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The Data-Element Industrial Chain and Corporate Disruptive Innovation: A Literature Review

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Abstract

As data increasingly become a key factor of production, the data-element industrial chain encompassing data collection, processing, circulation, and application has continued to expand. This paper systematically reviews research on data elements, industrial linkages, and corporate disruptive innovation, with particular emphasis on the mechanisms through which the data-element industrial chain may shape disruptive innovation via knowledge acquisition and recombination, factor allocation, and industrial linkages. Existing studies remain limited in measuring firm-level participation, capturing heterogeneity in industrial-chain participation, and identifying underlying mechanisms. Future research may further examine the intensity and depth of firms' participation in the data-element industrial chain, heterogeneity across different chain segments, and the mechanisms through which such participation affects disruptive innovation.

Keywords

Data Elements; Data-element Industrial Chain; Disruptive Innovation; Industrial Linkages.

1. Introduction

As digital technologies increasingly permeate economic and social activities, data have gradually evolved from an auxiliary resource generated in production and business operations into an important factor of production that participates in value creation and resource allocation. The value of data does not depend solely on scale; rather, it is realized through collection, processing, governance, circulation, and application, together with integration with technology, capital, talent, and specific application scenarios. As specialization in these activities deepens, the data-element industrial chain formed around the development and utilization of data resources is becoming an increasingly important organizational form in the digital economy.

At the same time, research on corporate innovation has shifted from innovation quantity and conventional measures of innovation quality toward disruptive innovation. Disruptive innovation emphasizes departures from established knowledge bases and technological trajectories and typically relies more heavily on access to heterogeneous knowledge, cross-domain knowledge recombination, and sustained innovation investment. By connecting data, technology, knowledge, and application scenarios, the data-element industrial chain may not only broaden firms' external knowledge sources but also reshape technological search and innovation trajectories through upstream-downstream coordination, factor allocation, and demand feedback.

Existing studies have separately examined the economic effects of data elements, the determinants of corporate disruptive innovation, and innovation spillovers along industrial chains. However, these three streams of research remain insufficiently integrated, particularly

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with respect to how firms' participation in the data-element industrial chain affects disruptive innovation. Accordingly, this paper systematically reviews the relevant literature, analyzes the major mechanisms through which the data-element industrial chain may influence disruptive innovation, and summarizes research gaps and future directions, with the aim of informing further research on data value realization and high-level corporate innovation.

2. Conceptualizing the Data-Element Industrial Chain

As digital technologies become increasingly embedded in economic and social activities, data have shifted from an accompanying resource generated by production and business operations to a factor of production capable of participating in value creation and resource allocation. Data resources constitute the foundation of data elements, but the two concepts are not equivalent. Raw data must be collected, stored, processed, governed, and analyzed, and subsequently embedded in production and business activities, before they can be transformed from informational resources into productive inputs. Shi (2022) argues that, under the digital economy, data have become a distinctive factor of production alongside traditional inputs such as capital and labor, and that their value realization depends on the development, processing, and application of data resources through digital technologies.[14] China's "Twenty Measures on Data" further clarify that data, as a new factor of production, have become widely integrated into production, distribution, circulation, and consumption, and that realizing their value requires compliant and efficient data circulation and use. Accordingly, data elements may be understood as data resources that, after being processed under appropriate technological and institutional arrangements, can enter production and business processes, combine with other factors of production, and contribute to value creation.

On this basis, data-related economic activities have gradually evolved from dispersed data development and technology application into an industrial system characterized by specialization and upstream-downstream linkages. In 2024, the National Development and Reform Commission, the National Data Administration, and four other departments jointly issued the Guidelines on Promoting the High-Quality Development of the Data Industry, defining the data industry as an emerging industry that uses modern information technologies to develop products or services from data resources and facilitate their circulation and application. Its scope covers data collection and aggregation, computing and storage, circulation and transactions, development and utilization, security governance, and data infrastructure, while explicitly calling for collaborative innovation across upstream and downstream segments of the industrial chain. This policy framework provides an institutional basis for understanding the development, circulation, and application of data resources from an industrial-chain perspective.

