

Article

Policy Tools and Configuration Paths in the Market-Based Allocation of Data Elements: Quantitative Analysis of China's Policy Framework

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Abstract

The market-based allocation of data elements is critical for unlocking economic value in the digital economy. Using policy tools theory, this study examines China's institutional framework for data marketization through a three-dimensional framework: policy issuers $\times$ policy tools $\times$ configuration paths. Based on a quantitative analysis of 569 policy units from 113 central and local documents (2020–2025), the study reveals key insights. First, central and local governments exhibit a clear division of labor: the central government prioritizes governance and ownership using information and regulatory tools, while local governments focus on circulation via service and environmental creation tools. However, distribution mechanisms remain underdeveloped, hindering operational effectiveness. Second, policy paths emphasize circulation and governance, with ownership and distribution systems lagging, leading to continuous infrastructure expansion but difficulties in market transactions. Third, service and environmental creation tools dominate, while regulatory and incentive tools are weaker. It reflects that the government prefers low-cost, low-conflict tools rather than transformative ones. These findings illuminate institutional complexities in data marketization and provide actionable recommendations for optimizing policy frameworks to balance ownership, circulation, distribution, and governance.

Keywords: data elements; market-based allocation; policy tools; configuration paths; content analysis

1. Introduction

In the new round of technological and industrial transformation driven by the digital economy, data is widely recognized as a new key factor of production following land, labor, capital, and technology. Extant research demonstrates that the marketization of data elements can improve enterprise-level investment efficiency [1] and productivity, reduce default risk [2], and stimulate urban innovation [3]. The marketization of data elements requires reliance on specific policies, which can achieve economic efficiency and value realization through the effective coordination and organization of policy instruments.

Around the ownership, circulation, distribution, and governance of data elements, countries have successively introduced policies related to data governance and the construction of data markets. China, in particular, has carried out large-scale institutional innovations and policy pilots in the marketization of data elements. Existing research has focused on top-level institutional design or analyzed local case innovations, but has failed



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to place the three dimensions of ‘who is making the policies’, ‘what tools are being used’, and ‘what goals are being pursued’ within the same analytical framework for quantitative correlation and cross-validation.

This study introduces the ‘policy tools–configuration paths’ analytical framework and, for the first time, incorporates the identity of policy issuers as a key variable, conducting a quantitative content analysis of 569 policy units from 113 central and local policy documents. We aim to gain insight into the deep policy logic of market-oriented allocation of data factors in China through empirical data. First, we systematically analyze the structural preferences and differences in policy tools selection between central and local governments. Second, we precisely map the specific configuration paths and combinations targeted by these tools. Finally, we reveal how the three interact with each other, collectively weaving a multi-dimensional policy network from institutional construction to market activation.

2. Literature Review

2.1. Research on the Digital Economy Policy System and Data Governance Policies

At a more macro level of digital economy governance, scholars have begun increasingly employing policy text analysis methods to construct a multidimensional analytical framework for the digital economy policy system. Cai et al. [4], using 971 Chinese digital economy policies from 2000 to 2022 as a sample, proposed an analytical framework of ‘policy issuers–policy tools–organizational management’ based on public policy theory, incorporating China’s distinctive ‘central–local’ institutional architecture. Through text mining and multidimensional coding, they characterized the evolutionary features of the digital economy policy system. In terms of data governance and the data market, some studies have explored the governance logic and regulatory challenges of the data market from the perspective of institutional design, pointing out issues such as the definition of data products, pricing mechanisms, asset confirmation, privacy protection, and liability allocation. These studies suggest that the marketization of data elements must rely on a complete set of institutional arrangements and combinations of policy tools, rather than on a single policy measure [5,6]. Although these studies have not directly adopted the three-dimensional framework of ‘policy issuers–policy tools–configuration path’, they have already echoed, at the level of policy systems and institutional structures, the consensus that the marketization of data elements requires governance that is systematic, holistic, and coordinated.

2.2. Research on Market-Based Allocation of Data Elements

With the rapid development of the digital economy, the market-oriented allocation path of data as a new type of production factor is attracting widespread attention.

Researchers have gradually shifted from a single-dimensional transaction mechanism to a systematic examination of the entire path chain. Firstly, the definition of data property rights is the institutional prerequisite for market-oriented allocation. Existing studies have pointed out that China has not yet formed a clear and operational data ownership system, facing problems such as a deficiency in data ownership theory supply, ambiguous legal nature of data rights, and unclear rules for data ownership and distribution [7,8]. Secondly, at the circulation and distribution mechanism level, a large number of studies focus on the construction of data trading platforms, standard formulation, and the realization path of trusted circulation [9,10]. These studies underscore the pivotal role of intermediary institutions in facilitating cross-domain, cross-sectoral circulation of data elements. Thirdly, at the income distribution level, it involves the value distribution rules among platforms, original data providers, and data users. The academic community advocates for the establishment of an incentive mechanism based on data contribution and usage efficiency [11].

Finally, at the data security and governance level, researchers emphasize that secure control is the bottom line for the sustainable circulation of data elements, advocating the parallel advancement of “available but invisible” and “compliant and auditable” governance frameworks through technologies and systems such as multi-party encryption and trusted computing [12].

3. Analytical Framework and Research Methods

3.1. Analysis Framework

This study takes the policy issuer, policy tools, and configuration paths as the core dimensions to construct a three-dimensional nested analytical framework. It is designed to systematically elucidate the supply logic, tool structure, and the mechanism of action of China’s data element marketization allocation policies in the process of factor allocation.

3.1.1. Policy Issuers

The governance logic and coordination methods of the policy issuer determine the type, ratio, and implementation intensity of policy tools. Therefore, the policy issuer dimension reflects the structural starting point of policy supply and lays the foundation for understanding the policy tools selection behavior. In the policy issuer dimension, this paper comprehensively considers the vertical hierarchical division characteristics in the process of promoting data element marketization in China, and divides the issuers into several types: First, the central-level issuers, including the State Council and its offices, the National Development and Reform Commission, the Cyberspace Administration of China, the Ministry of Industry and Information Technology, the Ministry of Finance, the People’s Bank of China, etc., as national-level comprehensive or specialized departments; Second, the local government issuers, including provincial-level people’s governments and provincial-level data bureaus and other relevant departments. Through statistical analysis of the policy quantities and tool combinations of different levels of issuers, the division pattern and coordination degree of data element marketization policy supply between the central and local governments can be identified.

