

Ethical Regulation of Fintech Innovation Based on Big Data

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Abstract

The innovative integration of fintech drives the digital transformation of finance, it also brings about technological alienation, prompting a shift in ethical perspectives. This paper, from a historical perspective, traces the trajectory of the evolution of technological ethics from a purely rational tool to a comprehensive reflection on social impact. Focusing on the field of fintech, the study systematically explores the essence of fintech ethics across four levels: micro to macro, proximal to distal causes, static and dynamic, endogenous and exogenous. From an ontological perspective, it constructs a hierarchical structure of fintech ethics encompassing four dimensions: individual, organizational, societal, and global community. Under the associative effects of intelligent financial systems, the process of constructing the sociality and relationality of fintech ethics is reexamined, breaking free from the traditional dichotomy between technology and ethics. By introducing a relational perspective, the paper aims to effectively address the systemic risks brought by artificial intelligence in the financial sector through the construction of a complex ethics framework, which incorporates systems thinking, adaptive governance, multi-stakeholder collaborative governance, and adherence to ethical boundaries. The goal is to leverage ethical considerations to drive the reform and optimization of the financial regulatory system, ensuring the steady progress of the fintech industry.

Keywords

FinTech Ethics; Technological Innovation; Systemic Risk; Ethical Regulation.

1. The evolution, ideological shifts, and fundamental issues of fintech ethics

1.1. The historical evolution of technological ethics: origins and development

Humanity is currently in a new epoch of digital technology—an era where data continuously reshapes the boundaries of knowledge. Interactions with information are increasingly reliant on systems metaphorically described as a "massive metadata computer," comprising data about people and metadata about that data, together forming a complex information network. Humanity has chosen to move towards a "new world" of its own creation—the infosphere, a hybrid reality made up of digital networks and virtual reality spaces. The essence of this new world lies in the infinite expansion and free flow of information, shaping a complex life structure where physical reality intertwines with informational virtuality. In such a structure, the boundaries between the real and the virtual are increasingly blurred, leading to constant clashes of values and ethical decision-making challenges. Technological revolutions driven by big data, such as artificial intelligence, blockchain, and quantum computing, are reshaping the way most people live at an unprecedented pace, ushering us from a naturally defined human civilization into a technologically defined "quasi-human civilization" stage. This rapid transition has not only brought material changes but also profound shifts in civilizational concepts and

lifestyles. Under the influence of technological forces, the ethics governing relationships between individuals and between humans and nature inevitably need to incorporate a technological dimension.

Technological surges do not necessarily imply disorder. By the late 1970s, the dual effects of new technologies began to manifest. Technological philosophers started to delve into the social consequences brought about by technological advancements, re-examining the dual nature of technological iterations, exploring human responsibility, and questioning what constitutes true progress. Within the expanding boundaries of modern technology, broad and complex ethical issues far exceed the intrinsic scope of technology and the handling capacity of traditional individual ethics, rendering the traditional ethical framework inadequate. At this juncture, there was an urgent need for new technological ethical theories to address the value conflicts arising from technological progress. The "ship" of the philosophy of technology began to sail towards the realm of ethics. During the process of the philosophy of technology's shift towards ethics, the renowned German philosopher Hans Jonas proposed the concept of technological responsibility ethics in his work *The Imperative of Responsibility: In Search of an Ethics for the Technological Age*. From an ontological perspective, Hans Jonas systematically expounded on the issue of responsibility, addressing three age-old yet emerging ethical issues: To whom are we responsible? Why are we responsible? Who is responsible? In the context of today's rapidly advancing technology, these issues exhibit new complexity and urgency. Jonas's theory does not merely focus on the direct consequences of technological applications but also broadly considers the potential impact of technology on humanity's future. He emphasized the necessity of anticipating and assuming responsibility for possible consequences during the process of technological innovation, advocating for a long-term, global ethical evaluation of technological actions, and considering their potential impacts on the environment and future generations. In the current era of rapid technological advancement and profound societal transformation, the perspective of responsibility ethics provides an ethical framework guiding technological development, encouraging people to pursue innovation without neglecting the risks posed by technology, ensuring that technological progress aligns with the long-term well-being of humanity and environmental sustainability.

Global technological legal norms are striving to keep pace with the speed of technological development but lack the rules to regulate the new flows of information, new uses, and new decisions derived from technological data. How can the need for innovation be balanced with potential risks? How can we ensure that technological development benefits all humanity and not just a few? These issues serve as both problems and warnings, reminding us to consider big data and other new technologies from the most fundamental technological ethics perspective because technology is not "naturally" occurring but rather a product of human choices that influence human values. We must ensure that technology shapes the society that humanity desires, as it will mold the society we live in and the kind of humans we will become.

1.2. The significant ideological shifts in technological ethics

Ethics and morals, as understood in the general sense, primarily concern core values and standards. The evolution of technological ethics is a historical narrative revealing the interplay between technology and human values. This process began with the early recognition of technology as a rational exploration tool and gradually evolved into a comprehensive reflection on the deep social impacts of technology over time. As a complex and diverse field, technological ethics on the theoretical level is characterized by the inheritance and development of existing ideas and the exploration of new issues; on the practical level, it is influenced by social context, technological development, cultural traditions, and moral concepts, forming technological ethical value norms with different focuses and characteristics of the times; on the main line of

thought development, it is marked by a shift from rational optimism to a deeper critique of technological impacts and an expansion from individual morality to global ethics.

