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The Restructuring of Commercial Credit under Digital Transformation: From Relational Contracts to Algorithmic Trust and Network Power

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Abstract

This paper aims to transcend the functionalist research paradigm currently prevalent in academia, which focuses on the economic consequences of corporate digital transformation. Instead, it constructs a purely theoretical framework for the structural restructuring of commercial credit. While existing research primarily concentrates on the positive impact of digitalization as an efficiency-enhancing tool on the scale of commercial credit financing, this paper argues that digital transformation is not merely an "enhancer" of commercial credit but a "reconstructor" of its intrinsic logic. This reconstruction unfolds along two intertwined axes. First, a paradigm shift in the foundation of trust: the basis for granting credit is moving from "interpersonal trust" and "relational contracts," rooted in long-term social interaction, to an impersonal "system trust" driven by data and executed by code, giving rise to a new form of trust-"algorithmic trust." Second, a re-centralization of power structures: power within the supply chain ecosystem has not been decentralized but is instead concentrating, shifting from traditional core enterprises that control production and financial capital to a new type of digital intermediary-the platform operator-that controls data, algorithms, and network connectivity. To systematically explain this transition, this paper integrates relational contract theory, Luhmann's system trust theory, and Castells' network power theory. It deeply analyzes the construction mechanisms and inherent risks of algorithmic trust (such as the "black box" problem and data bias) and deconstructs how platforms become new power centers by mastering "programming power" and "switching power," which may ultimately lead to "data monopolies." The paper concludes that we are witnessing a fundamental shift in commercial credit from a "relational paradigm" to an "algorithmic-network paradigm." This poses profound challenges to financial theory, business practice, and public governance, calling for a shift in research and regulatory focus toward issues of fairness and stability in the age of algorithmic governance.

Keywords

Digital Transformation; Commercial Credit; Algorithmic Trust; System Trust; Relational Contract.

1. Literature Review and Problem Statement

1.1. Literature Review: The Functionalist Paradigm of the Economic Consequences of Digital Transformation

The wave of the digital economy is reshaping the global industrial landscape with unprecedented depth and breadth, making corporate digital transformation an imperative rather than an option[1]. Against this backdrop, academic research on the economic

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consequences of digital transformation has deepened, forming a mainstream research paradigm: the functionalist theory of efficiency enhancement[2]. This paradigm views digital transformation as an advanced production tool or management technique, with its core logic focused on examining how the application of this "tool" improves corporate operational efficiency, thereby yielding a series of positive economic outcomes.

Within this paradigm, a large body of research has focused on the impact of digital transformation on a firm's internal efficiency and external market performance[3]. For instance, studies have found that digital transformation can optimize internal processes, reduce control costs, and enhance productivity and corporate performance. Externally, digital transformation has been shown to improve a firm's performance in capital markets, such as by increasing stock liquidity and improving the price discovery function[4].

Recently, this functionalist perspective has extended into the field of supply chain finance, particularly the study of commercial credit. The empirical research by Shu and Chen (2024) is a case in point, finding that a firm's digital transformation significantly increases its level of commercial credit financing. The mechanism is attributed to two core pathways: first, digital transformation reduces information risk among supply chain partners by increasing information transparency; second, it enhances the firm's operational efficiency and solvency by optimizing operational management[5]. Together, these factors bolster a firm's reputation within the supply chain network, making it easier to obtain commercial credit financing from suppliers.

Such research undoubtedly holds significant explanatory value. Through rigorous empirical analysis, it reveals the positive effects of digitalization at the micro-firm level, providing empirical support for corporations to adopt digital strategies[6]. However, this mainstream paradigm has its theoretical limitations. While affirming the "quantitative" contribution of digitalization, it may obscure its "qualitative" subversion of commercial credit. By confining the research scope to efficiency improvements, it essentially treats commercial credit as a static, homogeneous financial instrument, overlooking the profound paradigm shift occurring in the socioeconomic structures that underpin its operation. Digital transformation is far from a simple technological overlay or process optimization; it is a profound organizational and institutional revolution that is reshaping the foundations of trust and power structures upon which commercial activities depend[7].

1.2. Problem Statement: From "Efficiency Enhancement" to "Structural Restructuring"

The core question under the functionalist paradigm is "Can digital transformation improve the efficiency of commercial credit financing, and how?" Its analytical logic follows a linear path of "technology empowerment → efficiency enhancement → financing improvement". However, a more penetrating theoretical question demands an answer:

How exactly does digital transformation change the nature and substance of commercial credit itself?