3.1.2. Policy Tools

Policy tools are the specific means by which policy entities achieve governance goals, and they are the crucial link in transforming policy concepts into practical actions within the policy system. The theory of policy tools holds that the selection of tools is not neutral; it carries and transmits specific policy goals and value orientations [13,14]. How to select and reasonably combine these tools is the core issue in policy design. Due to the differences in research objects and research purposes, the classification standards for policy tools vary at present, and the classification systems exhibit diverse characteristics. C. C. Hood [15] proposed a classification of information, authority, finance, and organizational tools; M. Lorraine et al. classified policy tools into four categories: directive tools, incentive tools, capacity-building tools, and system-change tools [16]; Howlett and Ramesh proposed a classic classification framework for policy tools, dividing them into mandatory tools, incentive tools, information tools, and symbolic instruments [17]. From the perspective of policy integration, the key does not lie in the quantity of tools, but in whether the tools complement, connect, and collaborate within a common policy framework [18].

Based on the existing classification systems and considering that the policy text of this study is characterized by the marketization of data elements, it is classified into regulatory tools, incentive tools, service tools, information tools, organizational collaborative tools, and environmental creation tools. The reasons are shown in Table 1.

Table 1. Classification and definitions of policy tools.

Tool Type	Specific Description
regulatory tools	The data element market involves core issues such as data security, privacy protection, and fair competition. It is necessary to delineate red lines through mandatory rules to provide a basic framework for market operation.
incentive tools	The core means of market resource allocation are economic incentives. It is necessary to directly mobilize the enthusiasm of market entities through fiscal and financial measures to solve the problems of market failure and insufficient investment.
service tools	The development of the data element market requires infrastructure and public services as support. The government needs to build public platforms and provide common technical services to reduce the costs and difficulties for market entities to participate in data transactions and utilization.
information tools	In the data element market, information asymmetry is prominent. The government needs to provide clear signals and knowledge to market entities through the issuance of guidelines, white papers, and best practices, so as to promote information sharing and trust establishment.
organization/collaboration tools	The circulation of data elements involves multiple parties such as the government, enterprises, and research institutions. It is necessary for the government to coordinate relationships, establish cooperation mechanisms, and cultivate industry organizations to form a collaborative governance industrial ecosystem.
environmental creation tools	The data element market is a macro-level means that the government needs to create a favorable institutional environment, credit environment, and social cultural environment for the long-term healthy development of the entire market through top-level design, strategic planning, and cultural construction.

3.1.3. Configuration Paths

The ultimate goal of data marketization is to enhance and unleash the value of data. On one hand, from the perspective of classical property rights economic theory, in the real world where transaction costs are positive, clear initial assignment of property rights is a prerequisite for any resource to be traded in the market [19]. For data, it has characteristics such as non-competitiveness, unlimited replicability, and complex ownership, which result in extremely high transaction costs for its property rights definition. Secondly, Amnon Aumann and Harold Demsetz pointed out that the core function of property rights lies in guiding people to internalize externalities and transferring resources through transactions to the entities with higher valuation and greater potential for creating value [20]. The value of data elements must be activated and released in specific application scenarios. Through circulation, data can be made to flow and aggregate. Eventually, through transactions, the exchange and distribution can be completed. Data can be transformed from static resources into dynamic productivity. At the same time, Oliver Williamson's transaction cost economics indicates that due to bounded rationality, opportunism, and behavioral uncertainty, market transactions have a large number of costs [21]. The data element market has risks such as security, privacy, and fairness. Therefore, governance is the guarantee

throughout the entire process of the data element market, and through rules, standards, contracts, and technologies, a trustworthy trading environment is constructed to protect property rights and reduce transaction costs at all stages.

On the other hand, this configuration path directly corresponds and originates from China's top-level design. In the top-level design document "Opinions on Establishing Data Foundation Systems to Better Play the Role of Data Elements", four basic systems for data ownership, circulation and trading, benefit distribution, and security governance were proposed, which exactly correspond one-to-one with the "ownership, circulation, distribution, and governance" four paths and provide the most authoritative framework guidance.

3.1.4. Research Hypothesis

Based on the above three-dimensional analytical framework, this study proposes the following research questions and hypotheses:

RQ1: What are the differences in the selection and combination of policy tools between the central and local governments? H1: The central government uses regulatory and information tools more significantly than the local government, while the local government uses service and environmental creation tools more significantly than the central government.

RQ2: What are the characteristics of the distribution of different types of policy tools across the four configuration paths of circulation, governance, distribution, and ownership? H2: Policy tools are mainly concentrated on the circulation path and governance path, and the policy supply in the distribution path and ownership path is significantly insufficient.

RQ3: What are the combination patterns of the overall policy structure for data element marketization? H3: Service tools and environmental creation tools constitute the "core" of the policy tool system, and the combination frequency of these two tools is significantly higher than that of other tool combinations.

3.2. Research Design

3.2.1. Policy Text Selection and Unit Construction

This study draws on 113 authoritative policy documents issued by China's central and provincial local governments between January 2020 and April 2025. In April 2020, the "Opinions of the Central Committee of the Communist Party of China and the State Council on Establishing a More Complete Mechanism for the Market-based Allocation of Factors" first listed data as a production factor, marking the official launch of the policy for the marketization of data factors. To fully cover the context before and after, we set the starting time as January 2020.

The analysis is deliberately confined to policies issued at the central and provincial administrative levels. Municipal, county-level, and non-governmental documents (e.g., industry association guidelines or enterprise white papers) are excluded. This scope definition helps to focus on the interaction between the central and local levels in terms of top-level institutional design and implementation at the provincial level.

Policy texts are retrieved from two complementary sources: (a) official government websites: official websites of the State Council and various central ministries and commissions (www.gov.cn), and the official websites of provincial (autonomous region, municipality) governments; (b) professional legal and policy databases: PKU Law (www.pkulaw.com), and the policy text database of China National Knowledge Infrastructure (CNKI). The inclusion and exclusion criteria are as follows: (a) policy documents must be issued by the central or provincial government; (b) the effective date must be between January 2020 and April 2025; (c) the documents must directly involve the marketization of data elements, or contain specific chapters on the development of the data element

market; (d) if the document is only an internal administrative notice, meeting minutes, or a duplicate version, it will not be included.

To isolate analytically meaningful units directly tied to the research question, we adopted a three-stage, rigorously validated screening protocol:

First, all policy texts were automatically segmented at the paragraph level, resulting in 14,180 original text fragments. This step aimed to retain the complete context of each policy intention. Second, we constructed a domain keyword table covering core concepts such as “data elements”, “data market”, “data circulation”, “data transaction”, “data governance”, “rights attribution of data resources” and “data ownership”, as well as their synonyms. Using this keyword table, we conducted a machine initial screening of all paragraphs, quickly filtering out content that was obviously irrelevant to the research topic, and initially obtaining 584 relevant paragraphs. Third, two trained researchers independently verified the initial screened paragraphs. The verification criterion was whether the paragraph contained a clear, actionable government action or rule. We eliminated paragraphs that were merely principle-based, repetitive, or had ambiguous boundaries, and resolved disputes through discussion. This process ultimately determined 569 policy text units, forming the core analysis sample.

