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Beyond Structure: Structure Conformity of Local Fiscal Expenditure on S&T and Regional Innovation

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Abstract: In the context of fiscal constraints faced by local governments, it is an imperative issue to improve the allocation of science and technology (S&T) expenditure and enhance the efficiency of regional innovation systems. Research and development activities can be divided into basic research, applied research, and experimental development. Based on the resource-based view, extant studies suggest that the structure of local S&T expenditure as a critical resource endowment, directly shapes innovation performance. Beyond the resource-based view, local governments must weigh central mandates and peer competition — rather than efficiency alone — when setting S&T budgets, owing to multidimensional performance metrics. Extant literature show that local governments exhibit two distinctive traits when allocating S&T expenditure under the institutional pressure. First, local government complies the S&T strategies of central government. Within China’s centralized political system, subnational governments consistently align their fiscal priorities with those of the central government. When a national S&T initiative is announced, local governments rapidly mobilize resources to establish similar projects — such as provincial-level science parks, key laboratories, and engineering research centers — that closely reflect the central policy blueprint. Second, there is a convergence in S&T expenditure across local governments. As fiscal S&T expenditure has become a key performance metric in governmental evaluation systems, competition among local governments in

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the S&T domain has significantly intensified. In pursuit of competition advantage, local officials routinely benchmark their S&T expenditures against peer regions and recalibrate their budgetary allocations in response. This strategic behavior results in a noticeable homogenization of S&T funding patterns across local governments. Although existing studies indicate that local governments align their fiscal S&T expenditures with both central and peer governments, few studies have examined the impact of such conformity on regional innovation performance. Furthermore, while prior research has mainly examined convergence in the scale of S&T expenditure, little attention has been given to structural conformity in fiscal S&T expenditure. Under the current fiscal constraints, how local governments choose the structure of S&T expenditures to improve regional innovation performance is a critical issue. Based on organizational legitimacy theory, this study examines the relationship between compliance, convergence of local government of S&T expenditure structure and regional innovation, as well as the moderating role of local official turnover. Using an unbalanced panel dataset from 31 provinces (excluding Hong Kong, Macau, and Taiwan) from 2013 to 2022, we employ a fixed-effects ordinary least squares (OLS) model. The findings reveal that compliance with central government in fiscal S&T expenditure structure is positively associated with regional innovation. That is, when local governments align their S&T expenditure structure with that of the central government, they gain access to central S&T resources and policy support, thereby fostering regional innovation. Conversely, there is an inverted U-shaped relationship between convergence with peer governments and regional innovation. The moderate level of conformity in S&T expenditure structure among local governments helps accumulate R&D resources and facilitates innovation; however, beyond a certain threshold, the costs of homogenization outweigh the legitimacy benefits, ultimately hindering regional innovation. Furthermore, the local official turnover weakens the positive relationship between compliance and regional innovation but does not significantly affect the relationship between convergence and regional innovation.

Keywords: organizational legitimacy, structure conformity, fiscal expenditure on S&T, local government, central government, regional innovation

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China is currently facing increasingly tight aggregate fiscal constraints, and even the risk of fiscal contraction. Under such circumstances, how local governments optimize their fiscal S&T expenditure decisions has become crucial to enhancing regional innovation capacity and achieving high-quality economic development. Scientific and technological activities can be divided into basic research, applied research, and technology research and development, among others. From a resource-based perspective, the structure of local government S&T expenditure constitutes an important source of innovation capability or performance (Li P, Li L L, 2014; Zhao Y, Liu C, Gu J, 2021). In reality, however, because standards for evaluating governmental performance are complex, local government decision-making is not determined solely by performance feedback or efficiency orientation; it must also take into account constraints from the central government and competitive pressure from peer governments (Frumkin P, Galaskiewicz J, 2004).