Throughout history, technological ethical thought has undergone multiple transformations, often triggered by the rapid advancement of new science and technology, prompting the inheritance and transformation of societal ethical concepts (see Table 1). From the Enlightenment to the pre-Industrial Revolution period, with the application of scientific methods and the discovery of natural laws, scientists began to study the natural world through experiments and observation, described it in mathematical language, and regarded technology as a tool for rational exploration. This period saw a gradual departure from reliance on mysticism and supernatural forces in favor of solutions based on rationality and science. This shift prompted scientists and inventors to utilize technological means to solve real-world problems, contributing to human well-being. Nature had created everything, and science interpreted it, symbolizing the high regard for scientific methods and rational thinking during this period. From the Industrial Revolution to the modern era, technological progress accelerated social structural changes. Large-scale mechanized production led to a massive influx of workers from rural areas to cities, exacerbating class contradictions due to harsh working conditions and low wages. Technological progress began to be recognized as a double-edged sword, and technological ethics started to focus on the impacts of technology on laborers, social justice, and the environment, offering preliminary critiques of technological development. During the World War II and nuclear era, the view that science and technology were interconnected with morality and mutually influential became increasingly dominant; the social and moral responsibilities of technologists gradually increased; the development of nuclear technology sparked profound discussions on bioethics and nuclear ethics, highlighting the global moral responsibility of technological actions. Technological ethics focused on concepts such as bioethics and nuclear ethics, advocating for the peaceful use of nuclear energy and emphasizing nuclear safety and sustainable development. In the era of networks and informatization, the rise of information technology made technological ethical issues increasingly complex, particularly in areas like information control, privacy protection, and data security. People began to deeply understand that "technology is a form of cultural critique." Technological moral codes and norms started to become systematic, with an upgraded understanding of technological threats. Technological ethics engaged in deep reflections on how to balance technology with human well-being. In the era of big data and artificial intelligence, ethical discussions further delved into algorithmic biases, the moral consequences of automated decision-making, and AI's impact on personal privacy. Under the wrong conditions, AI systems can lead to widespread discrimination, invasions of privacy, and the erosion of democratic norms. Elon Musk's warning about AI possibly becoming the greatest risk to civilization underscores that ethical considerations must adapt to the rapid development of technology while aligning with humanity's long-term interests. As technology matures, ethical issues have expanded to include the autonomy of machines, the blurring of human-machine boundaries, and the moral implications of AI applications in critical areas such as finance and justice.

The ethics of technology have undergone a series of historical transformations and evolutions, from the initial rational optimism to a deep critique of the social impact of technology, and eventually to the construction of global ethics. This process has continuously expanded in scope and perspective. The values of technological ethics are the result of historical accumulation and are distinctly characteristic of their time. The practices of technological activities are constantly shaping the content of these ethical values. Technological ethics represent an ongoing, dynamic moral framework—a continuous reflection and adjustment of the interaction between technological practices and human values, reflecting a persistent pursuit of safeguarding human well-being and sustainable development.

Table 1 The representative ethical thought perspectives in each historical period

	Historical period	Representative ethical thought
1	Enlightenment to pre-Industrial revolution	Main Idea: Technology as a tool of rational exploration should promote human welfare and align with natural laws. Based on natural philosophy, this period emphasized the rational use of science and technology. Key figures like Immanuel Kant stressed the relationship between technology and morality, arguing that technology should adhere to moral principles and values. This reflects the conquest of nature and absolute trust in reason.
2	Industrial revolution and modernization	Main Idea: The development of technology must consider its comprehensive impact on the working class, social structure, and the natural environment. The Industrial Revolution brought initial critiques of technological impact. This period highlighted the dual nature of technology: as both a liberating force for humanity and a tool of oppression. Karl Heinrich Marx, for example, believed that technology should align with moral principles and values. Technology was seen not only as a means to enhance productivity but also as a means to reshape social relations. Emphasis was placed on placing technology in the hands of the working class to achieve social equality and progress.
3	World War II and the nuclear era	Main Idea: The global impact of technology necessitates global moral responsibility and ethical standards. This period saw the emergence of the theory of social responsibility and the moral responsibility of scientists. Key figures like Albert Einstein advocated that scientists have a responsibility to ensure their research is not used to harm society. If technological advancements are used for malevolent purposes, scientists should be held accountable. The existence of military applications of technology, such as nuclear weapons during the Cold War, led to profound reflections on global technological responsibility. American theoretical physicist Robert Oppenheimer argued that scientists should be responsible for ensuring their research aligns with public interest and universal human values. British physicist Joseph Rotblat actively advocated that scientific knowledge and technology should only be used for peaceful purposes, and that scientists must take responsibility for the consequences and social impact of their research.
s 4	Information and network era	Main Idea: Tech ethics must address issues of privacy, intellectual property, and other concerns in the information age. Advances in information technology expanded the scope of tech ethics to include digital morality, reflecting an emphasis on individual rights and human dignity. Richard O. Mason, for example, identified four major ethical issues in the

		information age: privacy, accuracy, property, and access to information, commonly known as the PAPA issues.
5	Big data and artificial intelligence era	Main Idea: AI ethics must ensure fairness, transparency, and explainability in the design and implementation of technologies while protecting individual privacy and data security. At the same time, it must address the ethical complexities of machine autonomy and human-machine collaboration while safeguarding human welfare. Key thinkers in this field include Isaac Asimov, who proposed the "Zero Law" of robotics—above the Three Laws—which states that a robot may not harm humanity, or, by inaction, allow humanity to come to harm. This law has become a widely accepted principle in AI ethics. Yuval Noah Harari, a key figure in the discourse on AI surpassing humans, argues that AI is already surpassing human capabilities in many cognitive skills, including understanding human emotions. Although human physical and cognitive abilities currently surpass those of machines, he suggests that AI will eventually replace humans.

