A Study on the System Architecture of Policy Tool Selection for Promoting China's Big Data Development and Its Optimization Strategies: Postprint

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Abstract

[Purpose/Significance] This study investigates the policy instrument selection system structure constructed by China to achieve the policy objectives of promoting big data development, reveals existing problems in big data policy instrument selection, and provides recommendations for optimizing China's selection of policy instruments for promoting big data development. [Method/Process] A policy sample set comprising 63 policy texts focused on big data development was constructed. Content analysis was employed to encode the policy instruments contained in the sample set. A three-dimensional analytical framework for policy instrument selection encompassing basic resource, technical, and domain dimensions was established, and its association with policy instrument coding was built through coding mapping. From the domain dimension, hierarchical clustering analysis was utilized to conduct cluster analysis on the sample policy texts. [Results/Conclusions] The policy instrument coding analysis reveals that China's big data policy instrument selection exhibits problems such as lack of long-term planning, insufficient coordination between policies and policy instruments, inadequate diversity in policy instrument selection, structural imbalance in policy instrument selection, vague expression of demands, and difficulty in identifying key policies and policy instruments. It is recommended to strengthen strategic planning and development concept guidance, emphasize coordination between policies and policy instruments, mitigate public risks, construct a demand-driven and problem-oriented policy instrument selection system structure, and innovate the design and application of key policy instruments.

Full Text

Abstract

This study investigates the architecture of policy instrument selection systems constructed by China to achieve the policy goal of promoting big data development, reveals existing problems in big data policy instrument selection, and provides recommendations for optimizing China's policy instrument choices for big data development. A policy sample set comprising 63 policy texts focused on big data development was constructed, and content analysis was employed to code the policy instruments contained within the sample set. A three-dimensional analytical framework for policy instrument selection was established, encompassing basic resource, technical, and field dimensions, with coding mapping used to create associations between the framework and policy instrument codes. From the field dimension, hierarchical cluster analysis was applied to cluster the sample policy texts. The coding analysis results indicate several issues in China's big data policy instrument selection: lack of long-term planning, insufficient coordination between policies and policy instruments, limited richness in instrument selection, structural imbalance in instrument choice, vague demand expression, and difficulty in identifying key policies and instruments. The study recommends strengthening strategic planning and development concept guidance, emphasizing policy and instrument coordination, avoiding public risks, constructing a demand-driven and problem-oriented architecture for policy instrument selection, and innovating the design and application of key policy instruments.

Introduction

A search of the "Beida Fabao" legal database for central and local policies and regulations targeting big data development reveals that from 2013 to 2017, Chinese state organs at various levels issued over 300 policies and regulations to promote big data development. These include important policies such as the "Action Outline for Promoting Big Data Development" (the national big data development plan, September 5, 2015), the "13th Five-Year Plan for National Economic and Social Development of the People's Republic of China" (which positioned big data development as a national strategy, March 17, 2016), and the "Guizhou Province Big Data Development and Application Promotion Regulations" (the first local regulation on big data development, January 15, 2016). These policies have driven China's big data development across different periods. In 2016, China's electronic information industry achieved a main business revenue of 17 trillion yuan, 1.55 times that of 2012, with an average annual growth rate of 11.6%. The electronic information manufacturing sector grew at 9.5%, while the software industry grew at 18.1%, consistently ranking among the top of all major industries and providing strong support for national economic stability and growth. The rapid development of the big data industry represents an important economic manifestation of the effectiveness of big data

policies and regulations.

Big data policy development and improvement constitute crucial safeguards for implementing the national big data strategy. Policy instruments, as techniques for achieving policy goals, play a fundamental role in policy implementation and have attracted widespread attention from policymakers and researchers. In December 2017, the Political Bureau of the CPC Central Committee conducted its second collective study session on implementing the national big data strategy. General Secretary Xi Jinping emphasized the need to advance the national big data strategy, accelerate the improvement of digital infrastructure, promote data resource integration and open sharing, ensure data security, accelerate the construction of a digital China, and better serve China's economic and social development and people's livelihood improvement. He also pointed out that countries worldwide are making forward-looking deployments in cutting-edge technology R&D, data openness and sharing, privacy and security protection, and talent cultivation, identifying key big data policy instruments that have received widespread attention. This study selected 63 big data policy texts issued by central state organs and provincial state organs from over 300 big data policies published between 2013 and 2017. Using content analysis and hierarchical clustering methods, it reveals the structural characteristics of policy instrument selection, explores major problems in big data policy and instrument selection, and provides recommendations for improving China's big data policy instrument selection.