Under the dual pressure of the central government and peer local governments, local governments tend to display two characteristics in their S&T expenditure decisions. First, they comply with the central government's S&T strategy. Under China's politically centralized system, local governments tend to imitate the central government's fiscal behavior when making decisions (Wang M, Lin J, Yu Z, 2010). When the central government establishes relevant S&T programs, local governments also channel funds into projects corresponding to those central initiatives, such as provincial science parks, key laboratories, and engineering technology centers (Li Z, Wen K, Fang X, 2018; Li C, Zhao W, 2016). In addition, local governments' policy implementation exhibits a marked selectivity: when tasks deployed by the center are backed by strong fiscal incentives and performance constraints, local governments are more likely to exert effort to complete them (Yang F, Wang S, 2015). Second, there is significant convergence in S&T expenditure strategies across local governments. In recent years, fiscal S&T input has become a hard indicator in local government assessment (Bian Y, Wu L, Bai J, 2020), intensifying intergovernmental competition in fiscal S&T spending. To avoid being placed at a competitive disadvantage, local governments determine and adjust the scale and proportion of their own S&T expenditure based on the spending behavior of rival jurisdictions, resulting in homogeneity in fiscal S&T expenditure across local governments (Li T, Zhou Y, 2009).

In sum, local governments adopt two types of fiscal S&T expenditure strategies to respond to institutional pressure: aligning with the central government's S&T expenditure and aligning with the S&T expenditure of other local governments. However, existing studies have focused mainly on the antecedents of consistency in local fiscal expenditure behavior, while neglecting its consequences, namely, whether consistency in local governments' S&T expenditure improves innovation performance. In addition, prior studies have mainly concentrated on consistency in the scale of local fiscal S&T expenditure (Bian Y, Bai J, 2017), rather than consistency in the structure of fiscal S&T expenditure. Under current aggregate fiscal constraints, the key question is how local governments should choose

the structure of fiscal S&T expenditure so as to improve regional innovation performance.

Accordingly, from the perspective of organizational legitimacy, this paper focuses on the consistency of local fiscal S&T expenditure behavior and proposes that compliance consistency in the structure of local fiscal S&T expenditure (consistency with the central government's S&T expenditure structure) and convergence consistency (consistency with the average structure of peer local governments' S&T expenditure) have distinct effects on regional innovation. It further examines the moderating role of local official turnover by using panel data from 31 provincial-level administrative regions in China from 2013 to 2022 (excluding Hong Kong, Macao, and Taiwan). This study extends research on consistency in local fiscal S&T expenditure from antecedents to consequences and explores the mechanism through which institutional pressure is transformed into innovation performance. By focusing on the structure of local fiscal S&T expenditure, it also broadens the connotation of consistency in governmental S&T expenditure behavior.

1.Theoretical Analysis and Research Hypotheses

1.1Consistency and Performance of Government Actions: An Organizational Legitimacy Perspective

According to the definition in the National Medium and Long Term Science and Technology Talent Development Plan (2010-2020), S&T professionals refer to individuals who possess certain professional knowledge or specialized skills, engage in creative scientific and technological activities, and make contributions to the S&T enterprise and socio-economic development; they mainly include personnel engaged in scientific research, engineering design and technological development, S&T services, S&T management, S&T popularization, and other related S&T activities. S&T talents are the primary demographic of a nation's scientific and technological innovation and constitute a vital national human resource. Currently, countries worldwide regard S&T talents as a crucial strategic resource for participating in international economic and technological competition, placing great emphasis on their education, cultivation, motivation, and recruitment. Talent evaluation and motivation are the core of S&T talent policies, serving as a critical guiding force and barometer for S&T personnel and activities (Li Zhe, 2017).

In the establishment of the S&T talent policy system, evaluation policies, as a subset of talent policies, have increasingly attracted the attention of policy-making departments and scholars in recent years. For example, Liu Zhongyan (2018) utilized S&T talent evaluation as one of nine element dimensions to analyze S&T talent policies from 1978 to 2017, discovering that the elements of S&T talent cultivation, motivation, and evaluation appeared most frequently in the policy system and accounted for a substantial proportion. This indicates that S&T talent evaluation policy is a focal point in the formulation of S&T talent policies. Concurrently, some scholars, in their research on S&T talent evaluation policies, found that the development of China's S&T talent evaluation and motivation

policies generally exhibits the characteristics of diversified issuing entities, flattened power structures, diversified policy instruments, and a scientific policy system (Tan Yu, 2019). However, such studies have not yet conducted specific analyses of S&T talent evaluation policies from the perspectives of policy elements, policy targets, and policy effectiveness. Analyzing policy elements, targets, and effectiveness facilitates a more comprehensive understanding of how S&T evaluation policy instruments are utilized and what problems exist, thereby enabling the proposition of targeted recommendations. Furthermore, a critical question remains: have the policy instruments, elements, targets, and effectiveness of China's S&T evaluation policies been systematically aligned over time? Facing the new situations and demands of current S&T talent evaluation, how should S&T talent management departments build and optimize new, appropriate policy instruments based on the experience drawn from previous evaluation policies? These questions are worthy of our in-depth exploration.