3.2.2. Policy Text Coding

We established a three-dimensional analysis framework of ‘policy issuers–policy tools–configuration paths’, and conducted systematic coding for the 569 selected units. During the coding process, this paper took policy provisions as the basic analysis unit. If a policy provision employed multiple policy tools, in order to comprehensively and accurately reflect its content, the same policy text of the same item would be coded repeatedly, resulting in a total of 940 codes.

In terms of the coding structure, out of the total 569 analysis units, there were a total of 228 single coding clauses (involving only one tool) (accounting for 40.1%), and 341 multiple coding clauses (involving two or more tools) (accounting for 59.9%). On average, each clause involved 1.65 types of tools. Further analysis revealed that the proportion of multiple coding in central policies was 76.5% (52/68), and in local policies it was 57.7% (289/501). The comprehensiveness of central policies was significantly higher than that of local policies. The specific combination patterns of multiple coding clauses are detailed in Section 4.2.2.

At the same time, to ensure the objectivity and consistency of the coding, two coders independently pre-coded 50 randomly selected units, compared the differences and discussed them, and formed a final coding manual with clear definitions and rich examples. Based on this manual, they independently completed all the coding and conducted cross-reviews. All differences were resolved through group discussions and reached consensus. The Cohen’s Kappa (κ) coefficient was used to test the reliability between the coders. The Kappa values for the two core dimensions of policy tools ($\kappa = 0.84$) and configuration paths ($\kappa = 0.80$) were both greater than 0.8, indicating that the coding results have high consistency and good reliability.

4. Results

4.1. Overview of the Policy Texts

An analysis of the release timing and quantity of 113 policy documents reveals the unique evolution trajectory of the marketization of data elements in China. Initially, it was mainly based on a localization pilot, and then designed by the central level, so as to promote the simultaneous deepening of implementation in all provinces, as shown in Figure 1.

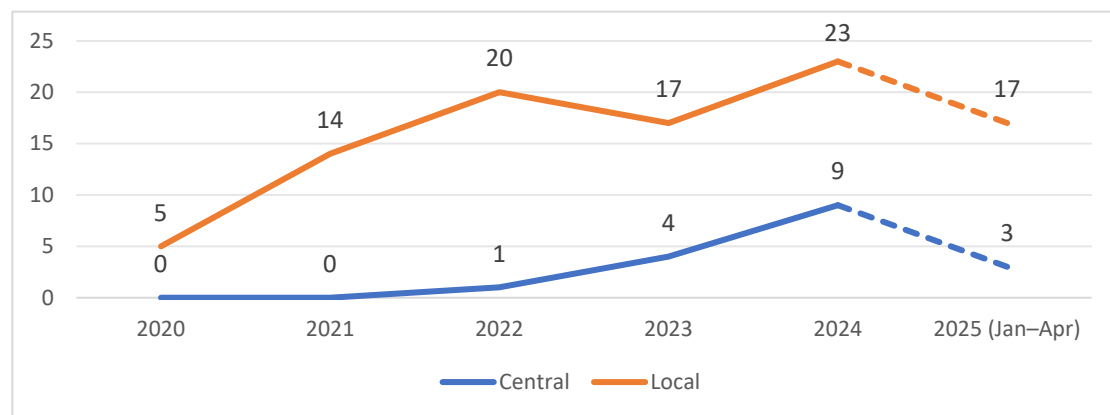


Figure 1. Distribution of policy texts by year and issuer type (2020–2025). Note: Data for 2020–2024 represent full calendar years. Data for 2025 represent January–April only (partial year) and are displayed with dashed lines to distinguish them from full-year data.

From 2020 to 2021, local areas such as Shanghai, Shenzhen, and Guizhou independently piloted policies, and the local exploration stage began with the release of local precedential policies such as data trading rules and data regulations, while the central government had not yet intervened. Since 2022, the central government has launched top-level design and released the first policy, marking the official layout of the national level for the data element market. Local governments have simultaneously deepened their implementation. After 2023, the number of policy releases gradually increased, indicating that the national strategy for the marketization of data elements has been fully implemented and local responses have been fully rolled out.

4.2. One-Dimensional Analysis

4.2.1. Analysis of Policy Issuers

In terms of the dimension of policy issuers, cross-departmental collaboration has become the mainstream mode for policy issuance. In this analysis, each individual policy document constitutes an observational unit. Jointly issued documents refer to those whose headers list two or more issuing departments, and the proportion of joint releases is calculated as the number of jointly issued documents divided by the total number of documents. Based on this, 65.5% of the policies were jointly released. This indicates that the data element market relies on multi-departmental collaboration to drive development.

At the central level, the proportion of joint releases is as high as 76%. Multi-departmental collaboration is the main approach, such as “National Development and Reform Commission + National Data Bureau”, “National Data Bureau + Central Cyberspace Administration + Ministry of Industry and Information Technology + Ministry of Public Security + State-owned Assets Supervision and Administration Commission”, with the maximum number of joint entities reaching 18 departments. This highlights the high degree of coordination in top-level design.

At the local level, 35 policies were issued by a single entity, such as “Shandong Provincial Big Data Bureau”, “Zhejiang Provincial People’s Government”, “Guizhou Provincial Big Data Development Administration”, “Fujian Provincial Data Administration”, etc., which issued policies independently. Some provincial government offices or people’s congress standing committees issued regulations or guidance documents separately. There were a total of 61 joint policies, showing widespread cross-departmental collaboration at the local level, such as “Jiangsu Provincial Data Bureau + Development and Reform Commission + Finance Department + Natural Resources Department + Housing and Urban-Rural Development Department”; “Guangxi Zhuang Autonomous Region Digital Guangxi

Construction Leading Group Office” led multiple departments to issue joint policies several times; Henan Province jointly issued policies by more than ten departments including Development and Reform Commission, Cybersecurity, Industry and Information Technology, Public Security, and Market Supervision and Administration; in Zhejiang Province, there were cross-system joint policies such as “Market Supervision Bureau + Procuratorate” and “People’s Congress + Government”. Overall, 63.5% of local policies were jointly issued, reflecting that local authorities’ need to integrate resources and break down the barriers of regional divisions when implementing.