1.3. The essential issue of fintech ethics

Fintech is an emerging financial industry that applies technology to improve financial activities, and is more accurately described as a new technological species. By using finance as an entry point, the application of new technologies generates new technological entities, which inherently possess financial attributes. This dual nature of fintech, combining both financial and technological characteristics, becomes particularly prominent in the digital age. Fintech has permeated every corner of the financial sector, becoming a core resource in decision-making, risk management, marketing, and more. However, it has also brought forth a series of essential ethical issues that must be explored.

1.3.1. Insights into the expansion of micro and macro ethics

In the context of fintech, micro-level individual ethics emphasize the behavioral norms and moral standards of single participants, while macro-level collective ethics focus more on the moral responsibilities and obligations of communities composed of multiple individuals engaged in financial activities. As individual behaviors gradually converge into influential collective behaviors, the complex interactions among different groups lead to an expansion of ethics from the micro individual level to the macro community level. This expansion underscores the importance of overall sustainable development and prompts us to re-examine the ethical responsibilities and obligations involved in the development of fintech. To address this challenge, it is necessary to construct a new type of community ethics to deal with the complex ethical issues brought about by fintech. This community ethics should emphasize collective action based on universal human consensus, focus on the reasonable use of public resources, consider the cumulative consequences of individual behaviors, and reflect universal human values in fintech activities. To achieve the sustainable development of fintech, it is essential to establish a new type of community ethics, strengthen international cooperation, jointly formulate global fintech ethical standards, and promote coordinated development in the fintech field across different countries.

1.3.2. Ethical forecasting of proximate and distant causes

As fintech evolves, ethical issues gradually emerge and become more diversified. From the perspective of fintech's full lifecycle development, ethical challenges are not limited to a single stage but continuously evolve as technology matures and its application scope expands. In the initial stages of technological experimentation, ethical concerns primarily focus on the infringement of individual rights during the research and development process. Ethical review during this phase is particularly crucial, ensuring that the initial design of the technology adheres to fundamental moral and ethical standards. This includes not only assessing the feasibility and functionality of the technology but also thoroughly exploring potential ethical issues that may arise, ensuring that the technology's development follows ethical guidelines. As fintech enters the market phase, ethical concerns expand to encompass broader market behaviors and business models. Beyond the technological aspects of ethical review, there is a growing need to address issues such as transparency and fairness in data sharing, consumer rights protection, and the prevention of unfair competition. These challenges call for the regulation and standardization of market behaviors to ensure that fintech's commercial development aligns with ethical requirements. As fintech becomes more widespread and embedded in society, its ethical impact extends beyond individuals and markets to encompass the well-being of society as a whole. Fintech ethics not only affect the stability of financial markets, institutions, and systems but also have significant implications for social justice and development. The ethical challenges arising from the interconnectedness of these issues require nations to examine fintech's ethical responsibilities from a macro perspective, considering them within a broader social and environmental context. This approach necessitates attention not only to immediate ethical concerns but also to the anticipation of future ethical challenges, facilitating a comprehensive evaluation.

1.3.3. Static ethical norms and dynamic ethical adaptation

Ethical norms are long-established and widely recognized moral and ethical principles, such as respect for human rights, justice, and integrity. Static ethical norms serve as the foundation of fintech, manifesting in the fintech domain as the protection of user privacy, data security, and the maintenance of fairness in transactions. These static norms delineate clear moral boundaries for fintech development, preventing technology from infringing on fundamental human rights in the pursuit of efficiency and innovation. Dynamic ethical adaptation, on the other hand, is crucial for responding to technological changes and challenges. Fintech's development is a rapid and ongoing process, with new technologies, applications, and scenarios constantly emerging, challenging existing ethical norms. Dynamic adaptation involves flexibly adjusting ethical standards and strategies based on technological advancements and changes in the social environment while adhering to fundamental principles. For instance, when addressing potential discrimination issues in fintech algorithmic decision-making, it is not only necessary to examine the neutrality of the algorithms themselves but also to consider their social impact. Enhancing transparency and explainability can help mitigate potential biases and discrimination.

Static norms provide a stable moral foundation, ensuring that fintech development does not deviate from basic ethical paths. Meanwhile, dynamic adaptation allows fintech to flexibly respond to technological changes and social challenges, pursuing efficiency and innovation without compromising human dignity and rights. However, there is also tension between static norms and dynamic adaptation. On one hand, an overemphasis on static norms may lead to unnecessary restrictions on fintech development, potentially missing opportunities for technological innovation. On the other hand, an overreliance on dynamic adaptation may result in ethical standards becoming blurred and chaotic, increasing uncertainty and risk in financial markets. Therefore, it is essential to recognize the coexistence and interaction between static

ethical norms and dynamic ethical adaptation in fintech, striving for a balance between the two, and ensuring their harmonious and dialectical development to address fintech's ethical challenges.