1.2 Governmental Behavioral Consistency and Performance from the Perspective of Organizational Legitimacy

In institutional theory, "legitimacy" is defined as a state in which a behavior or entity is widely recognized as reasonable and appropriate within a given system of social norms and values (Suchman M C, 1995). Individual organizations conform to institutional pressures and gain legitimacy by maintaining consistency in process or structure; they then use that legitimacy to mobilize other critical resources and build competitive advantages. Frumkin and Galaskiewicz (2004) pointed out that although scholars have generally recognized that organizations obtain legitimacy by maintaining consistency with other organizations in the same environment, the question of conformity to what — that is, the benchmark against which conformity is assessed — remains unclear. Ashworth et al. (2009) divided organizational behavioral consistency into compliance and convergence. Compliance consistency refers to the extent to which an organization evolves over time in a definite direction consistent with institutional pressure and ultimately resembles that direction. Convergence consistency refers to the extent to which all organizations within a field become more similar to one another through autonomous choice in the absence of imposed directional standards. In this paper, compliance consistency refers to the consistency between local governments' S&T expenditure structure and that of the central government under central institutional constraints, whereas convergence consistency refers to the consistency between local governments' S&T expenditure structure and the average structure of peer local governments under competitive pressure.

Existing studies suggest that organizations' legitimacy-seeking behavior affects organizational performance through two mechanisms. One view holds that organizations possessing legitimacy are more likely to acquire external resources and thereby improve performance (Zimmerman M A, 2002). Another argues that obtaining legitimacy is costly and may lead to stronger organizational inertia and

weaker adaptability, thereby undermining organizational development (Kraatz M S, Zajac E J,1996). Furthermore, some scholars have suggested that the mechanism through which organizational legitimacy affects performance depends on differences in the source of legitimacy, because different sources provide different types of resources and embody different institutional logics and interest claims, thus generating different performance effects (Guo H, Shen R,2018).

On this basis, this paper argues that compliance consistency and convergence consistency on the part of local governments influence regional innovation performance through differentiated mechanisms, and that this difference stems from differences in the source of legitimacy and in the nature of the resource's legitimacy provides (Guo H, Shen R,2018). On the one hand, the source of legitimacy for local government compliance consistency is the central government; by obtaining more central S&T resources and policy support, local governments can improve regional innovation. On the other hand, the source of legitimacy for local government convergence consistency lies with social actors in the market, such as the general public and investors; by attracting R&D capital, human capital, and other factors from the market, local governments can enhance regional innovation. However, there is an optimal threshold: once that threshold is exceeded, the costs of homogeneous competition outweigh the gains from cognitive legitimacy, and convergence consistency begins to inhibit regional innovation.

1.3 Compliance Consistency of Local Governments and Regional Innovation

Within governmental organizations, the institutional pressure underlying compliance mainly comes from higher-level governments possessing legislative and fiscal resources. The central government's emphasis on S&T innovation activities creates pressure on local governments. For example, the central government has repeatedly emphasized that strengthening basic research is an urgent requirement for achieving high-level self-reliance and strength in science and technology. When local governments display compliance toward the central government — that is, when they subordinate themselves to central interests and allocate resources in line with the central government's S&T strategy — they can obtain legitimacy recognition from the central government, thereby promoting regional innovation.