This paper argues that to answer this question, a shift in research perspective is necessary-from focusing on "efficiency enhancement" to examining "structural restructuring." The central thesis of this paper is that digital transformation is not merely an "enhancer" of commercial credit but a "reconstructor" of its intrinsic logic. This restructuring process unfolds along two intertwined axes:

A Paradigm Shift in the Foundation of Trust: The basis for granting credit is shifting from "interpersonal trust" and "relational contracts," rooted in long-term social interaction and reputation mechanisms, to an impersonal "system trust" driven by data and executed by code, giving rise to a new form of trust-"algorithmic trust."

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A Re-centralization of Power Structures: Power within the supply chain ecosystem has not been decentralized as envisioned by the promise of digitalization. Instead, it is concentrating, shifting from traditional core enterprises that control production and financial capital to a new type of digital intermediary-the platform operator-that controls data, algorithms, and network connectivity.

To systematically elaborate on this structural change, this paper will construct an interdisciplinary theoretical framework[8]. First, it will draw upon "relational contract theory" to analyze the socially embedded nature of traditional commercial credit, establishing a theoretical baseline. Second, it will borrow from sociologist Niklas Luhmann's "system trust theory" to explore the evolution of trust from "interpersonal trust" to "system trust," extending this to an analysis of the construction and risks of "algorithmic trust". Finally, it will apply Manuel Castells' "network power theory," focusing on the core mechanisms of "programming power" and "switching power" to deconstruct how digital platforms reshape power dynamics in the supply chain[9].

Through this theoretical progression, this paper seeks to reveal that the true impact of digitalization on commercial credit is not merely an increase in financing scale but a fundamental transformation of the trust and power relationships that support this financial activity. This aims not only to deepen the understanding of the new paradigm of commercial credit in the digital age but also to provide a more critical and theoretically profound perspective for comprehending the deep socioeconomic changes of the digital economy.

2. The Theoretical Foundation of Commercial Credit: Its Essence as a Relational Contract

In modern economic life, contracts form the basis for regulating transactional behavior. However, not all contracts rely on complete legal statutes and judicial enforcement. Theories in law, economics, and sociology clearly distinguish between two fundamentally different forms of contracts: "classical contracts" and "relational contracts." A classical contract deals with discrete, one-off transactions, with terms that strive to be exhaustive and enforcement that depends on an external legal system. In contrast, a relational contract is embedded in long-term, ongoing social interactions[10]. Its terms are often "incomplete," relying heavily on implicit understandings, shared norms, and the expectation of continued future cooperation to be sustained. The core of a classical contract is the transaction itself, whereas the core of a relational contract is the relationship itself.

Viewed from this theoretical perspective, traditional commercial credit is a quintessential example of a relational contract. Commercial credit, especially trade credit (accounts payable) and prepayments between firms, is essentially an informal financing behavior embedded within supply chain partnerships[11]. Its granting and maintenance are largely not based on standardized financial statement analysis or tangible collateral but are built upon a series of relational elements.

First, trust is the cornerstone and lubricant of a relational contract. The extension of commercial credit often stems from the mutual trust established between trading partners through repeated games over long-term cooperation. A supplier is willing to offer trade credit to a buyer because they trust the buyer's ability and willingness to pay in the future. This trust is a valuable form of social capital that significantly reduces transaction costs by mitigating information asymmetry and moral hazard, making financing possible without formal financial intermediaries. The establishment of this trust takes time and depends on behaviors such as reciprocity, honesty, and loyalty demonstrated during interactions.

Second, reputation mechanisms and the "shadow of the future" are its core enforcement guarantees. In tight-knit industry networks or local industrial clusters, information about a

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firm's reputation spreads quickly. If a firm defaults, its loss is not limited to the legal consequences of a single transaction; more severe is the damage to its reputation, which could lead to exclusion from the entire business network and the loss of future cooperation opportunities[12]. The value placed on future cooperation creates a more effective implicit enforcement mechanism than legal action, compelling parties to honor their commitments. This mechanism is particularly crucial in environments lacking strong third-party enforcement agencies.

Finally, commercial credit is deeply socially embedded. It does not exist in a vacuum but is deeply rooted in specific industry practices, social norms, and interpersonal networks. Trading partners may share similar cultural backgrounds, values, or belong to the same chamber of commerce or association[13]. These social ties strengthen mutual responsibility and obligation, providing an informal institutional environment for the stable operation of commercial credit. Relational contract theory emphasizes that all contracts are embedded in social relations, and commercial credit is a vivid manifestation of this embeddedness.