1.3.4. Ethical shaping of endogenous and external factors

The formation of fintech ethics is characterized by the interplay between endogenous motivations and external shaping forces, driven by both internal ethical beliefs and deeply influenced by external environmental factors. Different stakeholders, such as government agencies, financial institutions, and consumers, have diverse interests that naturally lead to varying moral judgments and values. Internal ethical beliefs serve as the instinctive, primary considerations for individual behavior choices and decision-making. Simultaneously, external factors such as laws and regulations, social and cultural backgrounds, and market competition significantly influence the ethical views of the participants, providing an essential context and framework for shaping fintech ethics, guiding and constraining the behavioral choices of stakeholders. External shaping is not a one-way influence but rather a dynamic interaction with the internal ethical beliefs of individuals, further highlighting the complexity and dynamism of fintech ethics construction. For example, stringent regulatory measures may encourage financial institutions to strengthen compliance awareness, but they might also lead to a dynamic interplay between the drive for innovation and regulatory requirements. On a deeper level, the interaction between stakeholders is expanding the ethical landscape of the fintech ecosystem, reflecting the intricate intertwining and reconstruction of ethical values. Government agencies, financial institutions, and consumers continuously adjust their ethical positions in this interactive process, forming a dynamic ethical equilibrium. For instance, financial institutions, while pursuing profit maximization, increasingly recognize the importance of social responsibility and proactively integrate ethical considerations into their decision-making processes. This shift is driven not only by regulatory pressure but also by a response to consumer demands and societal expectations. Concurrently, as consumers become more financially literate and aware of risks, they compel financial institutions to enhance the quality and transparency of their services. However, this process is not always harmonious. Ethical conflicts between different stakeholders arise from time to time, prompting all parties to re-examine and adjust their ethical stances. It is also important to note that the complexity of these interactions is evident in the blurring of ethical boundaries brought about by cross-sector integration. As finance and technology merge more deeply, traditional industry ethical boundaries are broken, leading to the emergence of new ethical issues. For example, the rise of algorithmic discrimination and data privacy protection challenges requires stakeholders to seek ethical accountability. The process of reshaping these boundaries is, in itself, a profound ethical interaction, driving the fintech ecosystem towards greater inclusivity, fairness, and sustainability. The multidimensional interaction mechanism has a profound impact on the moral advancement of fintech while also posing new challenges for ethical construction: how to ensure the balance and coordination of interests while maintaining the momentum of innovation; how to build a dynamic ethical framework that can adapt to the rapid development of fintech? These issues directly affect the ethical foundations of the future financial ecosystem. In summary, the exploration of fintech ethics can be viewed through four dimensions: the ethical relationships from micro to macro levels reveal the moral responsibilities individuals and communities bear in financial activities, emphasizing the importance of overall sustainable development; ethical forecasting of proximate and distant causes requires addressing current ethical issues while anticipating and preparing for future challenges; static ethical norms provide a stable moral foundation, while dynamic ethical adaptation allows for flexibility in adjusting to technological and societal changes, both working together to ensure the healthy development of fintech; the ethical shaping of endogenous and external factors emphasizes the interaction between internal ethical beliefs and external environmental factors, focusing on

achieving balance between these influences to maximize the synergy between fintech and social values. These dimensions collectively illuminate the core significance of fintech ethics: in the intertwining of technology and societal development, there should be a pursuit of harmony between individual and collective, traditional and modern, normative and dynamic elements, constructing a comprehensive and forward-looking ethical framework for fintech, thereby providing a solid ethical foundation for its sustainable development.

2. The four core levels of fintech ethics

Fintech involves not only technological innovation and application but also multiple dimensions such as economics, law, society, and ethics. On the one hand, the complexity of the ethical issues behind it makes it impossible to reduce or regulate them from a single perspective; instead, a holistic approach is required that considers various factors comprehensively. On the other hand, fintech ethics is dynamic and evolutionary, and a static, singular perspective cannot effectively address these issues. Continuous attention must be paid to the development of technology and changes in the social environment, examining the ethical problems brought about by fintech from a systematic and dynamic viewpoint.

From an ontological perspective, fintech ethics involves the essential relationship between technology and humanity, and technology and society. Traditionally, technology has often been viewed as a tool or means to solve specific problems or achieve particular goals. However, with the rapid development and widespread adoption of technology, it has had a profound impact on human lifestyles, social structures, and values. As a branch of technology, fintech demonstrates its value not only in its instrumental dimension but also by fundamentally altering people's ways of life and social structures. Furthermore, fintech influences human values. As financial markets globalize and

digitize, perceptions of wealth and value are changing. Fintech facilitates faster and more concealed accumulation and transfer of wealth, but it also challenges traditional values such as fairness and

justice. When considering fintech ethics, it is necessary to go beyond its instrumental dimension and

delve into its deeper impact on society and humanity. Therefore, existing ethical frameworks need to be revisited and adjusted to adapt to the rapid development and change of fintech.

The structural levels of fintech ethics should be composed of the structure of human involvement in technology and the corresponding ethical structures within technology ethics, with both being inherently unified within the technological ethics system. Focusing on different structural levels of technology ethics also implies an emphasis on the structural relationships between different levels of responsible actors. The activities at each level of community are governed by ethical norms corresponding to that level. Only by adhering to the ethical requirements appropriate to each level can the harmonious unity of technology and ethics be achieved. The hierarchical division of fintech ethics can broadly identify four core levels: individual level, organizational level, societal level, and global community level (see Figure 1). Individual Level: This level emphasizes the integration of ethical considerations by fintech workers in technological innovation, ensuring that the technology is safe, reliable, and does not harm the interests of users and public welfare. Organizational Level: This level focuses on the ethical responsibilities borne by organizations such as financial institutions and enterprises. Their behaviors and values directly impact the quality of services and society's trust in fintech. The organizational level is realized through the manifestation of human behavior and values and becomes a crucial component of fintech ethics, further highlighting the central role of human agency. Societal Level: This level involves regulatory agencies, industry associations, and oversight media. At this level, as members of society, individuals are both beneficiaries of

fintech and potential risk-bearers. The societal level requires the fintech industry to fully recognize its impact and responsibility toward society and even globally, and to take active measures to balance social responsibility with commercial value. Global Community Level: As the highest level, this level involves the roles played by national governments, international organizations, and multinational corporations in the context of globalization, presenting the greatest challenges. The cross-national nature and global impact of fintech emphasize the need to focus on inclusiveness, sustainability, and international cooperation, driving the development of fintech to truly benefit global economic progress.