Such central legitimacy recognition is embodied in support through central S&T resources, which can effectively compensate for deficiencies in regional innovation resources and thereby improve regional innovation. Specifically, first, the central government can fill resource gaps at the front end of the innovation chain through investments in basic research — for example, by increasing special transfer payments for S&T, supporting the development of local research infrastructure, cultivating specialized technology innovation platforms, and promoting demonstration S&T innovation projects. These measures strengthen the knowledge supply from basic research, reduce the fiscal burden of local S&T expenditure, and improve regional innovation. Second, local governments that behave compliantly are more likely to gain recognition from the central government and be selected as pilot

areas for policy experimentation, thereby attracting innovation factors and improving regional S&T innovation through specific guidance and supporting measures. Third, the central government provides fiscal rewards to regions that are more proactive in implementing central S&T innovation policies (Zhao X,2019). On this basis, the S&T resources brought about by central legitimacy recognition can be more precisely matched to regional innovation needs, guiding local governments in implementing S&T innovation strategies and ultimately improving regional innovation. Therefore, Hypothesis 1 is proposed:

Hypothesis 1: Local government compliance consistency — namely, consistency between the focal local government's S&T expenditure structure and that of the central government — is positively related to regional innovation.

1.4 Convergence Consistency of Local Governments and Regional Innovation

Within the structure of fiscal S&T expenditure, whether in basic research, applied research, or technology research and development, all activities face strong technological uncertainty and market risk. To reduce the risk of poor decision-making, local governments often imitate the S&T investment behavior of other local governments, thereby causing S&T expenditure structures to become more consistent across jurisdictions. When local governments maintain a moderate degree of consistency with the S&T expenditure structures of peer governments, they adopt S&T investment strategies that are widely recognized by market stakeholders such as investors and research personnel, thereby attracting innovation factors to agglomerate locally and promoting innovation. However, once the degree of convergence continues to increase and exceeds a certain threshold, it suppresses local governments' initiative in regional S&T innovation activities and becomes unfavorable to regional innovation.

More specifically, when the degree of convergence consistency is low, the focal local government's S&T expenditure structure deviates substantially from the average level of its peers, which damages its market legitimacy and is unfavorable to regional innovation. Because it does not follow conventional S&T expenditure patterns, the local government may trigger misunderstanding among the public and investors, leading to the outflow of R&D personnel and R&D capital. As convergence consistency increases, however, the market legitimacy of local governments' S&T affairs also rises, thereby winning the recognition and support of R&D capital and research personnel (Ma M, Lyu L,2023), attracting external R&D capital and other innovation factors into the region, promoting the accumulation and agglomeration of local innovation resources, reducing uncertainty and avoiding the risk of failure (Villadsen A R, Hansen J R,2010), and thus improving regional innovation.

However, when local governments place excessive emphasis on maintaining consistency with the S&T expenditure structures of other local governments, they may overlook local needs and conditions because of interregional differences in resource endowments, industrial structure, and S&T foundations,

thereby causing a mismatch between policy supply and innovation demand. Excessive copying of innovation models from other regions weakens the ability of local governments to formulate differentiated innovation policies based on their own comparative advantages, creating path dependence and lock-in effects. At that point, the costs brought about by homogeneity exceed the legitimacy benefits generated by stakeholders, thereby suppressing local innovative potential (Ma C, Zhu Y, 2021). Therefore, Hypothesis 2 is proposed:

Hypothesis 2: Local government convergence consistency — namely, consistency between the focal local government's S&T expenditure structure and the average structure of peer governments — is related to regional innovation in an inverted U-shaped manner

1.5 The Moderating Effect of Local Official Turnover

Political stability is an important factor affecting local governments' ability to obtain legitimacy-based resources. Officials differ significantly in governing philosophy, fiscal expenditure preferences, and risk tolerance. Official turnover usually leads to adjustments in local government policies and resource allocation strategies (Xu Y, Qian X, 2013), thereby affecting regional economic development, fiscal efficiency, and other outcomes (Yang H, Cai G, Li Z, 2015). Local official turnover also creates policy uncertainty, weakens the operation of legitimacy mechanisms, and attenuates the relationship between local government behavior and innovation performance.

Local official turnover weakens the positive effect of compliance consistency on regional innovation. Because official turnover leads to a readjustment of central-local interactions, it affects the central government's legitimacy perception of local governments and thereby constrains local innovation activity. Specifically, a change in principle local officials prompts the central government to reassess the willingness and capacity of the local government to carry out central policies. Under information asymmetry, the central government cannot easily judge in the short run the governing competence and cooperative tendency of newly appointed officials. It therefore tends to be more cautious in allocating S&T resources and reduces support for the region. As a result, the original path through which local governments actively responded to central strategies in order to obtain resource support is disrupted, and their ability to acquire key innovation resources through compliant behavior is weakened. Thus, Hypothesis 3 is proposed:

Hypothesis 3: Local official turnover weakens the positive relationship between local government compliance consistency and regional innovation.