1. Analytical Framework for Big Data Policy Instruments

1.1 Policy Instrument Research

Policy and policy instrument researchers have analyzed policy instrument types from different dimensions, proposing several classification frameworks. The most representative frameworks include: First, C. Hood and H. Margetts in *The Tools of Government in the Digital Age* classify policy instruments into exploratory and influential tools based on government functions, and further categorize them into four types based on basic resources required: information-based, authority-based, treasure-based, and organization-based tools—the "NATO" framework [5]. Second, A. Schneider and H. Ingram in "Behavioral Assumptions of Policy Tools" classify instruments into five types based on assumptions about target population behavior: authority, incentives, capacity-building, symbolic/hortatory, and learning tools (hereafter referred to as the technical framework) [2]. Third, R. Rothwell in "Government Innovation Policy: Some Past Problems and Current Trends" classifies instruments into three types based on their influence domains: supply-side, demand-side, and environment-side tools (hereafter referred to as the domain framework) [6]. Fourth, E. Vedung in "Policy Instruments: Typologies and Theories" constructs a framework comprising regulatory, economic, and informational tools from the dimension of influence means [7]. Gu Jianguang and Wu Minghua express similar frameworks in "A Review of Public Policy Instrument Theory" as

regulatory, incentive, and information transmission tools [8].

Quantitative studies on government data openness policies [23], data governance policies [24], and big data development policies and instruments [25-26] are increasing. However, due to the lack of multi-dimensional policy and instrument analysis, quantitative research has inadequately revealed the attributes and structural characteristics of policy instruments.

1.2 Three-Dimensional Analytical Framework for Policy Instruments

Different policy instrument classification frameworks compare instruments based on different aspects or dimensions. Researchers should analyze the basic descriptive characteristics of policy instruments to distinguish specific tools. Based on this, according to research purposes and analytical objectives, the structural architecture of policy instruments should be analyzed from multiple dimensions [27]. Referencing A. Hall's three-dimensional structural model [28], this study constructs a three-dimensional analytical framework for policy instruments based on the NATO, technical, and domain frameworks, according to the basic resource types utilized by policy instruments, the technical means employed to influence target populations, and the primary domains where instruments exert influence. This framework is illustrated in Figure 1 [Figure 1: see original paper].

The basic resource dimension comprises instruments based on four resources: information, authority, treasure, and organization. Information refers to the government's right to be at the center of information or social networks. Authority refers to the government's legal power to demand, prohibit, ensure, and adjudicate. Treasure refers to government control over money or substitutable movable property. Organization refers to government control and allocation of professional talent, land, buildings, materials, computers, and equipment [5]. The technical dimension comprises instruments centered on five techniques: authority, incentives, capacity-building, persuasion, and learning. Authority-based tools are among the oldest and most common techniques used by governments to achieve policy goals, representing statutory power to grant permission, prohibit, or require action under specific circumstances. Incentive-based tools assume that individual behavior related to policy can be positively driven by inducements such as tax reductions, payments, or criminal/civil penalties, as well as by charges, penalties, and state coercion. Capacity-building tools provide individuals, groups, or institutions with information, training, education, and resources to support decision-making and activity implementation. Persuasion-based tools influence target population concepts and values through cultural means such as promoting concepts of right/wrong, justice, fairness, and obligation. Learning-based tools are particularly suitable for situations with uncertain policy goals, facilitating communication between target populations and government agencies to enhance mutual understanding of policy-related behaviors and select effective instruments [2]. The domain dimension comprises three instrument types: supply-side, demand-side, and environment-side. Supply-side

instruments refer to government provision of economic and technical support to achieve effective supply in policy object activity domains. Demand-side instruments refer to central and local government stimulation of demand for products and services through procurement and contracts. Environment-side instruments optimize the development environment of policy object activity domains through tax policies, intellectual property policies, and regulation [6].

This study employs content analysis of China's big data policy texts and uses the three-dimensional framework to explore current utilization of government basic resources, adoption of techniques for cultivating policy-related practices, and domains of policy influence. It provides references for optimizing government basic resource allocation, technical means selection, and influence domain distribution to promote China's big data development and stakeholder positive action.