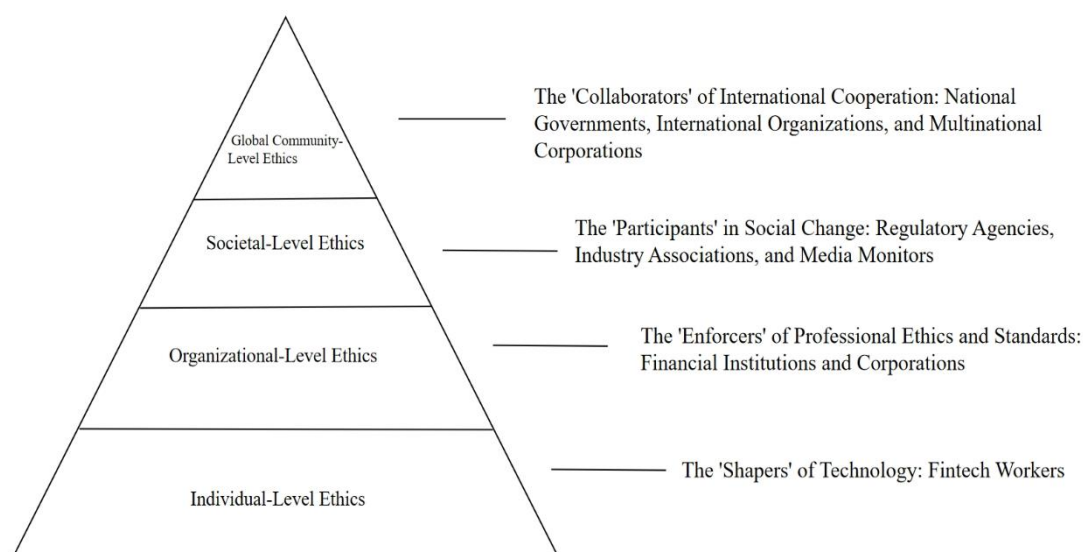


Fig 1 Logic diagram of fintech ethics hierarchy

2.1. Individual-level ethics: the transition from "pure science" to "ethical internalization"

Individual-level ethics primarily involve financial scientists and technological workers. As the initial and core driving forces behind fintech innovation, their decisions and actions directly influence the ethical direction of technology and serve as the foundation for other ethical levels. For individual actors, fintech ethics emphasize the professional conduct of technology experts and developers, stressing the importance of social responsibility awareness. The scientist's code and the ethic of development stand in a complementary relationship. Machines cannot be held morally responsible. Fintech workers must recognize the potential impacts of their research and development outcomes on society, the economy, and culture. They should actively assume the social responsibilities that arise, adhere to the bottom line of technological ethics, follow principles of scientific integrity, and ensure the safety, reliability, and fairness of the technologies they develop.

The underlying logic of the homogeneity and integration of science and economics indicates that science has surpassed its traditional boundaries of knowledge and has become a key force in influencing social organization and cultural values. Technological research and development are no longer isolated rational pursuits detached from economic activities but are closely linked to economic development. This close relationship is reflected in multiple aspects, including goal setting, operational mechanisms, social responsibility, and policy regulations. The roles and responsibilities of fintech workers have fundamentally transformed; their profession can no longer maintain a "pure science" status. Their decisions and technical practices must consider ethical responsibility alongside economic development value orientations. Therefore, at the individual ethical level, economic ethics have become a necessary measure.

Amartya Sen, the 1998 Nobel laureate in Economics, expressed concern over the detachment between modern economics and ethics in his book *Ethics and Economics*. He profoundly pointed out the contradiction between the "non-ethical" characteristic of modern economics and the fact that economics initially developed as a branch of ethics. He argued that economic research should pay more attention to the ethical aspects that influence human behavior to enhance the persuasiveness of economics. With the development of fintech, the conflict between technology and ethics has become increasingly prominent. Traditional economic research often neglects ethical issues, treating them as external or non-economic factors. In the field of fintech, a "non-ethical" attitude can no longer meet society's ethical expectations of fintech workers. The concept of economic ethics aims to transcend economic necessity and instead take a normative approach from the perspective of optimizing public welfare and maintaining human dignity, providing behavioral norms for economic agents. The core of economic ethics lies in restraining human greed and selfishness, requiring the pursuit of maximum benefit without endangering the interests of others and society. To effectively address individual-level fintech ethical issues, it is necessary to delve into the economic and social interest relationships behind technological activities and conduct a comprehensive examination of the impact of individual technological innovation processes and outcomes on social and economic interests from economic, ecological, and social dimensions.