When the degree of convergence consistency remains within the critical range, local official turnover weakens the positive effect of convergence consistency on regional innovation; when the degree of convergence consistency exceeds the critical threshold, official turnover can alleviate the inhibitory effect of convergence consistency on regional innovation.

Specifically, when local governments' convergence consistency remains within the critical

threshold, the policy uncertainty caused by official turnover disrupts stable expectations regarding innovation factors, causing venture capital to postpone entry in the short term. This partly offsets the legitimacy benefits brought by convergence consistency and weakens its positive effect on regional innovation. When the degree of convergence consistency exceeds the critical threshold, by contrast, newly appointed officials often seek to demonstrate governing capacity through new differentiated policies. Their attempts to break the pattern of homogeneous competition help reconstruct local comparative advantages. In addition, the policy adjustment opportunities brought about by official turnover can effectively overcome path dependence in the original S&T expenditure structure and make it possible to rematch local innovation needs, thereby further alleviating the negative effects of excessive convergence. Therefore, Hypothesis 4 is proposed:

Hypothesis 4: Local official turnover weakens the inverted U-shaped relationship between local government convergence consistency and regional innovation.

In sum, the conceptual model of this study is shown in Figure 1.

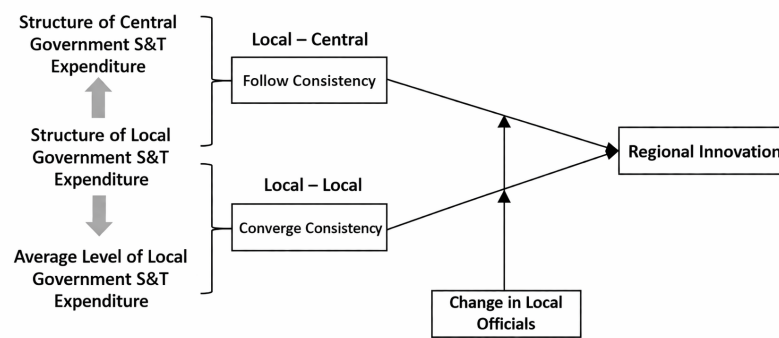


Figure 1. Conceptual Model of the Study

2. Research Design

2.1 Sample

This paper uses an unbalanced panel dataset covering 31 provincial-level administrative regions in China from 2013 to 2022 (excluding Hong Kong, Macao, and Taiwan) to examine the effect of consistency in the structure of local fiscal S&T expenditure on regional innovation. Traditionally, discussions of China's S&T powers and expenditure responsibilities have focused on three or more levels of government. However, given the special nature of S&T governance, it is more meaningful to focus on the central government and provincial governments. This is because city- and county-level governments, as grassroots units, spend most of their S&T funds on non-R&D activities with relatively weak innovation attributes, such as agricultural technology extension, so as to ensure the orderly functioning of local affairs (Zhang M, 2016).

At present, statistical materials do not systematically report detailed subcategories of provincial

government S&T expenditure, such as S&T administrative affairs, basic research, and applied research. This paper manually collected annual fiscal final accounts for provincial-level governments from the Ministry of Finance's provincial budget and final account disclosure section and from unified budget disclosure platforms on provincial government websites, extracting expenditure data under Science and Technology Expenditure (Item 206) and its subcategories (Items 20601 to 20699) from the tables of general public budget final accounts for provincial-level governments. Because the time span of fiscal disclosure differs across provincial government websites, the sample period for each province was determined according to the earliest year in which that province publicly disclosed its provincial final accounts. In addition, data on the central government's fiscal S&T expenditure were compiled from the central budget and final account disclosure platform using the same extraction criteria as those applied to provincial governments.

Other data were obtained mainly from the China Statistical Yearbook on Science and Technology, the China Finance Yearbook, the China Statistical Yearbook, the China City and Industrial Innovation Report, and official websites of provincial statistical bureaus. Because some indicators contain missing values in certain years, this paper fills missing data by interpolation. Finally, because detailed provincial S&T expenditure data for 2012 are seriously incomplete, with only two provincial-level administrative regions disclosing such data, the paper ultimately obtains an unbalanced panel dataset for 31 provincial-level administrative regions in China from 2013 to 2022 (excluding Hong Kong, Macao, and Taiwan) after data preprocessing.