2. Research Methods

2.1 Collection of Big Data Policy Texts

To investigate state organs' actions in policies and regulations for achieving big data development goals and reveal the development level of big data policies and current status of policy instrument selection, this study's policy scope includes policies and regulations formulated and published by state organs to achieve big data development objectives. Specific sample selection criteria include: issuing institutions being central state organs and provincial state organs; policy goals being big data development promotion; policy types including laws, regulations, notices, opinions, etc. Additionally, selected policies must employ multiple policy instruments—documents reflecting specific measures such as the "National Health and Family Planning Commission's Approval on the Preliminary Design and Investment Estimate for the Big Data Integration and Application Platform Construction Project of West China Hospital of Sichuan University" and the "State Forestry Administration Office Notice on Establishing the National Ecological Big Data Research Institute" were excluded from the investigation.

Based on the institutional distribution of China's big data policies, this study examined big data policy texts issued by the State Council and its ministries, provincial people's congresses, and provincial people's governments, comprising 63 big data policy samples (see Table 1). Policy texts were retrieved and obtained through government websites and the "Beida Fabao" database (the retrieval and sample collection cutoff date was November 6, 2017).

2.2 Policy Instrument Selection Analysis Strategy

Clearly and completely describing policy instruments forms the foundation for multi-level, multi-dimensional analysis of instrument selection and represents a process from fine-grained to coarse-grained data description and analysis. The bottom-up policy instrument coding method extracts describable policy

instrument objects from policy text paragraphs, sentences, or even smaller phrase expressions (fine-grained), extracts policy instrument codes through open coding, axial coding, and selective coding, induces secondary codes (coarse-grained), refines primary codes (coarser-grained), and under conditions of high coding consistency, forms precise and comprehensive descriptions of policy instruments [14]. Based on descriptions of policy instruments, researchers can construct multi-dimensional policy instrument analytical frameworks according to research objectives and designs, classify policy instrument codes from different dimensions, and through data mining, deeply reveal characteristics of policy instrument selection in terms of attributes and structure.

Given the overlap between big data policies and informatization policies, market regulation policies, industrial development policies, and other policies, top-down policy coding approaches struggle to comprehensively reveal big data policy instrument selection. This study adopts a bottom-up coding strategy to code describable policy instrument objects contained within big data policy texts. Based on this, integrating domestic and international policy instrument research, this study proposes and applies a three-dimensional policy instrument analytical framework to demonstrate big data policy instrument characteristics across three dimensions: basic resources, techniques, and influence domains. Using hierarchical clustering methods, it reveals selection preferences for policy instruments with different domain attributes (supply-side, environment-side, demand-side), forming clustering results for big data policies in the domain dimension. Furthermore, it conducts "basic resource dimension-technical dimension" cross-analysis on domain-dimension policy clustering results to create three-dimensional analysis of big data policy instrument selection, exploring preferences for basic resources, techniques, and influence domains in big data policy instrument selection and revealing structural characteristics of instrument choice.

2.2.1 Policy Instrument Coding and Analytical Framework This study employs a bottom-up coding strategy to code policy instruments contained in chapters and clauses of big data policy texts. Through inductive convergence, 38 specific policy instrument codes, 21 secondary codes, and 3 primary codes were obtained (Table 2). To test coding consistency, 20 specific policy instrument codes were randomly selected from the 38 codes and independently coded by two graduate students experienced in content analysis research. The mean consistency was 92.91% and frequency consistency was 89.47%, indicating good coding consistency.

Basic-level policy instruments constitute fundamental elements widely applied in various policy systems, functioning through tool combinations. Comprehensive-level instruments concretize strategic-level instruments and integrate combinations of basic-level instruments. Strategic-level policy instruments refer to macro policies, concepts, and objectives with forward-looking and guiding significance [10]. Currently, China's big data policy instruments

are dominated by basic-level instruments. Comprehensive-level big data policy instruments construct market development, industrial development, and innovation-entrepreneurship strategies by integrating basic-level instruments. Strategic-level big data policy instruments mainly include top-level planning and unified guiding ideology and development concepts.

To explore big data policy instrument characteristics across the three dimensions of basic resources, techniques, and influence domains, this study constructed a three-dimensional policy instrument analytical framework. Through coding mapping, associations between big data policy instrument codes and the three-dimensional framework were established, as shown in Table 3 .