2.2. Organizational-level ethics: the responsibility and integrity of the fintech professional community

Robert K. Merton once proposed four norms of scientific development: Universalism, Communism, Disinterestedness, and Organized Skepticism. These four norms are fundamental to modern scientific development. Building upon Merton's idealized organizational norms, more scholars have advocated for adding Responsibility as a behavioral norm, prompting the scientific professional community to pay more attention to social responsibility and moral ethics. In the context of the highly integrated modern technology and industry, originally independent technological entities are gradually merging into a complex community network. This not only fosters interdisciplinary and cross-field collaborative efforts but also promotes the formation of a super-community encompassing all scientific professionals. Within this framework, the professional community in the field of fintech is particularly prominent. It has evolved beyond the traditional notion of a physical construct into a spiritual community characterized by a shared paradigm and professional identity. This professional identity is not only rooted in a common knowledge system and technical practice but is also crucially based on a deep resonance with the shared ethical responsibilities. The weakening or disappearance of this sense of ethical responsibility is the fundamental cause of ethical disorder in the fintech field. Therefore, constructing and improving a technological ethics system within the fintech professional community and strengthening the sense of ethical responsibility have become urgent tasks for technological ethics in this field. Each entity within the fintech professional community bears its responsibilities and missions. Whether financial institutions or enterprises, they must adhere to organizational-level principles, with integrity, responsibility, and innovation as core values, to promote the healthy development of fintech and achieve harmonious unity of social value. Market entities, as active participants in the fintech industry, primarily include traditional financial institutions and innovative fintech companies. They are not only drivers of technology but also bearers of social responsibility. In the wave of financial innovation, they shoulder the mission of innovation, not only driving the upgrading of products and services to meet the ever-changing needs of consumers but also proactively preventing potential risks to ensure the stable development of the market. Service institutions, as key supporters in the fintech ecosystem, including investment institutions, consulting firms, and technology providers, provide the necessary funding, knowledge, and technological support for

fintech innovation. Service institutions must undertake ethical responsibilities, such as providing professional services, fostering win-win cooperation, and contributing to society. By offering specialized services, establishing good cooperative relationships, and focusing on social responsibility, service institutions provide strong support for the sustainable development of the fintech industry.

The responsibility and integrity of the fintech professional community are particularly crucial at the organizational level. They are not only related to the reputation and long-term development of financial institutions and enterprises but also affect the stability of the entire fintech industry and society's trust in it. In this data and algorithm-driven field, responsibility and integrity become essential safeguards for maintaining industry order, preventing risks, and protecting consumer rights. By emphasizing responsibility and integrity, the fintech professional community is more likely to establish unified behavioral norms and moral standards, promote fair competition and cooperation among market participants, and enhance the quality and efficiency of services across the industry. Only through continuously enhancing ethical self-awareness and a sense of responsibility within the professional community can the healthy development of the fintech industry be promoted, ensuring alignment between technological progress and social ethics.

2.3. Societal-level ethics: the synergy between fintech development and social progress

In the broader view of fintech ethics, the societal level presents a multi-governance structure consisting of government regulation, industry self-regulation, and public oversight. Each governance body bears its respective ethical responsibilities based on its functions, collectively maintaining the ethical order and public interest in the fintech sector. Government departments enact laws to ensure activities are legal and compliant; industry associations draft guidelines to promote internal self-discipline; and the media monitors and discloses information, revealing potential risks. This collaborative effort helps build an ethical governance system that supports the healthy development of fintech.

At its core, the multi-governance structure reflects the intrinsic value rationality of social ethical order. Different social entities assume distinct ethical duties based on their expertise, engaging in mutual checks and collaboration. This division of labor and cooperation aligns with the inherent demand for social ethical progress. The governance model evolved from the communal ethical structure embodies the internal logic of social ethical development.

The rapid growth of fintech has gradually transcended the confines of the financial sector, becoming a significant force influencing the global economy and society. It has not only accelerated the flow of capital and the spread of financial services but also provided powerful support for decision-makers worldwide in data collection, analysis, and application. However, this rapid development has also led to the widening of the digital divide and challenges in privacy protection. Despite the fintech industry's promises of financial inclusion, underserved populations continue to experience unequal access to financial services and wealth. Faced with the expanding, interconnected, and global impact of fintech on society, it is essential to explore ethical issues beyond mere technological advancement. Specifically, the development of fintech must be aligned with social fairness and justice, reducing the wealth gap through inclusive finance; establishing algorithmic review mechanisms to prevent discrimination; and strengthening cybersecurity regulation to protect data and privacy. Only by prioritizing the maximization of social benefits can the unity of economic efficiency and ethical value be achieved, promoting sustainable social development.

2.4. global community-level ethics: building a fair and sustainable digital financial future

The powerful driving force behind the globalization and widespread adoption of fintech not only impacts the interests of individual countries or regions but also profoundly influences the global economic, social, and political landscape. The global community level of fintech ethics involves addressing global fintech issues, international cooperation, and considerations of cultural sensitivity, collectively forming the ethical foundation for the sustainable development of fintech on a global scale. Multinational corporations bear moral responsibilities, and their business operations must comply with internationally recognized ethical standards, avoiding the exploitation of their global presence to evade ethical constraints. National governments and international organizations should actively promote the establishment of ethical governance rules and international cooperation frameworks for fintech that involve all nations. At the level of the global human community, a fintech ethical value system that aligns with global public interests must be constructed. Regarding global issues, national governments, international organizations, and multinational corporations should assume responsibility for addressing global digital divides, establishing effective global cybersecurity and data privacy protection mechanisms, and utilizing fintech to enhance global resilience. In terms of international cooperation, countries can jointly establish algorithmic review and cross-border data flow regulation mechanisms, sign treaties on data security and privacy protection, and build rapid warning and coordinated response frameworks for global fintech risks. International exchanges and cooperation should be conducted based on mutual trust and respect for diversity. In the process, attention must be paid to different cultural ethical orientations, adopting culturally sensitive strategies, and avoiding simply overriding the varying demands of countries in fintech ethics governance. Broad consensus should be sought.