From the perspective of value formation, data elements exhibit a clear chain-like structure. Raw data are first collected, aggregated, stored, cleaned, and governed to form usable data resources; they are then further valorized through algorithmic analysis, data services, and data circulation and transactions, before being embedded in concrete production and business scenarios where their value is ultimately realized. The data-element industrial chain can therefore be conceptualized as a vertically specialized and interconnected system in which different actors participate in data-resource formation, value-added processing, and application. Existing studies also show that data and digital technologies generate spillovers through industrial linkages. Yang et al. (2023) find that corporate digitalization produces significant industrial-chain spillovers through upstream-downstream input-output relationships, while Song et al. (2026) show that data elements can generate innovation spillovers through both vertical industrial chains and horizontal intra-industry networks.[6, 4] Examining data elements through an industrial-chain lens therefore helps reveal the division of labor and value-

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transmission mechanisms among actors involved in data-resource formation, value-added processing, and scenario-based application.

3. Data Elements and Their Economic Effects

With the development of the digital economy, data have gradually evolved from a by-product of economic activity into a new factor of production with independent economic value. Early studies primarily focus on the characteristics that distinguish data from traditional factors of production. Xu et al. (2021) identify virtuality, non-rivalry, increasing returns to scale, externalities, and ambiguous property rights as key characteristics of data.[10] Non-rivalry implies that the same dataset can be repeatedly used by multiple actors without materially reducing its availability to others. Jones and Tonetti (2020) likewise emphasize the non-rival nature of data, arguing that data sharing can increase social value, whereas firms may hoard data to preserve competitive advantage, thereby generating allocative inefficiencies.[19]

Once the factor-of-production attributes of data had been established, the literature increasingly turned to their economic effects. Existing studies generally suggest that data affect firm operations by reducing information-acquisition costs, improving decision quality, and enhancing resource allocation. The marketization of data elements further improves the efficiency with which data resources are transformed into productive inputs. Using the establishment of data trading platforms as a quasi-natural experiment, Zheng et al. (2023) find that data-element marketization significantly promotes corporate digital transformation, primarily through cost savings, the alleviation of financing constraints, and technological innovation.[12] These findings indicate that the value of data depends not only on data scale but also on circulation mechanisms and firms' capacity to use data effectively.

Building on this line of research, the innovation effects of data elements have become an important focus. Chen and Jiang (2024) find that open government data promote corporate innovation mainly by supplementing data resources and strengthening innovation incentives.[9] At the same time, the literature suggests that increases in data volume do not necessarily strengthen innovation effects; transmission efficiency and actual usability may be more important. Thus, the impact of data on innovation is not a simple "quantity effect," but depends more fundamentally on data quality, circulation efficiency, and the degree of fit between data and firms' technological and knowledge bases.

More recent studies have begun to examine heterogeneous effects across different types of innovation. Xu et al. (2023) distinguish breakthrough innovation from iterative innovation and argue that data advantages may strengthen large firms' incentives to pursue iterative innovation around existing products and users, thereby creating a "data-element trap"; data sharing and network effects can help mitigate this problem.[13] He et al. (2026) further show that the coordination between data and technology elements has a nonlinear effect on corporate disruptive innovation.[11] Moderate coordination can alleviate constraints on innovation resources, whereas excessive coordination may lead to resource misallocation and path dependence. These findings suggest that data elements do not automatically generate higher-level innovation; their effects depend on effective complementarities with technology, knowledge, and other resources.

Overall, research on data elements has expanded from their fundamental economic properties to microeconomic outcomes including productivity, digital transformation, and corporate innovation, while increasingly recognizing potential problems such as allocative distortions and innovation path dependence. However, existing studies primarily examine data ownership, open government data, data-element marketization, or regional factor allocation. Less attention has been paid to how data are continuously transmitted through industrial-chain stages such as collection, processing, circulation, and application, or to how firms' participation in the data-

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element industrial chain reshapes innovation resources and technological trajectories. This leaves substantial scope for examining the relationship between data elements and corporate disruptive innovation from an industrial-chain perspective.