2.2 Variable Measurement

To empirically test the hypotheses proposed in this paper, specific variable names and measurement methods are defined on the basis of the existing literature and the available data, as shown in Table 1.

	Variable name	Symbol	Measurement
Dependent variable	Regional innovation	<i>Innovation</i>	Measured by the number of invention patents granted per 10,000 persons in the region (units: patents per 10,000 persons).
Independent variable	Compliance consistency	<i>Compliance</i>	Measured by the cosine similarity coefficient between the focal region's S&T expenditure items and those of the central government.
	Convergence consistency	<i>Convergence</i>	Measured by the cosine similarity coefficient between the focal region's S&T expenditure items and the average item structure of peer governments.
Moderating variable	Local official turnover	<i>Turnover</i>	Following prior studies, assigned a value of 1 if the provincial Party secretary or governor changes in that region, and 0 otherwise.
Control variable	Economic development level	<i>GDP</i>	Measured by regional GDP per capita (unit: 100 million yuan per 10,000 persons).
	Industrial development level	<i>Industry</i>	Measured by the share of value added of the secondary industry in regional GDP.
	Human capital level	<i>HC</i>	Measured by the number of enrolled university students per million persons in the region.

	Fiscal input level	<i>Fiscal</i>	Measured by per capita fiscal expenditure in the region (unit: 100 million yuan per 10,000 persons).
	Market activity level	<i>Market</i>	Measured by the ratio of technology market transaction value to GDP in the region.

Table 1. Definition and Measurement of Variables

(1) Dependent Variable

Regional innovation. This paper uses innovation output as the indicator of regional innovation. In the existing literature, the main indicators of innovation output include sales revenue from new products and patents. New-product sales revenue does not fully reflect the knowledge-creation function of technological innovation, whereas patents more directly capture the knowledge outcomes of innovation. Accordingly, following previous studies (Dang J, Motohashi K, 2015; Li X, Wang F, Yang B, 2022), this paper selects patents as the indicator of regional innovation. To eliminate the influence of population size, regional innovation is measured by the number of invention patents granted per 10,000 persons (Innovation), calculated by dividing the number of domestic invention patents granted in the region by the year-end regional population. In addition, considering the socioeconomic value of patents, the robustness tests use the city innovation index reported in the China City and Industrial Innovation Report, aggregated to the provincial level, as an alternative indicator of regional innovation output.

(2) Independent Variables

Compliance consistency (Compliance) and convergence consistency (Convergence). Compliance consistency refers to the degree of similarity between the focal local government and the central government in the structure of detailed S&T expenditure items. Convergence consistency refers to the degree of similarity between the focal local government and the average structure of detailed S&T expenditure items among peer local governments.

Drawing on existing studies that measure structural similarity (Fricke D, 2016), this paper uses the cosine similarity coefficient to measure the degree of consistency in the S&T expenditure structure of the focal local government. According to the types of governmental S&T expenditure and the attributes of innovation activities, the government subdivides the S&T budget (Item 206) into 10 categories: S&T administrative affairs (Item 20601), basic research (Item 20602), applied research (Item 20603), technology research and development (Item 20604), S&T conditions and services (Item 20605), social sciences (Item 20606), science and technology popularization (Item 20607), S&T exchanges and cooperation (Item 20608), major S&T projects (Item 20609), and other S&T expenditure (Item 20699).

The degree of compliance consistency is measured as follows:

$$Compliance_{it} = \frac{\sum_{k=1}^{10} X_{itk} X_{centralk}}{\sqrt{\sum_{k=1}^{10} X_{itk}^2 \sum_{k=1}^{10} X_{centralk}^2}} \quad (1)$$

where k denotes a specific subcategory under the S&T classification (from 20601 to 20699), $k=1, 2, \dots, 10$. For region i in year t , X_{itk} denotes the share of expenditure on S&T subcategory k , and $X_{centralk}$ denotes the share of the central government's expenditure on each S&T subcategory in year t .

