continuously adjusted and improved with technological development and social cognition.

3. Fairness Dilemmas Caused by Algorithmic Discrimination

3.1. Impaired Consumer Rights and Widened Digital Divide

In terms of price equality, algorithm-based differentiated pricing based on user characteristics leads to obvious unfairness. Empirical research shows that under the same commodity conditions, users residing in specific regions need to pay approximately 15% higher return insurance premiums than the benchmark rate^[4]. This geographical location-based pricing mechanism constitutes price discrimination against specific groups. More notably, when algorithms incorporate indirectly relevant factors such as users' consumption levels and device types into risk assessment models, low-income groups often bear higher security costs, which not only increases their economic burden but also restricts their right to equal access to services.

At the level of service access, erroneous algorithmic judgments may harm users' rights and interests. Internal data from a certain e-commerce platform shows that tens of thousands of users are mistakenly labeled as high-risk customers by the system every year, and more than one-third of them cannot complete appeals through regular channels. These users lose convenient services such as instant refunds and face stricter review processes when initiating normal returns. Due to the opacity of the algorithmic decision-making process, users often find it difficult to know the specific basis for the judgment and cannot conduct effective rights remedies, which essentially renders the legal consumer rights protection mechanism ineffective.

In the information environment, the "filter bubble"^[5] effect caused by algorithmic labeling has become increasingly prominent. Users marked as price-sensitive by the system tend to receive more recommendations for low-priced products with varying quality. This algorithm-based information filtering limits consumers' choices and may trap them in a vicious cycle of low prices, low quality, and

frequent returns. Over time, consumer groups with different characteristics will form distinct digital experiences under the influence of algorithms, further deepening and solidifying the traditional consumption gap.

3.2. Platform Trust Crisis and Accumulated Development Risks

From the perspective of brand reputation, the exposure of algorithmic discrimination incidents will directly impact the user trust foundation. In 2022, a well-known e-commerce platform experienced a decline in user satisfaction due to a big data price discrimination incident^[6], resulting in three consecutive quarters of negative growth in the number of active users. This indicates that algorithmic discrimination is not only a technical issue but also an operational risk related to the core values of enterprises. In the current era of highly developed information dissemination, a single algorithmic discrimination incident may be amplified through the Internet, evolving into a comprehensive brand trust crisis.

In terms of legal compliance, algorithmic decision-making faces increasingly stringent regulatory constraints. Article 17 of the E-commerce Law clearly requires operators not to conduct false or misleading commercial promotions, and the Personal Information Protection Law puts forward clear requirements for the transparency and fairness of automated decision-making. Recent cases of penalties imposed by regulatory authorities on a platform for algorithmic discrimination show that enterprises violating relevant regulations will face economic penalties and may also be required to suspend some businesses for rectification. This compliance risk has become a real challenge that platform enterprises must face squarely.

From the perspective of market development, algorithmic discrimination inhibits consumption potential. Research shows that user groups who perceive unfair treatment have a repurchase rate approximately 30% lower than ordinary users, and they are more inclined to compare prices across different platforms. This weakening of consumer confidence not only affects the short-term revenue of platforms but may also restrict their long-term development space.

3.3. Eroded Social Equity and Shaken Institutional Foundations

In terms of bias consolidation mechanisms, algorithms may amplify existing social inequalities. When training data itself contains historical discriminatory patterns, algorithms will not only replicate these biases but also further strengthen them through decision-making results. For example, if a region has a relatively high return rate due to historical reasons, algorithms may attribute this to geographical characteristics rather than objective factors such as insufficient infrastructure, thereby implementing systematic restrictions on users in that region.

At the social cognitive level, algorithmic discrimination may weaken the public's belief in fairness. When technical systems appear in an objective and neutral manner, their unfair decision results are more likely to be rationalized. In recent years, the discourse that "technology equals justice" has to a certain extent concealed the value-laden nature of algorithmic decision-making, reducing society's sensitivity to unfair phenomena. This cognitive shift may reduce society's motivation to pursue fairness, thereby shaking the ethical foundation of social systems.

From the perspective of governance systems, traditional legal systems based on clear rules often show lag and incompatibility when facing highly complex and self-evolving algorithmic systems. This disconnect between institutions and practices not only affects the effectiveness of protecting specific rights and interests but may also arouse public doubts about the effectiveness of the governance system.

In summary, the dilemmas caused by algorithmic discrimination in e-commerce return services have transcended the purely technical scope. These dilemmas not only reflect practical problems in the process of technological application but also highlight the importance and urgency of institutional construction during the digital transformation period. An in-depth understanding of these dilemmas will provide a necessary theoretical foundation and problem orientation for subsequent discussions on governance paths.

4. Systematic Governance Paths to Achieve Algorithmic Fairness

4.1. Constructing Fairness-Oriented Algorithmic Systems

Technical improvements are the foundational work for addressing algorithmic discrimination. Fairness constraints should be embedded in the algorithm design stage^[7]. Developers can adopt technical means such as bias mitigation algorithms and adversarial learning to ensure that models do not make decisions based on sensitive attributes such as gender and region. Establishing regular algorithmic auditing mechanisms is essential, including conducting periodic fairness tests on algorithmic decision results and monitoring indicator differences among different groups. Introducing third-party auditing institutions can effectively enhance the independence and credibility of audits. A leading e-commerce platform has significantly improved the fairness and transparency of its system by cooperating with professional institutions to conduct quarterly compliance reviews of its return algorithms. Enhancing algorithm interpretability is also crucial. By adopting technologies such as local interpretable model-agnostic explanations (LIME), clear and understandable decision explanations can be provided to users.