Therefore, defining traditional commercial credit as a relational contract establishes a crucial theoretical frame of reference. It reveals that before the digital age, the core asset supporting commercial credit was not financial capital or legal documents, but the hard-to-quantify yet vital "relational capital"-the socioeconomic network composed of trust, reputation, and long-term interaction. Understanding this allows for a deeper insight into how the intervention of a new technology capable of generating, measuring, and trading "trust" (i.e., digital platforms) impacts and replaces this traditional relational infrastructure, triggering a structural revolution rather than a simple efficiency improvement.

3. Paradigm Shift in the Foundation of Trust: From Interpersonal Trust to Algorithmic Trust

As digital transformation deepens, the foundation of trust upon which commercial credit is built is undergoing a profound paradigm shift. The classic distinction of trust by social systems theorist Niklas Luhmann provides a sharp analytical tool for understanding this change. Luhmann identified two fundamentally different trust mechanisms in modern society: "interpersonal trust" and "system trust".

Interpersonal trust is built on familiarity, personal experience, and direct interaction. It is characterized by being personal, particularistic, and non-transferable, making it the primary form of trust in small-scale, high-density social networks. This corresponds precisely to the mode of trust inherent in the relational contracts discussed earlier. A business owner trusts his long-term supplier because he knows the person's character and past transaction history. This trust is a combination of emotion and cognition, requiring continuous interaction to maintain.

In contrast, system trust is confidence in the effective functioning of abstract, anonymous social systems (such as money, law, and professional knowledge systems-what Luhmann called "generalized media of communication"). People accept paper money not because they trust the counterparty, but because they trust the national financial system behind it. The advantage of system trust lies in its impersonality and scalability; it can transcend circles of acquaintances to reduce complexity and facilitate cooperation in a wider society of strangers.

One of the core arguments of this paper is that digital platforms are becoming the central engine for constructing a new type of "system trust" in the realm of commercial credit. By digitizing and standardizing transaction processes, platforms replace traditional interpersonal relationship reviews with automated credit assessments, thereby driving the foundation of commercial credit trust from interpersonal trust to system trust. A supplier no longer needs to spend years "getting to know" a buyer to build personal trust; he only needs to trust the credit score and payment guarantee system provided by the platform. This transformation makes

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trust scalable, calculable, and tradable, greatly expanding the coverage of commercial credit financing.

In this process, a highly influential new form of system trust-"algorithmic trust"-has emerged. We define "algorithmic trust" as a specific variant of system trust in the digital age, where the object of trust is no longer a person or institution in the traditional sense, but the algorithm itself. People believe that algorithms can perform objective, neutral, and efficient risk assessments and behavioral predictions based on massive amounts of data. This trust is constructed through a series of technical means: platforms aggregate multi-dimensional data such as transaction flows, logistics information, and performance records, and use machine learning models for dynamic credit granting. Its real-time nature and precision theoretically surpass traditional models that rely on static information and subjective judgment. For example, products like JD Finance's "Jingbaobei" automatically calculate credit limits based on a supplier's historical transaction data on the platform, achieving automated approval and lending, which is a concrete manifestation of algorithmic trust in business practice.

However, algorithmic trust is not a perfect substitute for interpersonal trust. While it overcomes old limitations, it also introduces new, more hidden risks and vulnerabilities.

First is the "algorithmic black box" problem and the accountability dilemma. The decision-making logic of modern machine learning models, especially deep learning networks, is often extremely complex and difficult to explain, creating a de facto "black box". When a small or medium-sized enterprise (SME) is denied credit by a platform's algorithm, it often has no way of knowing the specific reasons for the rejection, let alone appealing or correcting an opaque algorithmic decision. This power asymmetry and lack of accountability mechanisms pose a potential threat to commercial fairness. The theory of Algorithmic Governance points out that a lack of transparency and accountability is a core challenge facing algorithmic power.

Second is the systemic risk of data bias and algorithmic discrimination. The "objectivity" of algorithms is an illusion because algorithms are designed by humans with subjective biases and trained on historical data that reflects existing structural societal biases. If historical data contains credit discrimination against certain industries, regions, or types of enterprises (such as startups or female-led businesses), algorithms will not only replicate these biases but may also solidify and amplify them through self-reinforcing learning mechanisms, leading to systemic and hard-to-detect algorithmic discrimination.