In conclusion, at the global community level, building fintech ethics requires the participation of all human actors to actively address global issues, strengthen international cooperation, and embrace cultural differences to promote human welfare. Global fintech development is at a crossroads, offering both endless opportunities and ambiguous risks. What is the true pursuit of financial innovation? Is it short-term profit or long-term prosperity? Is it individual victory or the harmonious coexistence of all humanity? The power of fintech is complex and immense, capable of connecting every corner, facilitating the free flow of information, and making capital flow more conveniently. However, this power is also a double-edged sword, not only a strong engine for social progress but also a potential risk to stability. The establishment of global fintech ethics is not only about regulating this power but also ensuring it genuinely serves the welfare of humanity. Financial innovation cannot be content with mere technological progress while ignoring the importance of ethics. Building global fintech ethics requires collectively formulated and adhered-to ethical guidelines to safeguard the healthy development of fintech, truly achieving a fair, just, and sustainable digital future.

3. Constructing an ethical framework based on the complexity of relationships within financial intelligence systems

The widespread application of cutting-edge technology in the financial sector, represented by artificial intelligence, has brought a lot of convenience to the industry, but has also raised concerns about financial stability. The World Economic Forum, the Financial Stability Board and regulators such as BaFin have all pointed out that, if not handled properly, AI could become a new source of systemic risk and make the financial system more volatile. We need to make sure that AI should be used for good. FinTech ethics should therefore be complemented by structural or complex arguments that consider how technology can shape the broader environment and regulatory strategies in disruptive or harmful ways, avoiding homogenized

competition through policy guidance, facilitating negative feedback between algorithms, and applying them to fair and just scenarios. The ethics of complexity will establish many original starting points that can help address the systemic risk dilemmas raised by standard ethical approaches in the fintech space.

3.1. The interconnected effects of financial intelligence systems and the importance of complexity ethics

The ethical issues involved in fintech, a key application area of AI technology, have become increasingly complex with the widespread use of the technology. Financial intelligence systems themselves are highly dynamic and changing networks that are not composed solely of independent elements, but rather complex wholes that include multiple participants, technologies, rules, and market forces, and the interactions between the various components have a decisive impact on the system's behavior and outcomes. When AI technology is introduced into the financial system, it not only affects specific operations or decision-making processes, but also has a wide range of impacts at the system level. The introduction of AI technologies exacerbates the non-linear and non-deterministic nature of financial markets. Traditional ethical frameworks based on individual behavior and its direct impact on responsibility and transparency are difficult to cope with. The systemic risks faced by FinTech are no longer just a technical issue, but also an ethical issue of deep complexity.

The ethical framework of complexity emphasizes the interaction and interdependence of elements within a system. In the intelligent application of financial technology, ethical thinking should go beyond the limitations of a single algorithm or decision-making system and focus on the complex network formed by human-computer interaction and inter-algorithmic interaction in the entire financial ecosystem, which involves multiple levels and dimensions, including algorithmic interaction on the technological level, human-computer collaboration on the application level, and cross-influences on the broader socio-economic level. Only by examining the dynamic and multidimensional system of fintech can we gain insight into the complex nature of its ethical issues. Specifically, at the technological level, the interaction between different intelligent algorithms may produce unpredictable emergent effects, and the rational design of individual algorithms does not necessarily guarantee the ethical operation of the overall system. At the application level, differences in human-computer collaboration modes will significantly affect the attribution and accountability of ethical consequences. From a macro point of view, the ethical impact of fintech will be transmitted to all fields of society and economy, and it is necessary to build a system of ethical norms that matches the complex reality on the basis of a deep understanding of the complexity of the system, transcending the local perspective, and examining the intricate interconnections and veins in an open, dynamic and holistic way of thinking.

3.2. Social and relational reflection and shaping of fintech ethics

While ethical responsibility has traditionally often been attributed to an individual or a single organization, this attribution is too homogenous in the context of financial intelligence. The ethical regulation of technology in finance is essentially a social and relational construction process. The design and operation of science and technology systems cannot be separated from the context of human society, and are themselves forming more complex and interconnected ecosystems. The shaping of ethics in science and technology can never be accomplished by a single subject of interest alone, but requires the wisdom of different professional groups and the concerted efforts of an intricate social network. In the process of change and development, it involves not only direct participants such as technologists, financial practitioners and regulators, but also related parties such as policymakers, academic researchers and the public. The communication and dialog among multiple subjects, coordination of interests and consensus building will help to continuously shape ethical and moral norms of science and

technology finance in the dynamically evolving social context. From the perspective of social constructivism, the definition and practice of the ethics of financial science and technology is by no means the sole role of a single group, but the result of the common game of many actors in the social system. Each participant participates in and influences the formation of ethical rules through discourse practice and behavioral expression in the social network relationship in which he or she is located. Clarifying the power relations among different actors and their discursive strategies is crucial to understanding the social construction process of FinTech ethics. The social and relational construction of FinTech ethics does not happen overnight, but progresses gradually through continuous interactions, conflicts and compromises. Based on their own interests, all actors either adopt the game strategy of hard-line confrontation or seek a win-win solution by compromising their interests. As time passes and the environment changes, the changing attitudes and positions of the participants will lead to the dynamic adjustment of the ethical rules in the future, and careful attention should be paid to this process. Examining the process of constructing the social and relational nature of the ethics of financial science and technology provides an important perspective for understanding its complexity. Fintech ethics need to be shaped and carried in a wide range of social interactions, and policymakers should be based on the interactive game process of multiple interest groups and keep a keen insight into their discourse practices and power operations, so as to better grasp the logic of the formation of ethical norms for science and technology finance and promote the optimization and improvement of regulatory policies.