2.2.2 Big Data Policy Cluster Analysis To analyze characteristics of China's big data policies and their instrument selection from the influence domain perspective, this study used SPSS software and hierarchical cluster analysis, with frequencies of supply-side, environment-side, and demand-side policy instruments in policy texts as variables, to cluster 63 big data policy texts. Simultaneously, this study conducted two-dimensional analysis of basic resources and techniques on policy instrument selection in each big data policy type, revealing how different policy types utilize basic resources and select technical means.

3. Big Data Policy and Policy Instrument Selection

3.1 Statistical Description of Policy Text Content Analysis

Based on coding segment frequencies, big data policies most frequently selected basic-level policy instruments (85.08%) dominated by information support (23.85%), work systems (18.32%), public services (17.23%), and regulations and standards (12.62%). These include specific instruments such as government data lifecycle management (21.60%), public service informatization construction (11.93%), organizational leadership (8.02%), scientific and technological support (6.59%), and policies and regulations (6.50%). Comprehensive-level policy instruments (13.02%) such as market development strategy (6.57%), industrial development strategy (4.12%), and innovation-entrepreneurship strategy (2.33%) emphasize social credit system construction (4.13%), industrial development (4.12%), innovation-entrepreneurship (2.33%), market regulation (1.72%), and market cultivation (0.71%). Currently, strategic-level policy instruments like top-level planning (1.65%) and guiding ideology (0.25%) are selected least frequently in big data policies.

From the domain dimension, big data policy instruments are dominated by supply-side instruments (50.68%), followed by environment-side instruments (48.16%), with demand-side instruments being the least (1.16%). From the basic resource dimension, authority-based instruments dominate (44.31%), followed by organization-based (28.88%) and information-based instruments (23.45%), with treasure-based instruments being the least (3.36%). From

the technical dimension, capacity-building instruments dominate (51.44%), followed by authority-based instruments (44.16%), with incentive (3.51%), persuasion (0.51%), and learning-based instruments (0.38%) being the least.

According to publication dates of big data policies, from 2013 to November 2017, the most policies were issued in 2016 (33 items). Analyzing the proportion of various instrument frequencies within specific time periods, from the domain dimension, supply-side instrument proportions have shown an increasing trend since 2016, exceeding environment-side instrument proportions. Demand-side instrument proportions have consistently remained below 2.00%. From the technical dimension, capacity-building instrument proportions have increased since 2016, while authority-based instrument proportions have decreased and fallen below capacity-building instrument proportions. Incentive instrument proportions have declined since 2015 (11.84%). Persuasion and learning-based instrument proportions have consistently remained below 2.00%. From the basic resource dimension, except for 2013, authority-based instruments have consistently maintained the highest proportions. Information-based instrument proportions continued increasing from 2013 to 2016. Since 2016, organization-based instrument proportions have shown an increasing trend, surpassing capacity-building instrument proportions.

3.2 Cluster Analysis of Big Data Policies from Policy Instrument Perspective

3.2.1 Big Data Policy Clustering Results Based on big data policies' selection of supply-side, environment-side, and demand-side policy instruments, 63 big data policy texts were clustered into four categories, with clusters named accordingly (Table 4). Overall, China's big data policies are dominated by policy instrument-poor categories. Among policies with richer instrument selection, environment-side instrument-preferring categories dominate, followed by supply-side and environment-side balanced categories, with supply-side instrument-preferring categories being the least numerous. All categories rarely select demand-side policy instruments. Policy instrument-poor big data policies show average frequencies for all policy instrument types below the overall sample averages (Figure 2 [Figure 2: see original paper]). Central government big data policies are more strategic and guiding, while local regulations, rules, notices, and opinions demonstrate characteristics of operationalizing and concretizing central government policies.

According to the "Regulations on the Handling of Official Documents in Party and Government Organs" [29], opinions represent views and solutions for important issues, while notices communicate matters requiring awareness or execution to subordinate agencies and relevant units. Environment-side instrument-preferring big data policies are primarily opinion documents issued by local governments, while the other three categories are mainly notice documents issued by local governments.