4.2.2. Analysis of Policy Tools

In terms of policy tools, the frequency of tool combinations far exceeds that of individual tools. This indicates that the policy design demonstrates strong systematic and collaborative thinking, as shown in Table 2. Additionally, the frequent occurrence of numerous three-element combinations, such as “service–regulatory–environment creation” and “information–organization/collaboration–service”, suggests that policies are expected to address multiple goals including development, regulation, and coordination. Simple tool combinations are no longer sufficient to cope with the situation; a more sophisticated “policy toolkit” integration design is necessary.

Table 2. Top 10 frequency of policy tools combinations.

Combination Type	Occurrence Frequency	Combination Type	Occurrence Frequency
service–environmental creation	118	incentive–environmental creation	16
service–information	66	organization/coor-dination–service	14
organization/colla-boration–environmental creation	33	information–environmental creation	6
regulation–service	20	incentive–service	5
information–regulatory	19	service–regulatory–environmental creation	4

Secondly, policy tools are centered around the “service–environmental creation” combination. This indicates that the policy on the marketization of data elements emphasizes market cultivation and empowerment. Service tools and environmental creation tools are not only used most independently, but also together they account for over 64% of all tools, forming the dual core of the policy tools. Their combination frequency is also extremely high. This directly reflects the current core orientation of the policy, which is not simply managing data, but through service tools, such as registration, or authorization for operation, building a trading platform, and constructing a trustworthy data space. At the same time, environmental creation tools are leveraged, relying on sound institutional rules, strengthened standards, pilot demonstrations, and an improved price mechanism, to create a supportive ecosystem. This is consistent with the country’s construction of the “1 + 3” public data development and utilization policy system and the promotion of data integration and application through the “Data Element ×” action.

Regulatory and information tools rarely appear alone; instead, they are typically used in combination or in conjunction with other tools. This indicates that while policies encourage data development and utilization, they also attach great importance to risk prevention. In contrast, tools and incentive tools are used less frequently, and are mostly deployed in

combined forms. This reflects that when policies promote the specific implementation, they mainly do so by establishing chief data officers, establishing cross-departmental coordination mechanisms, etc., and through design of financial incentives and revenue distribution mechanisms. These measures are intended to stimulate the enthusiasm and collaboration of various parties such as local governments, enterprises, and data service providers, to jointly foster a thriving data industry ecosystem.

4.2.3. Analysis of Configuration Paths

With regard to the dimension of market-oriented configuration paths, Table 3 shows that “circulation” and “governance” are the dominant policy action paths, accounting for nearly 90% of the total path frequency. This indicates that they form the core dual focus of this policy area. Specifically, the current priority is to break down data barriers and promote efficient sharing, while simultaneously establishing a corresponding security supervision and compliance framework, thereby laying the foundation for application and management order for the valuation of data. The configuration of distribution and ownership is relatively weak. Policies often combine them with circulation. This is reflected in the fact that, without completely resolving the issue of ownership, they accumulate experience in distribution through circulation practices, and then use the practical needs in application to push for the gradual improvement of the rule system in reverse. “Ownership” rarely appears alone, but frequently appears in combinations with “distribution” and “circulation”.

Table 3. Statistical table of policy issuers–policy tools–configuration paths.

Policy Tools			Policy Issuers			Configuration Paths		
Type/Frequency	Individual	Combined	Central	Local	Circulation	Governance	Distribution	Ownership
service tools	59	254	43	270	174	119	29	17
environmental creation tools	93	197	20	270	199	83	15	12
information tools	15	108	27	96	51	61	5	8
regulatory tools	37	56	21	72	17	62	10	14
organization/collaboration tools	2	68	7	63	34	32	0	4
incentive tools	22	29	3	48	28	22	2	3
Total	228	712	121	819	503	379	61	58

Among them, the total frequency of the tool is 1001 times, which is greater than the 940 times previously recorded. This is because these two figures represent different analytical levels. The 940 items of coding refer to the quantity at the tool level, indicating the situation where there are duplicate encodings among different types of tools within the same policy clause. The 1001 total tool frequencies represent the quantity at the tool and path pairing level, where each tool is separately counted for each different configuration path it covers. The 61-point difference reflects the extent of “path overlap”, indicating that in the same policy provision, a single tool is applied to multiple paths.

In terms of the configuration path combinations, “circulation–distribution” accounted for an overwhelming 41.9%, making it the most dominant configuration paths, as shown in Figure 2. This confirms the core logic of the data element marketization policy, which aims to release the value potential of data through circulation, and to achieve feedback on

circulation vitality through distribution, with the goal of breaking down barriers to data circulation. To examine whether multiple coding clauses might lead to an overestimation of the frequency of specific tools, this study further narrowed down the analysis unit to the policy clause level ($n = 569$), and calculated the “clause mention rate” of each tool, comparing it with the proportion at the coding level ($n = 940$) (see Table 4). The clause mention rate refers to the number of policy clauses that mention the tool divided by the total number of clauses.

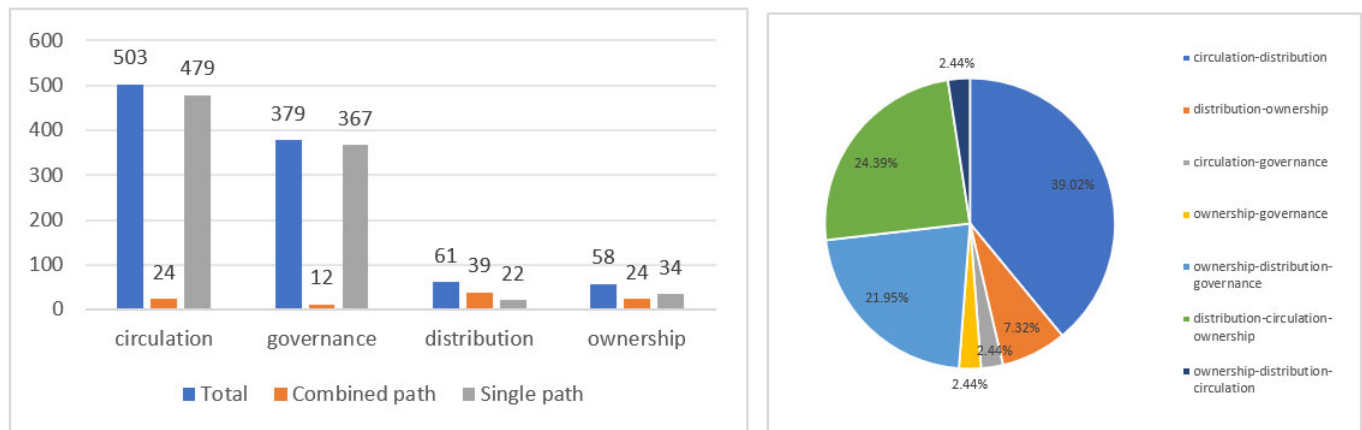


Figure 2. Configuration paths by single and combined usage.