3.3. Ethical analysis of relationships within fintech

Complex interactions between humans and algorithmic market participants, as well as between algorithms, form the basis of modern financial ecosystems. The creation and amplification of systemic risk is often not caused by a single individual or isolated behavior; the deep network structure, dynamic feedback loops and interaction effects of the interactions reshape the nature of market behavior and significantly increase the potential for systemic risk. For example, the collective effect of the behavior of algorithmic traders as they mimic each other's strategies and data feeds in the market leads to increased pro-cyclicality in the market, which in turn exacerbates systemic risk. In addition, the widespread use of internet-based financial platforms has enabled non-bank institutions to provide credit-like services through big data and algorithmic models, accelerating the correlation between banks and non-banks and quantum increasing the difficulty of regulation. The popularity of algorithmic trading has also led to the homogenization of the investment strategies of different financial institutions, and once certain resonance algorithms go awry, they are prone to cause a chain reaction and violent shocks in the market.

From an ethical perspective, focusing on technology-related relationships rather than isolated individual behaviors allows for a more accurate identification of and response to systemic risks arising from new technologies such as AI. The use of technology-related relationships as an analytical framework closely connects AI ethical issues with contemporary debates on finance, macroprudential regulation, and the complexity of economics, emphasizing the need to take into account the relational dynamics within the financial system when formulating policies and regulatory measures, which can be pertinent for revealing the risk-generating mechanisms of technological technology when embedded in the financial market. Introducing a relevant relational perspective that crosses the boundaries of traditional ethical and regulatory frameworks can further clarify the complexity of human-computer interaction and the interplay between algorithms within the system, and lead to a new type of ethical and regulatory strategy that promotes technological innovation and safeguards financial stability and fairness. At the same time, a deep understanding and forward-looking thinking on the

ethical issues of fintech can help strengthen the ethical and social responsibilities in the development of fintech.

3.4. The role of complexity ethics in complementing financial regulation

In a highly interconnected and dynamically changing financial system, traditional financial regulation is insufficient to anticipate or manage the complexity and systemic risks brought about by artificial intelligence. Complexity ethics offers a new perspective to supplement traditional financial regulatory frameworks, particularly in the emerging field of AI ethics within the financial sector. Key considerations from this perspective include the following:

Firstly, complexity ethics urges regulators to break free from the constraints of linear determinism and instead re-examine the inherent logic and dynamic evolution of financial innovation based on complex adaptive systems theory. Regulatory bodies need to actively foster systems thinking and develop tools for systemic risk monitoring, adopting a panoramic view to assess the potential risks of AI applications. Additionally, regulators should create diverse experiments in controlled environments to explore AI innovations, continuously optimizing regulatory designs through iterative and adaptive approaches to safeguard financial innovation.

Secondly, complexity ethics advocates for adaptive governance to enhance the flexibility and resilience of regulation. Regulatory bodies should establish mechanisms for the periodic evaluation of regulatory policies, dynamically optimizing the rule system to align policy supply with market demand. At the same time, regulatory technology should be vigorously developed, leveraging cutting-edge technologies such as AI and blockchain to enable precision regulation. This approach ensures compliance while leaving sufficient space for innovation, fostering a dynamic balance in regulation.

Thirdly, complexity ethics emphasizes the concept of multi-stakeholder collaboration for governance, providing a guiding philosophy to mobilize regulatory synergy. Regulatory bodies should actively build open regulatory collaboration networks, widely incorporating stakeholders from industry, academia, and the public in the policy-making process. Through equal consultation, consensus can be reached, and plans optimized, forming a scientific and democratic mechanism for regular participation. Creating an open and inclusive innovation ecosystem is also crucial, encouraging industry associations and standardization bodies to establish codes of conduct and best practices for AI applications. This not only promotes industry self-regulation but also facilitates effective collaborative governance.

Fourthly, upholding the principle of "Tech for Good," complexity ethics provides fundamental guidance for maintaining the ethical baseline of financial innovation. In this regard, regulatory agencies should incorporate ethical considerations into the core policy-making process, ensuring that innovative practices align with fundamental moral principles such as fairness, responsibility, and transparency. Simultaneously, various nurturing measures should be implemented to strengthen ethical awareness among practitioners, guiding companies to prioritize social responsibility in their business decisions. This conscious adherence to a "people-centered" industry ethic is crucial for steering AI applications in finance toward the right value orientation.

Taking a broad view, the philosophy of complexity ethics holds profound significance for the reform and optimization of financial regulatory systems. Regulating fintech innovation should be grounded in a systems theory perspective, with a forward-looking, adaptive mindset that responds dynamically to change. It requires a concerted effort from diverse stakeholders and a firm commitment to ethical guidance to strategically navigate the waves of financial innovation driven by AI, ultimately leading the industry towards sustainable and stable development.

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