Based on average frequencies of various policy instrument selections across different policy types (Figure 2), supply-side instrument-preferring big data policies focus on selecting instruments such as government data lifecycle management, public service informatization construction, organizational leadership, scientific and technological development, and industrial development. Environment-side instrument-preferring big data policies select social credit system construction, policies and regulations, planning schemes, and market regulation more frequently than other categories, while also emphasizing government data lifecycle management and public service informatization construction. Compared with other policy types, supply-side and environment-side balanced policies select infrastructure construction and fiscal-financial instruments more frequently, and also frequently choose government data lifecycle management, public service informatization construction, industrial development, and scientific and technological development instruments. Government data lifecycle management and public service informatization construction are frequently selected across all policy types. Among these, platform construction (frequency 1,326) receives more attention than platform interconnection (frequency 309).

3.2.2 Two-Dimensional Analysis of Resource-Technology Policy Instrument Selection This study conducted two-dimensional analysis of basic resource and technical dimensions on policy instrument selection across big data policy types, revealing how policy instruments utilize basic resources and technical means to influence big data supply, environment, and demand domains. Based on average frequencies of differently dimensioned policy instruments, big data policy instruments overall primarily utilize authority, organization, and information-based resources, employing capacity-building and authority-based technical means (Figure 3 [Figure 3: see original paper]), through instruments such as government data lifecycle management, public service informatization construction, organizational leadership, scientific and technological development, industrial development, policies and regulations, and standards and norms, emphasizing supply of data, public services, and technology while optimizing development environments for work systems, policy standards, and industrial development strategies.

Supply-side instrument-preferring big data policies primarily utilize information and organization-based resources, employing capacity-building technical means (Figure 4 [Figure 4: see original paper]), through specific instruments such as government data lifecycle management, public service informatization construction, scientific and technological development, project demonstrations, infrastructure construction, and talent cultivation and management to strengthen effective supply of data, public services, technology, and talent. Additionally, such policies also emphasize utilizing authority-based resources and authority-based technical means through organizational leadership, industrial development, and standards and norms to optimize organizational guarantees and industrial development environments for big data development, attaching importance to standards and norms system construction.

Environment-side instrument-preferring big data policies primarily utilize authority-based resources and authority-based technical means (Figure 5 [Figure 5: see original paper]), through specific instruments such as organizational leadership, social credit system construction, policies and regulations, planning schemes, implementation guarantees, and market regulation to improve policies, regulations, and work systems for promoting big data development, strengthen market regulation, and optimize market environments for big data development. Such policies also utilize organization-based resources and learning-based technical means through citizen participation as a primary instrument more frequently than other policy types.

Supply-side and environment-side balanced big data policies emphasize utilizing information and organization-based resources (Figure 6 [Figure 6: see original paper]), employing capacity-building technical means through government data lifecycle management, public service informatization construction, scientific and technological development, infrastructure construction, and talent cultivation and management to supply data resources, public services, technology, and talent for big data development. These policies also emphasize utilizing authority-based resources and authority-based technical means through industrial development, policies and regulations, security guarantees, organizational leadership, and innovation-entrepreneurship strategies to improve policy and organizational guarantees and optimize network security, industrial development, and innovation-entrepreneurship environments for big data development. Additionally, compared with other policy types, such policies more frequently utilize treasure-based resources and incentive-based techniques through fiscal-financial instruments such as social capital participation, subsidies, and government investment funds.

Policy instrument-poor big data policies (Figure 7 [Figure 7: see original paper]) utilize information and organization-based resources, employing capacity-building technical means through government data lifecycle management, public service informatization construction, and scientific and technological development to supply data resources, public services, and technology. In such policies, environment-side instrument frequencies are similar to supply-side instrument frequencies, optimizing policy environments, financial environments, and work system design for big data development through specific instruments such as policies and regulations, implementation guarantees, standards and norms, security guarantees, and fiscal-financial measures, utilizing authority and treasure-based resources.

4. Strategies for China's Big Data Development Policy Instrument Selection

4.1 Deficiencies in Big Data Development Policy Instrument Selection

4.1.1 Lack of Long-Term Planning and Coordination in Big Data Policies, with Limited Instrument Selection Richness Currently, China's

issued big data policies primarily take the form of notices and opinions, treating big data development as an important issue or matter requiring execution to be communicated and transmitted to subordinate agencies and relevant units, with medium-term plans of four to seven years. No national laws or administrative regulations on promoting big data development have been promulgated; only one local regulation, the "Guizhou Province Big Data Development and Application Promotion Regulations," provides provisions for promoting big data development and application in that region. China's big data policy development suffers from low legal guarantee levels and urgently requires long-term planning at the strategic level and development concept design and guidance at the ideological level.