Finally, there is the devaluation of relational capital and the erosion of supply chain resilience. Over-reliance on algorithmic scores may lead companies to neglect the maintenance of long-term, stable, and mutually beneficial supply chain relationships. The flexibility, implicit guarantees, and shared risk-bearing capacity inherent in traditional relational contracts are difficult for cold, hard algorithms to fully capture and quantify. When commercial credit is entirely defined by algorithms, supply chain relationships may become more transactional, short-term, and fragile. In the face of external shocks, a system lacking the buffer of relational capital may be more prone to collapse.

In summary, the shift from interpersonal trust to algorithmic trust is a double-edged sword. It solves the scalability problem of traditional trust through systematic means, allowing credit to flow more broadly. At the same time, however, it creates new, more concentrated forms of risk. This risk is no longer individual and incidental betrayal, but systemic and structural algorithmic flaws and abuses of power, posing unprecedented challenges to the fairness and stability of the economic system.

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4. The Reshaping of Supply Chain Power Structures: A Network Power Theory Perspective

The transformation of the trust foundation and the reshaping of power structures are two sides of the same coin. When the logic of granting commercial credit shifts from relational networks to algorithmic systems, the actors who control these systems gain new power. Sociologist Manuel Castells' network power theory provides a powerful theoretical tool for analyzing this power shift. Castells argues that in the information age, the primary source of social power is no longer traditional hierarchical control or the monopoly of material resources, but the ability to control networks. He introduces the core concept of "network-making power," which he further divides into two key forms of power: "programming power" and "switching power".

"Programming power" refers to the ability to set the goals, agendas, rules, and protocols of a network. It determines the network's internal value hierarchy, resource allocation standards, and the logic of action for its members. In short, programming power is the power to "write the code" for the network.

"Switching power" is the ability to control the connections and interactions between different networks or nodes, acting as a "gatekeeper" for the flow of information, capital, and resources. Actors who hold switching power can coordinate, integrate, or block resource exchange between different networks through their central position in the network topology, thereby gaining immense influence.

Applying this theoretical framework to the field of digital supply chain finance, we can clearly see that platform operators have become the new power centers of the ecosystem by simultaneously mastering both programming and switching power.

First, as "programmers," platforms' core power is manifested in the design and definition of credit assessment algorithms. The platform decides which data dimensions are included in the credit model (e.g., transaction volume, fulfillment rate, customer reviews), how the weights of each dimension are set, and the threshold for the final credit score output. This process is far from a purely technical operation; it is a profound act of value selection and rule-making. Through algorithms, the platform is, in effect, "programming" which types of enterprises are "trustworthy" and which business behaviors are "encouraged." This gives the platform the power to define the "rules of the game" for the entire ecosystem. All participants must adapt to this set of rules, written in code, to obtain the financial resources necessary for survival and development.

Second, as "switchers," platforms' power derives from their pivotal position in the network. In traditional supply chain structures, the flow of information and capital is relatively linear. In contrast, digital platforms create a many-to-many network topology, connecting thousands of SMEs, core enterprises, financial institutions, and logistics service providers. By leveraging the "structural hole" advantage of their central node, platforms control the flow and matching of key information within the network. They act as a "switchboard" for credit information and a "router" for financial capital, determining who can connect with whom and under what conditions. By controlling and "rent-seeking" from these connections, platforms convert data flows into value streams, solidifying their indispensable gatekeeper status.

The combination of this dual power leads to a fundamental reshaping of the supply chain power structure. Power is no longer solely attached to the traditional "core enterprise." In the past, the power of a core enterprise stemmed from its large procurement volume, strong financial resources, and bargaining power in the industry chain. In the digital ecosystem, however, even large core enterprises are increasingly dependent on the platform's data network and financial services, and their power boundaries are being eroded. Power is systematically shifting from the domain of production to the domain of data and network control, ultimately concentrating

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in the hands of platform operators. Nick Srnicek, in his theory of "platform capitalism," also points out that the core business model of platforms is to extract and control data, thereby gaining market dominance.