Table 4. Comparison of coding share and provision mention rate by policy tools type.

Policy Tools Type	Coding Frequency ($n = 940$)	Coding Share	Provision Mentions ($n = 569$)	Provision Mention Rate	Gap
service tools	313	33.3%	310	54.5%	+21.2 p.p.
environmental creation tools	290	30.9%	290	51.0%	+20.1 p.p.
information tools	123	13.1%	124	21.8%	+8.7 p.p.
regulatory tools	93	9.9%	94	16.5%	+6.6 p.p.
organization/collaboration tools	70	7.4%	69	12.1%	+4.7 p.p.
incentive tools	51	5.4%	51	9.0%	+3.6 p.p.

The comparison results show that the clause mention rate of all six types of tools is higher than their coding-level proportion. Among them, the clause mention rate of the service tools (54.5%) is significantly higher than their coding proportion (33.3%), with a difference of 21.2 percentage points. This indicates that more than half of the policy clauses independently mentioned the content of service supply, and their frequent use is not due to the repetitive accumulation of comprehensive policies, but rather truly reflects the fundamental orientation of policy supply. The environmental creation tools also exhibit similar characteristics, with the difference between the clause mention rate (51.0%) and the coding proportion (30.9%) being 20.1 percentage points, further verifying their core position in market cultivation.

In conclusion, the verification results at the clause level indicate that the structural characteristics of the frequency distribution at the coding level also hold true at the clause level.

4.3. Two-Dimensional Combined Analysis

4.3.1. Analysis of Policy Issuers and Policy Tools

The overall structure of policy tools at the central and local levels is similar, but a detailed analysis of the proportion of individual and combined use reveals significant differences in roles and functions. As shown in Table 3, the use of policy tools at the central level exhibits stronger macroscopic orientation, combinability, and normativity. In central policies, the relative proportions of information tools and regulatory tools are much higher than those at the local level, and both are often used in combination, reflecting the core functions of the central government in setting data standards, establishing regulatory frameworks, and delineating market boundaries. Local policies place more emphasis on specific implementation and economic incentives. Incentive tools are frequently combined with “environmental creation tools”, demonstrating the local government’s active encouragement of market participation through specific measures such as financial rewards and pilot demonstrations. The use of tools in local policies is also much higher than that at the central level, reflecting the important role of the local government in promoting cross-departmental collaboration and establishing regional coordination mechanisms in operational matters.

Furthermore, to verify the statistical reliability of the aforementioned differences, this study conducted a Pearson chi-square test. The results showed a highly significant difference in the distribution of the six types of policy tools between the central and local levels ($\chi^2 = 29.035$, $df = 5$, $p < 0.001$). Further, through the analysis of adjusted standardized residuals, the specific sources of the differences were identified (see Table 5). The criterion for judgment was that $|\text{residual}| > 1.96$ corresponding to $p < 0.05$.

Table 5. Adjusted standardized residual analysis of differences in the use of central and local policy tools.

Policy Tools Type	Central ($n = 121$)	Local ($n = 819$)	Residual Difference	Significance
service tools	43 (+0.6)	270 (−0.6)	1.2	-
environmental creation tools	20 (−3.7)	270 (+3.7)	7.4	$p < 0.001$
information tools	27 (+3.2)	96 (−3.2)	6.4	$p < 0.01$
regulatory tools	21 (+2.9)	72 (−2.9)	5.8	$p < 0.01$
organization/collaboration tools	7 (−0.7)	63 (+0.7)	1.4	-
incentive tools	3 (−1.5)	48 (+1.5)	3.0	-

Note: The numbers in parentheses represent the adjusted standardized residuals; bold indicates $|\text{residual}| > 1.96$ ($p < 0.05$), indicating a significant difference.

The residual analysis indicates that information tools (residual = +3.2, $p < 0.01$) and regulatory tools (residual = +2.9, $p < 0.01$) have significantly higher usage frequencies at the central level compared to the local level, verifying the dominant role of the central government in data rule-making, standard setting, and regulatory framework construction. Environmental creation tools (residual = +3.7, $p < 0.001$) have significantly higher usage frequencies at the local level compared to the central level, demonstrating the role of local governments in promoting the marketization of data elements by optimizing the business environment. The absolute values of the residuals for the service tools (residual = +0.6), organization/collaboration tools (residual = −0.7), and incentive tools (residual = −1.5) are all less than 1.96, indicating that the distribution differences in these three types of tools between the central and local levels do not reach the statistical significance level.

The above statistical results rigorously verify the core assertion of this paper that the central government focuses on system design and macro guidance, while the local government focuses on implementation and scenario innovation. This effectively eliminates the interference of sampling errors on the conclusion.

4.3.2. Analysis of Policy Tools and Configuration Paths

As shown in Figure 3, the distribution of different types of policy tools along the configuration paths shows significant differences. Service tools and environmental creation tools are most frequently applied in the circulation path, accounting for over 74% of the total. This indicates that policies promoting data circulation mainly rely on providing service support and establishing a friendly institutional environment. Regulatory tools and information tools have the highest concentration in the governance path. This suggests that regulation and supervision, as well as disclosure and transparency, are two core means for achieving effective data governance. The supply of tools in the distribution and ownership stages is generally weak. Tools are zero in the distribution and only appear four times in the ownership. This indicates that in the process of promoting the clarification of ownership rights and the distribution of complex market returns, the construction of cross-departmental and cross-entity collaborative mechanisms is significantly lacking. Incentive tools are rarely applied in distribution and ownership, indicating that policies are very cautious in directly stimulating the realization of market revenues and innovation in ownership definition.