4. Corporate Disruptive Innovation and its Determinants

Compared with incremental innovation, which improves technologies along established trajectories, disruptive innovation places greater emphasis on departures from existing knowledge bases and technological paths and is generally associated with greater uncertainty and resource requirements. In recent years, improvements in patent-citation data have shifted research attention from innovation counts and citation frequency toward whether innovations alter subsequent technological trajectories. Using large-scale data on scientific papers and patents, Park et al. (2023) document an overall decline in the disruptiveness of scientific and technological outputs and associate this trend with a narrowing of the range of prior knowledge being used.[15] Their findings highlight the knowledge base and the way knowledge is recombined as central to understanding disruptive innovation.

The literature on the determinants of corporate disruptive innovation first emphasizes firms' capabilities for knowledge acquisition and recombination. Disruptive innovation often requires firms to move beyond familiar knowledge domains and recombine knowledge elements that were previously weakly connected. Fleming (2001) argues that the use of unfamiliar technological components and novel combinations increases the uncertainty and probability of innovation failure, but also expands the possibility of generating breakthrough outcomes.[16] Zhou et al. (2025) find that the adoption of artificial intelligence significantly promotes disruptive green innovation by broadening and deepening firms' knowledge search.[8] Wang et al. (2016) likewise show that external network relationships can promote breakthrough innovation by strengthening absorptive capacity, with heterogeneous knowledge acquisition and complex knowledge transfer playing important roles.[7]

Second, internal resource allocation and organizational incentives determine whether external knowledge can be effectively transformed into disruptive innovation. Because disruptive innovation typically entails long development cycles and high risks of failure, firms require not only R&D funding and technological capabilities but also managerial incentives that support long-term innovation. Using the CD index to measure the degree of innovation breakthrough, Wang and Qin (2023) find that innovation competition encourages firms to adopt higher-quality innovation strategies, partly by strengthening executive innovation incentives and adjusting R&D investment and technology-import strategies.[2] These effects are more pronounced among firms with stronger R&D capabilities and higher patent quality. External innovation opportunities are therefore more likely to generate genuine technological breakthroughs when they are matched by firms' own R&D capabilities, financial commitment, and incentive structures.

Third, organizational structure and the external innovation environment also shape disruptive innovation. Analyzing more than 65 million papers, patents, and software products, Wu et al. (2019) find that small teams are more likely to produce disruptive outcomes that redirect existing trajectories, whereas large teams tend to develop and refine established directions, indicating that team size and patterns of knowledge search affect the type of innovation produced.[20] The external environment is likewise important: the more dynamic the market and technological environment, the greater the pressure on firms to depart from established technological paths, while digital infrastructure and R&D support can reduce the costs of adopting new technologies and acquiring knowledge. Zhou et al. (2025) show that the positive effect of artificial intelligence on disruptive green innovation is stronger among firms operating in regions with better digital infrastructure and receiving greater R&D subsidies.[8]

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Recent research has further emphasized new factors of production and the coordination of external resources. He et al. (2026) find that the coupling of data and technology elements affects corporate disruptive innovation through the breadth of patent knowledge and the transfer of knowledge embodied in talent, but that this relationship is not simply linear; excessive coordination may also generate resource misallocation and path dependence.[11] This suggests that disruptive innovation increasingly depends not only on firms' internal R&D investment but also on the flow and coordinated allocation of external data, knowledge, technology, and talent.

Overall, the literature explains the emergence of corporate disruptive innovation from multiple perspectives, including knowledge search, R&D capabilities, organizational structure, market competition, and digital technology. Nevertheless, much of the existing research remains focused on internal capabilities or isolated external factors. Insufficient attention has been paid to how firms continuously acquire data, technology, and heterogeneous knowledge by participating in specific industrial chains, and whether such cross-organizational resource linkages can alter established technological trajectories. Examining disruptive innovation from the perspective of firms' participation in the data-element industrial chain can therefore extend existing research on the external resource foundations and formation mechanisms of disruptive innovation.