Big data policies intersect with informatization policies such as e-government policies, government information disclosure policies, and Internet Plus policies, as well as market cultivation policies, market regulation policies, industrial support policies, and science and technology policies. Numerous Chinese policies are formulated by various departments and levels from their own perspectives, and without policy coordination, their combination may create "composition fallacies" [30] and lead to redundant provisions, policy conflicts, or policy gaps. Accompanying the lack of coordination in policy instrument selection is the problem of limited richness in instrument selection. According to clustering results, among the surveyed big data policy samples, policy instrument-poor categories dominate. Although local government big data policies demonstrate characteristics of operationalizing and concretizing central government policies, they generally exhibit limited richness in policy instrument selection. Insufficient instrument selection negatively impacts policy goal achievement and effective policy implementation.

4.1.2 Structural Imbalance in Big Data Policy Instrument Selection
Applying the three-dimensional policy instrument analytical framework to analyze the structure of big data policy instrument selection reveals that from the domain dimension, big data policy instrument selection structure is characterized by dominance of supply-side and environment-side instruments, with extremely few demand-side instruments. Since 2016, environment-side instrument proportions have shown an increasing trend. Supply-side instruments primarily utilize organization and information-based resources, employing capacity-building techniques to achieve policy goals. Environment-side instruments mainly utilize authority-based resources, employing authority-based techniques to achieve policy goals. Treasure-based resources and incentive-based techniques constitute the primary resource foundation and technical means for demand-side instruments. Emphasizing information and organization-based resources and capacity-building techniques to strengthen supply of data resources, public services, technology, and talent represents the main structural characteristic of supply-side instrument-preferring big data policies. Emphasizing authority-based resources and authority-based techniques to construct policy and work system guarantees and optimize market

environments represents the main structural characteristic of environment-side instrument-preferring big data policies. The main structural characteristic of supply-side and environment-side balanced policies is the comprehensive utilization of authority, organization, and information-based resources.

From the technical dimension, big data policy instrument selection is dominated by capacity-building and authority-based instruments, with insufficient selection of incentive, persuasion, and learning-based instruments. Insufficient attention is paid to big data development concepts and their promotion and publicity. The level of encouragement and attention to citizen participation in big data development urgently needs improvement, and the role of crowdsourcing and crowdfunding in promoting big data development and application has not been fully stimulated.

From the basic resource dimension, big data policy instrument selection structure shows high proportions of information support, work systems, public services, and regulations and standards as basic-level instruments. While policies have integrated basic-level instruments with big data development goals and needs for specific objectives, the policy goal orientation, demand-driven nature, and problem orientation of basic-level policy instruments still need improvement. Comprehensive-level instruments are more closely integrated with development strategies, possess stronger policy goal orientation, and integrate multiple basic instruments, representing important means for implementing key domain development tasks. The low proportion of comprehensive-level instruments and high proportion of basic-level instruments in big data policies reflect inadequate policy goal orientation and unclear identification of key development domains and key policy instruments.

4.1.3 Vague Expression of Big Data Development Demand, Making It Difficult to Identify Key Policies and Instruments Although a few policies summarize the current background and important development domains of big data development, the lack of effective investigation into big data development status, practical problems, and development needs makes it difficult to clearly express fundamental problems and practical needs in big data development. Since 2013, China has successively issued big data policies. Big data policy and instrument selection remain in an exploratory and rapid development stage, with insufficient analysis of policy and instrument effectiveness. This phenomenon makes it difficult to clearly express big data development demands and practical problems, conduct demand- and problem-oriented policy improvement and structural adjustment of instrument selection, and precisely identify key big data policies and key policy instruments.

4.2 Policy Recommendations

Addressing the major problems in big data policy and instrument selection discussed above, and combining big data policy text analysis and clustering results,

this study proposes the following recommendations for further development and improvement of big data policy instrument design, selection, and application.