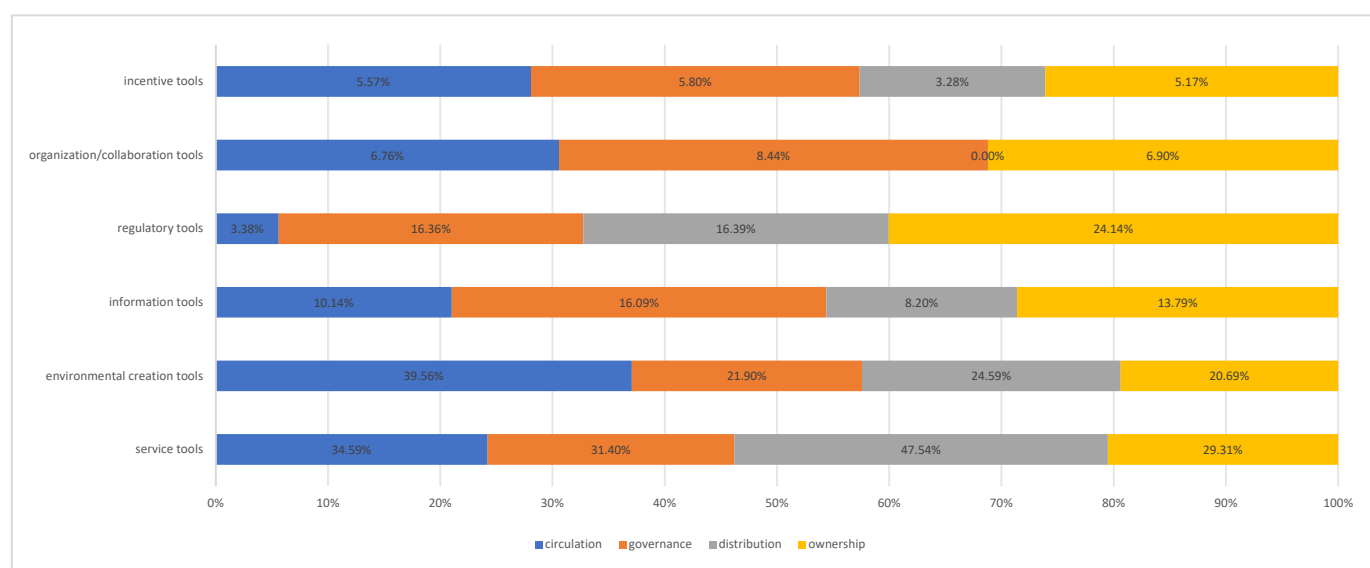


Figure 3. Distribution of policy tools along the configuration path.

In summary, the circulation path is the main choice for most policy tools, while the frequency of the ownership and distribution paths is generally low. This indicates that the current application of policy tools is more focused on resource flow and governance optimization, while the support for property definition and the realization of market-based income is relatively insufficient.

To verify the statistical reliability of the aforementioned distribution differences, this study conducted a Pearson chi-square test and adjusted standardized residual analysis. The results showed that there were extremely significant differences in the distribution of different policy tools across the four configuration paths ($\chi^2 = 92.551$, $df = 15$, $p < 0.001$), indicating that the association between the tools and the paths was not random but rather had a systematic functional division (see Table 6).

Table 6. Adjusted standardized residuals for policy tools by configuration pathway.

Policy Tools	Circulation (<i>n</i> = 503)	Governance (<i>n</i> = 379)	Distribution (<i>n</i> = 61)	Ownership (<i>n</i> = 58)
service tools (<i>n</i> = 339)	174 (+0.5)	119 (−1.3)	29 (+2.3)	17 (−0.8)
environmental creation tools (<i>n</i> = 309)	199 (+6.0)	83 (− 4.8)	15 (−1.1)	12 (−1.7)
information tools (<i>n</i> = 125)	51 (− 2.3)	61 (+2.7)	5 (−1.0)	8 (+0.3)
regulatory tools (<i>n</i> = 103)	17 (− 7.2)	62 (+4.9)	10 (+1.6)	14 (+3.6)
organization/col- laboration tools (<i>n</i> = 70)	34 (−0.3)	32 (+1.4)	0 (− 2.2)	4 (+0.0)
incentive tools (<i>n</i> = 55)	28 (+0.1)	22 (+0.3)	2 (−0.8)	3 (−0.1)

Note: Data are presented as “observed frequency (adjusted standardized residual).” Bold indicates $| \text{residual} | > 1.96$ ($p < 0.05$), denoting statistically significant deviation from expected frequency. Chi-square test: $\chi^2 = 92.551$, $df = 15$, $p < 0.001$.

The residual analysis reveals a clear functional division of policy tools across configuration paths. Environmental creation tools are significantly concentrated in the circulation path (residual = +6.0, $p < 0.001$) but underrepresented in governance (residual = −4.8, $p < 0.001$), indicating that institutional environment optimization is currently geared toward promoting circulation rather than governance. Conversely, regulatory tools are concentrated in governance (residual = +4.9, $p < 0.001$) and ownership (residual = +3.6, $p < 0.001$), while being significantly absent from circulation (residual = −7.2, $p < 0.001$), forming a distinct “governance–ownership” dual-core function. Information tools are also concentrated in governance (residual = +2.7, $p < 0.01$), reinforcing the role of transparency in data governance. On the distribution path, service tools are used more frequently (residual = +2.3, $p < 0.05$), whereas tools are notably lacking (residual = −2.2, $p < 0.05$), suggesting that supportive services are advancing revenue realization while cross-departmental coordination lags behind. Incentive tools show no significant path preference ($| \text{residual} | < 1.96$), indicating that fiscal incentives have yet to acquire a clear functional orientation.

The above statistical results have empirically verified that the circulation path is the main direction for the configuration of policy tools, while the core finding is that the support for the ownership path and the distribution path is relatively insufficient.

4.3.3. Analysis of the Policy Issuers and Configuration Paths

As shown in Figure 4, a comparison of the central and local governments, path configurations reveal a clear functional division. The central government assumes more fundamental and normative responsibilities in governance and ownership, while the local government mainly focuses on the construction of circulation. Both levels invest less than 6%. This further confirms that the current data element marketization policies are still in the exploratory stage of first facilitating circulation and then distribution. The establishment and improvement of the income distribution mechanism still await policy attention.

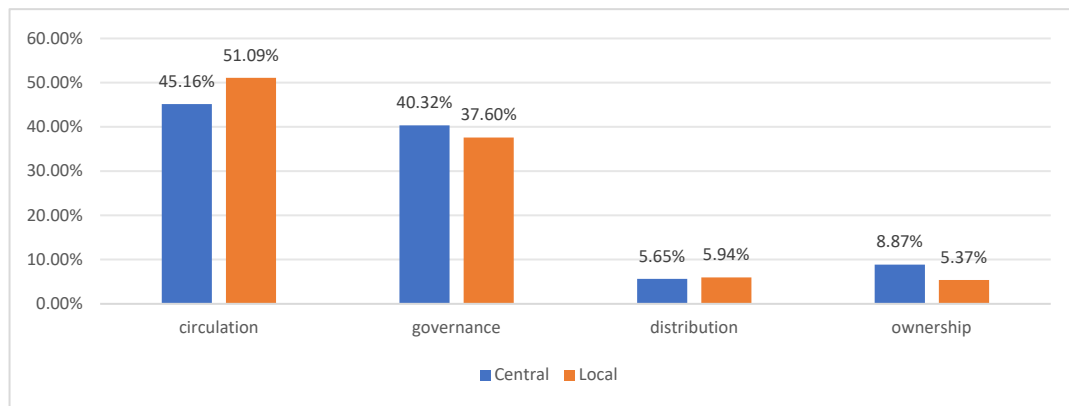


Figure 4. Configuration path of central and local policies.