4.2. Improving Regulatory and Accountability Systems

Institutional construction provides rigid constraints for algorithmic fairness. It is necessary to clarify the main responsibilities of platforms in algorithm governance. This requires platforms to establish sound internal governance mechanisms, including setting up algorithmic ethics committees and formulating standard operating procedures for fairness^[8]. An e-commerce enterprise has effectively prevented discrimination risks by establishing an independent algorithm governance department to supervise the entire process of algorithm development, deployment, and operation. Regulatory frameworks need to keep pace with the times. It is recommended to establish a risk-based hierarchical regulatory system, imposing stricter regulatory requirements on high-risk algorithmic systems. For example, for return permission determination algorithms that directly affect users' rights and interests, they should be required to have complete decision log records and regular evaluation reports. Meanwhile, regulatory authorities may consider establishing an algorithm filing system, requiring platforms to report the basic principles and risk assessments of key algorithms^[9]. In terms of accountability mechanisms, it is necessary to establish sound remedy channels. This includes setting up convenient appeal processes for algorithmic decisions to ensure that users can obtain timely and effective manual reviews when they believe they have been treated unfairly.

4.3. Cultivating a Responsible Algorithmic Culture

Ethical construction provides soft constraints and cultural support for algorithmic fairness. Firstly, efforts should be made to promote the formation of industry self-regulation mechanisms. By formulating industry-wide algorithmic ethics guidelines, basic principles such as fairness, transparency, and accountability can be clarified. Secondly, strengthening the cultivation of algorithmic ethics awareness among enterprises is crucial. This includes conducting systematic ethics training for key positions such as algorithm developers and product managers, and incorporating ethical performance into performance appraisal systems. Finally, enhancing users' digital literacy and right awareness is also an important part of ethical construction. Platforms should explain the basic principles of algorithmic decision-making to users in a clear and understandable manner to help them understand their digital rights. Meanwhile, through digital literacy education, users' cognitive abilities and rights protection awareness regarding algorithmic systems can be enhanced. Research shows that users with basic algorithmic knowledge are more able to rationally treat algorithmic decisions and take correct rights protection measures when their rights and interests are infringed.

4.4. Building a Multi-Stakeholder Co-Governance Ecosystem

Algorithmic governance requires the joint participation and collaboration of various stakeholders. A cross-departmental collaborative governance mechanism should be established, involving regulatory authorities, industry associations, platform enterprises, user representatives, and other stakeholders. Through regular consultations, joint research, and other forms, governance synergy can be formed. For example, an inter-ministerial joint meeting system for e-commerce algorithm governance can be established to jointly study and solve key and difficult issues in governance. Encouraging supervision and evaluation by third-party institutions^[10] is also important. Third-party forces such as academic

institutions and professional organizations have unique advantages in algorithm testing and standard setting. Strengthening international exchanges and cooperation is necessary. Algorithmic discrimination is a common challenge faced by global e-commerce platforms. By sharing governance experiences and coordinating regulatory standards, it is possible to more effectively address complex issues such as cross-border data flows and algorithmic governance. In recent years, several international organizations have launched cooperative projects on e-commerce algorithm governance, providing an important platform for China's participation in global digital governance.

Through systematic governance in three dimensions—technology, institutions, and ethics—and the collaborative participation of multiple stakeholders, a algorithmic governance system that both promotes innovation and ensures fairness can be constructed. This not only helps solve the current problem of algorithmic discrimination in e-commerce return services but also provides a referable practical path for algorithmic governance in other fields.

5. Research Conclusions and Prospects

This study systematically examines the fairness dilemmas caused by algorithmic discrimination in e-commerce return services and their governance paths. The research finds that algorithmic discrimination has evolved from a technical issue into a systematic challenge involving consumers' rights and interests, enterprise benefits, and social equity. In the e-commerce return scenario, algorithmic discrimination is specifically manifested in phenomena such as price differentiation, unequal service permissions, and inconsistent review standards. These phenomena not only harm individual consumers' rights and interests but also pose potential threats to social fairness concepts.

The main conclusions of this study include: Firstly, the root cause of algorithmic discrimination lies in the value-laden nature of technical systems, which makes algorithms may overlook fairness requirements while pursuing efficiency. Secondly, the impacts of algorithmic discrimination are multi-dimensional, causing not only rights infringements at the individual level but also trust crises at the enterprise level and fairness risks at the social level. Furthermore, effective governance requires the adoption of systematic solutions; a single technical improvement or institutional constraint is difficult to achieve substantial results.

In terms of theoretical contributions, this study expands the application scenario of algorithmic fairness research by combining algorithmic ethics theory with e-commerce practice. At the practical level, the proposed governance framework provides specific guidance for platform enterprises to optimize their algorithmic systems and offers policy references for regulatory authorities to improve the governance system. This study has certain limitations: the analysis based on public data may not fully reflect the actual operation of algorithmic systems; the effectiveness of the proposed governance paths still needs to be further verified through practice.

In the context of the continuous development of the digital economy, building a fair and reasonable algorithmic governance system requires the joint efforts of academia, industry, and regulatory authorities. Only by finding a balance between technological innovation and institutional guarantee can the sustainable development of e-commerce services be realized, and the sound evolution of the digital economy be promoted.

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