Big data policy development should strengthen strategic planning and concept guidance, enrich policy instrument selection and application, and emphasize policy and instrument coordination. Big data policies should enhance strategic planning for big data's overall and long-term development, cultivate strategic vision, and achieve scientific planning. During strategic planning, attention should be paid to the relationships and distinctions between the big data strategy and national informatization strategy, science and technology strategy, industrial development strategy, and other strategies to determine big data development's positioning in national long-term strategic planning. Construct a theoretical system of big data development concepts, strengthen development concept guidance, and pay attention to the application of guiding ideology and promotion and publicity as persuasion-based instruments in big data development to create a favorable ideological atmosphere for big data development throughout society. Further improvement of big data policies should achieve policy synergy with existing, developing, and future cross-cutting policies through top-level design, overall coordination, and policy research. State organs should emphasize strengthening policy instrument coordination through means such as overall planning, evaluation and assessment, and supervision and regulation. The government should strengthen coordination and supervision of fiscal-financial policy instruments. With China's increasing concerns about local government debt and financial risks, and the issuance of multiple policies including the "State Council's Opinions on Strengthening Local Government Debt Management" and the "Ministry of Finance's Opinions on Implementing Quota Management for Local Government Debt" implementing lifelong accountability and strictly controlling local government debt increases [32], the Central Economic Work Conference held on December 20, 2017, emphasized the need to adjust and optimize fiscal expenditure structure, ensure support for key domains and projects, compress general expenditures, and effectively strengthen local government debt management [31]. On March 5, 2018, Premier Li Keqiang stated in the government work report at the first session of the 13th National People's Congress that China should strengthen local government debt management and prevent and resolve local government debt risks, strictly prohibiting various illegal and non-compliant debt-raising and guarantee behaviors [33]. Against the backdrop of increasingly prominent local government debt issues in China, effective supervision and overall coordination of local governments' fiscal-financial policy instrument selection must be achieved through performance evaluation, regionally appropriate selection of fiscal-financial instruments, and coordinated regional fiscal-financial instrument selection, to scientifically apply fiscal-financial policy instruments to promote big data development while effectively preventing and controlling public risks. The government should strengthen planning regulation, evaluation and assessment, audit and accountability, and collaborative construction and sharing of data infrastructure and platform construction to achieve infrastructure and data platform interconnection and open sharing. The "No-

tice on Issuing the Beijing Municipal New Industry Prohibition and Restriction Directory (2015 Edition)" published by the Beijing Municipal People's Government Office, which strictly prohibits new construction and expansion of data centers within Beijing's six urban districts [34], represents a powerful measure to prevent "composition fallacies" in policy instruments.

Strengthen investigation of big data development demands and problems, conduct research on policy and instrument effectiveness, and design demand-driven and problem-oriented policy instrument selection structures. Through government-industry-academia-research-application collaboration, conduct investigations on the status quo of national big data development, express multi-stakeholder big data demands, and identify key problems in big data development. From the dimensions of basic resources, techniques, and domains, explore multi-stakeholder demand and development problem solutions at the policy instrument selection level. Conduct research on policy and instrument effectiveness, and design policy instrument selection structures adapted to demands and problems based on investigation findings. Innovate policy instrument design and application solutions with key policy instruments as the focus, adjusting selections of instruments with different basic resource, technical, and domain distributions. Enhance the effectiveness of policy instruments in utilizing basic resources, rationally design technical routes and domain distributions, strengthen effective supply for big data development, optimize the environment, and stimulate demand.

Big data policy development also requires innovative design and application of key policy instruments. Innovation in big data policy instrument design and application should primarily consider strategic planning, policy goals, demands and problems, instrument characteristics, and effectiveness. According to big data development strategy and policy goals, innovatively design policy instruments that can address unique and key needs in the big data domain. Innovate application solutions for traditional policy instruments. Pay attention to instrument characteristics across basic resources, techniques, and domains, conduct effectiveness analysis, and enhance the rationality of innovative policy instrument design and application solutions. Taking demand-side instrument innovation as an example, traditionally, demand-side instruments focused on government procurement and outsourcing increase local government fiscal expenditure burdens and do not adapt to current needs for adjusting fiscal-financial policy instruments. The government should apply instruments such as information support, technical support, talent support, and promotion and publicity to demand domains, innovating demand-side instrument composition. By providing market demand data, demand analysis technology and services, demand analysis talent teams and training, data awareness, and typical case promotion and publicity, help manufacturing industries clarify market demands, reduce low-end repetitive manufacturing, connect demand and supply sides [35], and leverage big data's driving role in manufacturing transformation and upgrading.

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Note: Figure translations are in progress. See original paper for figures.