5. Industrial Chains, Digital Industrial Linkages, and Corporate Innovation

As specialization deepens, corporate innovation has increasingly evolved from an isolated activity within individual firms into a collaborative process embedded in industrial chains and production networks. Upstream and downstream firms maintain continuing relationships through product transactions, technological cooperation, and supply-demand linkages, through which knowledge, technology, and market information are transmitted across firms. From a production-network perspective, Acemoglu et al. (2012) argue that industrial sectors are not connected merely through first-order input-output relationships but form interconnected networks in which local shocks can propagate to other actors through production linkages.[17] At the firm level, Bellamy et al. (2014) further show that supply-network accessibility is significantly associated with innovation output and that greater network interconnectedness strengthens this relationship.[18] These findings suggest that a firm's position within a supply network shapes the flow of knowledge and information and, in turn, affects innovation. Industrial chains therefore function not only as channels for the movement of products and production factors but also as important mechanisms through which firms access external innovation resources.

Domestic studies further explain innovation outcomes in terms of the degree to which firms are embedded in industrial chains. Using interfirm relationship data to construct industrial-chain maps and firm-level measures of industrial-chain integration, Chen et al. (2024) find that deeper integration into industrial chains significantly improves innovation performance, primarily through knowledge spillovers and economies of scale.[1] More specifically, industrial-chain integration strengthens firms' capacity to absorb advanced technologies and knowledge from upstream and downstream partners while increasing incentives for R&D investment through expanded output and market scale. This implies that the relationship between a firm and an industrial chain is not simply a question of whether the firm is "on the chain"; the depth of embeddedness and the strength of ties with other actors also shape access to innovation resources. Industrial-chain stability is another important external condition for innovation. Zhan and Liang (2024) find that China's "chain chief" policy promotes technological innovation by stabilizing upstream-downstream supply and demand, alleviating financing constraints, reducing R&D uncertainty, and attracting R&D talent.[5] Industrial chains can

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therefore affect innovation through both knowledge and technology spillovers and improvements in resource security, demand stability, and innovation risk.

The development of the digital economy has further altered the nature of traditional industrial-chain linkages. The pervasive nature of digital technologies allows a firm's digital capabilities to generate external effects along upstream-downstream relationships. Yang et al. (2023) find that upstream firms' digitalization not only improves their own productivity but also generates significant spillovers to downstream firms by reducing administrative expenses, increasing inventory turnover, improving resource-allocation efficiency, and raising total factor productivity.[6] The effects of digitalization therefore extend beyond firm boundaries and diffuse to related actors through industrial-chain relationships. Accordingly, research on industrial chains has gradually expanded from traditional material inputs and supply-demand relationships to the flow and transmission of data, digital technologies, and knowledge across industrial networks.

Against this background, recent studies have begun to examine digital industrial linkages and their innovation effects more directly. Compared with conventional industrial linkages, digital industrial linkages encompass not only upstream-downstream input-output relationships but also more pronounced flows of data, technology diffusion, and coordination across application scenarios. Song et al. (2026) classify digital industrial linkages into vertical industrial-chain linkages and horizontal intra-industry linkages. Vertical relationships include a "forward linkage effect" from upstream digital industries and a "backward linkage effect" from downstream digital industries, while horizontal relationships generate a "lateral effect" among firms within the same industry. Their findings show that open government data promote innovation in key digital technologies not only through the direct supply of data resources but also through innovation spillovers arising from these industrial linkages.[4] Upstream digital industries transmit basic data, algorithms, technologies, and other production factors downstream, facilitating knowledge diffusion and innovation matching; downstream digital industries, in turn, feed application scenarios, procurement demand, and technical standards upstream, creating demand pull and technological pressure that can stimulate breakthroughs in key technologies. This research advances the digital-economy literature from a focus on firms' own digitalization toward the transmission of digital factors and technologies through industrial linkages, providing more direct evidence on the chain-based innovation effects of data-related economic activities.