In terms of path complexity, the central policies are more intricate, with an average of 2.24 paths covered per policy, significantly higher than the 1.38 paths covered by local policies. Moreover, local policies are more focused, with over 70% of local policies targeting a single path, and their goals are more specific. This indicates that in the policy design, there is a clear “governance–circulation” division of labor pattern between the central and local authorities in terms of path allocation, and it matches differentiated policy tool combinations.

4.4. Multidimensional Cross Analysis

Integrating the three analytical dimensions, the study finds that the central and local governments strategically select and combine differently according to their respective governance levels and core responsibilities, while precisely focusing on different configuration paths. Together, they form a complete policy system from top-level institutional design to grassroots vitality stimulation.

The central government, as the designer of the system, exhibits a strong governance orientation in its policy actions, favoring the use of information, regulatory, and complex combination tools. Through comprehensive policies covering multiple paths, it conducts macro planning and rule setting, aiming to build a unified and stable national governance framework. Local governments, as the implementers of development, exhibit a strong circulation orientation in their policy actions. They rely on environmental creation tools, incentive tools, and “service + environment creation” combination, and employ targeted single-path policies to promote the smooth flow of local resources and stimulate market vitality.

In terms of tool selection, service tools and environmental creation tools constitute the dual core of the policy toolbox, while regulatory and information tools respectively become the key levers for central governance and central–local coordination.

4.5. Robustness Test

To address the concern that multiple coding may amplify the frequency of comprehensive policies, we conducted robustness checks on 228 single-coded provisions across both analytical dimensions. Due to the existence of cells with an expected frequency less than 5 in a single-coding sample (the minimum expected frequency is only 0.14), this study employed Fisher’s Exact Test for the difference test.

For the policy issuers and policy tools dimension, the results indicated that there was a significant difference in the choice of tools between the central and local authorities in the single-coding policy ($p = 0.011 < 0.05$), which is fully consistent with the conclusion of the chi-square test for the entire sample ($\chi^2 = 29.035$, $df = 5$, $p < 0.001$). Local governments

continue to favor service tools (residual = +2.9), while the central government favors information tools (residual = +2.0) (see Table 7).

Table 7. Distribution of policy issuing and policy tools for single coding clauses.

Policy Tools type	Central (<i>n</i> = 16)	Local (<i>n</i> = 212)	Adjusted Residual (Central/Local)
service tools	7 (43.8%)	52 (24.5%)	+1.7/−1.7
environmental creation tools	1 (6.3%)	92 (43.4%)	−2.9/+2.9
information tools	3 (18.8%)	12 (5.7%)	+2.0/−2.0
regulatory tools	4 (25.0%)	33 (15.6%)	+1.0/−1.0
organization/col-laboration tools	0 (0.0%)	2 (0.9%)	−0.4/+0.4
incentive tools	1 (6.3%)	21 (9.9%)	−0.5/+0.5

Note: The values within the cells are “Frequency (Percentage)”; bold indicates that the absolute value of the adjusted residual is greater than 1.96 ($p < 0.05$); since the expected frequency in some cells is less than 5, Fisher’s Exact Test is used.

For policy tools and the configuration paths dimension, the results indicated that the correlation between policy tools and configuration paths remains significant ($p < 0.001$), and is in complete agreement with the conclusion of the chi-square test for the entire sample ($\chi^2 = 92.551$, $df = 15$, $p < 0.001$) (see Table 8). Environmental creation tools concentrated in circulation, regulatory tools concentrated in governance, and organization/coordination tools were absent from the distribution.

Table 8. Distribution of policy tools and configuration path for single coding clauses.

Policy Tools Type	Circulation	Governance	Distribution	Ownership
service tools	53 (54.1%)	34 (34.7%)	10 (10.2%)	1 (1.0%)
environmental creation tools	67 (59.8%)	41 (36.6%)	2 (1.8%)	2 (1.8%)
information tools	6 (37.5%)	8 (50.0%)	0 (0.0%)	2 (12.5%)
regulatory tools	4 (9.5%)	32 (76.2%)	4 (9.5%)	2 (4.8%)
organization/col-laboration tools	0 (0.0%)	2 (100%)	0 (0.0%)	0 (0.0%)
incentive tools	6 (25.0%)	16 (66.7%)	1 (4.2%)	1 (4.2%)

These two single-coding robustness tests jointly confirmed that the core conclusion of this study is statistically robust and is not affected by the multiple coding strategies.

5. Discussion and Conclusions

5.1. Discussion

Based on the systematic coding and quantitative analysis of 113 policy samples, this study reveals the structural characteristics and collaborative logic of China’s data element marketization policies within a three-dimensional framework of policy issuers, policy tools, and configuration paths.

5.1.1. The Institutional Logic of Central–Local Division of Labor

The significant differentiation in the selection of policy tools and the configuration paths between the central and local governments essentially reflects the hierarchical gover-

nance system in the field of data elements. The central government prefers information tools and regulatory tools, and focuses on governance and ownership paths. The local government prefers environmental creation and service tools, and focuses on circulation and distribution paths. This is a rational choice determined by the structural differences in administrative levels, information advantages, and resource endowments between the central and local governments.

The central government's preference for information tools and regulatory tools stems from their institutional legitimacy as rule-makers. The information tools can establish a unified cognitive framework, while regulatory tools can delineate unbreachable bottom lines. Together, these two types of tools serve the goal of providing institutional support for a unified market. The reason why local governments prefer environmental creation and service tools is that, in the process of policy implementation, local governments can only attract data elements to gather locally by optimizing the business environment and providing direct services, thereby gaining an advantage in regional competition.

The research has revealed a crucial tension. When macro-level rules formulated by the central government are transmitted to the local level, "rule attenuation" may occur due to inconsistent interpretations of technical standards and differences in regulatory scales. When the information tools at the central level need to be transformed into service tools at the local level, there is a lack of standardized translation mechanisms in the middle, resulting in deviations in the policy logic between the central and local levels during the transmission process. Importantly, this is not attributable to local implementation failure but rather reflects the inherent technical complexity of data governance and the absence of intermediary translation mechanisms.