The inevitable result of this process is the formation of "data monopolies" or "data-opolies". Platform businesses exhibit strong network effects: the more enterprises that join the platform, the richer the data the platform accumulates, the more accurate its algorithmic models become, and the more attractive its financial services are, thus attracting more enterprises to join, creating a positive feedback loop. This "winner-take-all" dynamic allows a few leading platforms to rapidly accumulate massive, multi-dimensional proprietary data, creating barriers that are difficult for competitors to overcome. Ultimately, the vast number of SMEs in the supply chain shift from a dependence on core enterprises to a deeper, more comprehensive dependence on the platform's data and algorithms. This new power structure, as warned by Shoshana Zuboff in her theory of "surveillance capitalism," is more stable and insidious than traditional market power, posing a long-term challenge to market competition and economic fairness.

5. Conclusion and Theoretical Outlook: A New Paradigm for Commercial Credit in the Age of Algorithmic Governance

By constructing an analytical framework that integrates relational contract theory, system trust theory, and network power theory, this paper has conducted a deep, purely theoretical analysis of the transformation of commercial credit under digital transformation. The core conclusion of the study is that the impact of digitalization on commercial credit is far from the efficiency improvements emphasized in existing literature; it is a profound structural restructuring. This restructuring marks the transition of commercial credit from a traditional paradigm based on relational contracts and interpersonal trust to a new paradigm defined by algorithmic trust and centralized network power.

To more clearly present the internal logic and multi-dimensional changes of this paradigm shift, the following table provides a systematic comparison of the two paradigms:

Table 1. Dimensional paradigm comparison

Dimension	Traditional Commercial Credit (Relational Paradigm)	Digital Commercial Credit (Algorithmic-Network Paradigm)
Contractual Basis	Relational Contract (implicit, long-term, socially embedded)	Platform-Mediated Agreement (explicit, transactional, rule-encoded)
Trust Foundation	Interpersonal Trust (reputation, familiarity, repeated interaction)	Algorithmic Trust (system trust in data, code, and platform protocols)
Power Center	Dispersed among key actors (e.g., core enterprises, established suppliers)	Centralized in digital platform operators
Power Mechanism	Bargaining power, reputation, control over material resources	Network Power (programming algorithms, switching information/capital flows)
Core Asset	Relational Capital / Social Capital	Data and Network Control
Nature of Risk	Idiosyncratic Risk (e.g., individual default, betrayal of trust)	Systemic Risk (e.g., algorithmic bias, platform failure, data breaches)

As shown in the table, this transformation is comprehensive. The contractual basis shifts from implicit social relationships to explicit platform rules; the anchor of trust moves from personalized reputation to impersonal algorithms; the center of power transfers from

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controllers of the production chain to architects of the information network; the core asset determining a firm's fate evolves from relational capital to data capital; and the primary risks facing the economic system change from isolated individual defaults to systemic algorithmic failures or platform monopolies that could trigger chain reactions.

This conclusion holds profound implications for theoretical research, business practice, and public governance.

First, for theoretical research, this paper calls for future studies in finance and management to move beyond functionalist and efficiency-centric analytical frameworks. The research agenda needs to shift towards a political economy analysis of digital platforms, deeply exploring the social consequences of algorithmic decision-making and the long-term impact of new power structures on market fairness, economic resilience, and social welfare. We need new theoretical tools to understand and evaluate the emerging system of "Algorithmic Governance" constituted by private code.

Second, for business practice, firms must soberly recognize that the logic of their survival and development has changed. In the algorithmic-network paradigm, a firm's competitiveness depends not only on the quality of its products or services but also on its position within the platform ecosystem, its data contribution capacity, and its "trustworthiness" as assessed by algorithms. Corporate strategy needs to shift from mere operational optimization to active network positioning and "algorithmic reputation" management.

Finally, for public governance and policymaking, the rise of the new paradigm poses a severe challenge to traditional regulatory systems. When the allocation of credit resources is increasingly determined by opaque private algorithms, ensuring procedural fairness, outcome justice, and protection for vulnerable groups becomes an urgent issue. Future regulatory focus must expand from compliance oversight of traditional financial institutions to include accountability, transparency, fairness, and antitrust review of platform algorithms. Establishing effective algorithmic audit mechanisms, safeguarding users' data rights, and curbing the formation of data monopolies will be key to maintaining economic order and social justice in the digital age.

In conclusion, we are at a historic turning point. The digital restructuring of commercial credit is a microcosm of the profound reshaping of the entire economy and society by data and algorithms. Understanding and prudently guiding this transformation to ensure that the benefits of technological progress are shared fairly, while effectively mitigating its potential systemic risks, is a common mission for all researchers, entrepreneurs, and policymakers.

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