Innovation itself can also generate reverse spillovers along industrial chains. From a supply-chain perspective, Zhang et al. (2024) find that improvements in the innovation quality of focal firms can be transmitted to upstream and downstream partners through production-demand adjustments and financing spillovers, thereby improving their operating performance; these effects are stronger when supply-chain dependence is high.[3] Industrial chains and innovation therefore interact bidirectionally: industrial linkages promote innovation, while innovation outcomes diffuse along the chain. The more deeply firms are embedded in industrial networks, the more likely they are to access technologies, knowledge, demand information, and data resources from upstream and downstream partners, and the more readily their own innovation outcomes can be transmitted to other actors along the chain.

Overall, the literature has developed from conventional industrial linkages to industrial-chain integration, digital industrial-chain spillovers, and digital industrial linkages, and has demonstrated the importance of knowledge spillovers, factor transmission, demand pull, and resource allocation for corporate innovation. Nevertheless, several gaps remain. First, existing industrial-chain studies mainly examine general technological innovation, innovation quality, or productivity, with limited attention to disruptive innovation that replaces or redirects established technological trajectories. Second, research on digital industrial linkages has focused largely on open government data, regional digital-industry foundations, or the degree

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of digitalization among upstream and downstream firms, while paying less attention to firms' own participation in the data-element industrial chain. In particular, there is still little systematic micro-level evidence on whether deeper participation in different stages of data-resource formation, processing and circulation, and application and value enhancement can promote disruptive innovation through closer data, technology, and knowledge linkages. Studying the disruptive-innovation effects of firms' participation in the data-element industrial chain can therefore provide a bridge between the literature on industrial-chain innovation and that on digital industrial linkages.

6. Literature Review and Synthesis

Overall, existing research has generated a substantial body of evidence on data elements, corporate disruptive innovation, and industrial and digital linkages. First, research on data elements has progressed from their fundamental economic characteristics to microeconomic outcomes such as productivity, resource allocation, digital transformation, and corporate innovation, while increasingly emphasizing the importance of data quality, circulation efficiency, and coordination between data and other factors such as technology. Second, research on corporate disruptive innovation has moved beyond innovation quantity and conventional innovation quality to examine knowledge search, knowledge recombination, R&D capabilities, organizational incentives, and the external environment, thereby deepening understanding of the conditions under which disruptive innovation emerges. Third, studies of industrial chains and digital industrial linkages show that knowledge, technology, capital, demand, and data can be transmitted continuously through upstream-downstream relationships and industrial networks, and that firms' integration into industrial chains can generate knowledge spillovers, resource sharing, and demand pull that ultimately affect innovation.

7. Future Research Directions

First, research on data elements has mainly examined data-resource supply, open government data, data-element marketization, and regional data allocation, while devoting less attention to how firms continuously acquire and utilize data elements by participating in data-related industrial activities. Firms' access to data does not depend solely on external policy supply; it may also be strengthened through participation in data collection, processing and governance, circulation services, and scenario-based applications, which can create more stable data resources and technological linkages. Analyses conducted only at the regional or policy level therefore have difficulty capturing firm-level differences in participation. Future research should further investigate how participation in the data-element industrial chain promotes corporate disruptive innovation.

Second, although research on industrial chains and corporate innovation has shown that industrial-chain integration can promote general technological innovation and high-quality innovation, disruptive innovation has received comparatively limited attention. Relative to conventional innovation, disruptive innovation depends more heavily on heterogeneous knowledge acquisition, departures from established technological paths, and high-risk resource investment. Knowledge spillovers, technological coordination, and demand feedback within industrial chains may therefore operate differently in this context. Existing studies have not yet adequately established whether participation in industrial chains can alter firms' existing technological trajectories and increase innovation disruptiveness, leaving an important avenue for future research.

Third, although research on digital industrial linkages has begun to examine the transmission of data and digital technologies along industrial chains, it has mainly focused on open

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government data, upstream digitalization, and regional digital-industry foundations, with limited systematic measurement of firms' own participation in the data-element industrial chain. In particular, there remains a lack of micro-level empirical evidence on whether the intensity and depth of firms' participation across different stages of the data-element industrial chain affect their access to innovation resources, knowledge recombination, and technological breakthroughs. Future research should investigate these dimensions in greater depth.

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