5.1.2. Configuration Paths Imbalance

The circulation and governance aspects consume nearly 90% of the policy resources, while the supply of tools for distribution and ownership is severely insufficient. Behind this situation lies the dual constraints faced by policy makers.

First, the data element market is still in the exploratory stage. The issue of ownership and distribution involves complex ownership relationships and interest conflicts. If the policy design is improper, it may lead to systemic risks such as privacy leakage and data monopolization. In contrast, circulation and governance are relatively mature policy areas. Circulation focuses on breaking down technical barriers, while governance emphasizes establishing a compliance framework. Both can be advanced through infrastructure construction and standardization, and the risks are controllable. Allocating policy resources to low-risk areas is a rational choice in the early stage of institutional exploration.

Secondly, the enthusiasm of local governments for promoting the construction of circulation infrastructure far exceeds its concern for the design of the benefit distribution mechanism. The improvement of circulation capacity will lead to quantifiable and visible results. Such indicators include the rate of government data sharing, milestones for platform construction, the number of departments that have been connected, and the volume of data exchange. These metrics are easy to measure and can be conveniently conveyed to higher-level authorities. Moreover, it is consistent with the traditional bureaucratic performance evaluation system, thus becoming a favorable goal for local policymakers to showcase administrative efficiency. However, the benefit distribution involves coordination among stakeholders, normative games, and iterative adjustments of rules, which entail significant uncertainties, political sensitivities, and a long time span. Its effectiveness can only be gradually revealed through market behavior over time, rather than relying on public ceremonies. This has led to a systematic bias, where local policies have overly

invested in infrastructure that facilitates circulation, while remaining relatively stagnant in terms of value acquisition and benefit distribution mechanisms.

The cumulative effect of this bias has led to an increasingly widening gap between the two. Eventually, data is flowing but no wealth is being created; infrastructure exists but the market fails to thrive.

5.1.3. The Collaborative Logic of Tool Combination

The utilization rate of the tool combinations reached as high as 75.74%, and there were numerous tripartite combinations coexisting. This is not merely a stacking of policy quantities, but rather reveals the underlying mechanism of the coordination of policy tools.

When the “service-environmental creation” combination becomes the absolute dominant force, its synergy effect has gone beyond simple functional superposition. The service tools reduce market participation costs by providing infrastructure, while environmental creation tools generate development expectations through strategic planning and institutional signaling.

When regulatory tools and information tools are integrated into the combination, it not only prevents market disorder but also avoids excessive intervention. However, the insufficient innovative application of incentive and organization/collaboration tools has revealed that the current policy mix still prioritizes stability. The incentive tools involve the core interest game of profit distribution, while the organization/collaboration tools require breaking down departmental barriers and redefining the relationship of responsibilities and authorities. The advancement of these two types is much more difficult than the provision of services and the creation of an environment.

The choice of the current policy combination model essentially involves the trade-off between reform costs and institutional benefits.

5.2. Policy Recommendations

Based on the above three discussion dimensions, we propose priority-based policy recommendations to bridge the structural gaps in the design of data element market policies.

5.2.1. Mechanism for Converting Central Standards into Local Service Design

Our analysis has confirmed that the central government emphasizes regulatory and information tools, while local governments prioritize service and environmental creation tools. However, the lack of a standardized conversion mechanism may lead to the central intention being diluted or selectively reinterpreted during the implementation process at the local level. We propose two ways to bridge this gap.

One is for the central government to uniformly set standards and for localities to implement them flexibly. The central government should continue to issue national data classification and grading standards, security assessment frameworks, and cross-border data flow rules as regulatory benchmarks. Localities should obtain clear flexibility through a dual framework of standards and guidelines, adjusting these standards according to regional industrial characteristics.

The second is the promotion channel from pilot to practice. The central government should institutionalize the dissemination of successful local policy innovations through the following: First, selection of pilot regions for new service models within 6 months. Interim evaluation of pilot outcomes within 18 months of pilot launch. Second, national rollout of validated models within 24 months of pilot launch. And then, annual best-practice compilations published each December, featuring successful local innovations and implementation experiences.

Meanwhile, a “policy laboratory” approach should be adopted, wherein designated pilot regions test new service models under central supervision, with successful models codified into national standards and rolled out nationally.

5.2.2. Tools for Promoting Market Benefit Distribution

Our empirical analysis shows that organizational/coordination tools are completely absent in the path of distribution, while incentive tools have not shown statistically significant path preferences (see Table 3). These gaps explain why benefit distribution lags behind circulation and governance. We propose two instruments to address these deficiencies.

Strengthened incentive mechanisms: A multi-layered incentive framework should be established to stimulate market participation. This includes performance-based fiscal incentives for enterprises achieving data transaction milestones, subsidy programs to lower entry barriers for small and medium-sized enterprises, and tax incentives to signal long-term policy commitment.

Institutional infrastructure for benefit distribution: The zero-presence of organization/coordination tools in this pathway requires foundational institutional interventions. On one hand, we suggest establishing cross-departmental coordination mechanisms at both the central and local levels to supervise data transactions. Specifically, at the central level, a joint meeting is held every six months, with representatives from the National Data Bureau, CAC, MIIT, and Commerce Ministry participating to coordinate and solve cross-departmental coordination issues in data transaction supervision. At the local level, a joint office composed of full-time personnel from relevant local departments is responsible for daily affairs supervision and cross-institutional coordination work. Additionally, the annual cross-provincial joint meetings aim to address interconnection issues and coordinate regulatory standards across regions. On the other hand, we recommend mandating cross-departmental coordination mechanisms for data transaction oversight at both central and local levels, developing interoperable transaction platforms across regions, and formulating unified product specifications, valuation methods, and contract templates to reduce transaction friction.

Innovation in tool combinations: Local governments should be encouraged to innovate at the level of the tool set, integrating incentive tools and organization/collaboration tools systematically into the existing framework. By promoting innovation in the combination rather than making single-tool adjustments, the policy effectiveness can be enhanced.

5.3. Limitations and Future Research

This study mainly relies on quantitative analysis of policy texts to address the insufficient attention paid to the policy implementation effect and the perception of market entities.

However, there are the following shortcomings. Firstly, the sample scope mainly covers central and provincial policies, while local-level innovative explorations may not have been fully captured. Secondly, no empirical assessment of the policy implementation effects has been conducted. Future research can conduct policy effect assessment by combining actual indicators such as transaction scale and the inclusion of enterprise data assets in the balance sheet, and reveal the micro-mechanism of policy transmission through in-depth interviews. At the same time, with the development of technologies such as generative artificial intelligence and privacy computing, the form and value realization mode of data elements will continue to evolve, and the policy system and tool combination also need to be continuously optimized in a dynamic adjustment process.

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