The degree of convergence consistency is measured as follows:

$$Convergence_{it} = \frac{\sum_{k=1}^{10} X_{itk} X_{alltk}}{\sqrt{\sum_{k=1}^{10} X_{itk}^2 \sum_{k=1}^{10} X_{alltk}^2}} \quad (2)$$

where k, i, t , and X_{itk} have the same meanings as in Equation (1), and X_{alltk} denotes the average share of expenditure on S&T subcategory k across all local governments in year t .

$Compliance_{it}$ reflects the degree of structural consistency between the local government of region i and the central government in year t . $Convergence_{it}$ reflects the degree of structural consistency between the local government of region i and the average structure of peer local governments in year t . Both $Compliance_{it}$ and $Convergence_{it}$ range from 0 to 1. The larger the value, the higher the degree of structural consistency; the smaller the value, the lower the degree of consistency.

(3) Moderating Variable

Local official turnover (Turnover). This paper uses turnover of the provincial Party secretary or governor to reflect local official turnover. The year in which either the Party secretary or the governor changes in the focal region is coded as 1; otherwise, it is coded as 0.

(4) Control Variables

Following previous studies, this paper includes economic development level (GDP), industrial development level (Industry), human capital level (HC), fiscal input level (Fiscal), and market activity level (Market) as control variables, so as to control for the influence of regional resources, environment, and related characteristics on regional innovation. Specifically, economic development, human capital, and fiscal input are measured respectively by GDP per capita, the number of enrolled university students per million persons, and fiscal expenditure per capita. Industrial development and market activity are measured respectively by the proportion of value added by the secondary industry in GDP and the proportion of technology market transaction value in GDP.

2.3 Econometric Model

This paper examines, from the perspective of organizational legitimacy, the effects of compliance consistency and convergence consistency in the structure of local fiscal S&T expenditure on regional innovation, as well as the moderating role of local official turnover. To test the hypotheses, fixed-effects

OLS regression models are constructed as follows:

$$Innovation_{it+1} = \alpha_0 + \alpha_1 Compliance_{it} + \sum \alpha_i Controls_{it} + \gamma_i + \mu_t + \varepsilon_{it} \quad (3)$$

$$Innovation_{it+1} = \alpha_0 + \alpha_1 Convergence_{it} + \alpha_2 Convergence_sq_{it} + \sum \alpha_i Controls_{it} + \gamma_i + \mu_t + \varepsilon_{it} \quad (4)$$

$$Innovation_{it+1} = \alpha_0 + \alpha_1 Compliance_{it} + \alpha_2 Turnover_{it} + \alpha_3 Turnover_{it} \times Compliance_{it} + \sum \alpha_i Controls_{it} + \gamma_i + \mu_t + \varepsilon_{it} \quad (5)$$

$$Innovation_{it+1} = \alpha_0 + \alpha_1 Convergence_{it} + \alpha_2 Convergence_sq_{it} + \alpha_3 Turnover_{it} + \alpha_4 Turnover_{it} \times Convergence_{it} + \alpha_5 Turnover_{it} \times Convergence_sq_{it} + \sum \alpha_i Controls_{it} + \gamma_i + \mu_t + \varepsilon_{it} \quad (6)$$

Here, i and t denote the regional unit and observation year, respectively. $Innovation_{it+1}$ denotes the level of regional innovation in region i in year $t+1$, measured by the number of invention patents granted per 10,000 persons. $Compliance_{it}$ and $Convergence_{it}$ denote the levels of compliance consistency and convergence consistency in region i in year t , respectively. $Convergence_sq_{it}$ is the quadratic term of convergence consistency. $Turnover_{it}$ indicates whether the Party secretary or governor in region i changed in year t . $Controls_{it}$ denotes the vector of control variables. γ_i and μ_t represent the individual fixed effect and time fixed effect, respectively, and ε_{it} is the error term. To avoid multicollinearity, the independent variables and moderating variable in Equations (5) and (6) are mean-centered before constructing interaction terms. In addition, to alleviate potential endogeneity and account for the lag between innovation input and innovation output, the dependent variable is led by one period.

3. Empirical Results and Analysis

3.1 The Current State of Consistency in Local Fiscal S&T Expenditure

To more intuitively describe the cross-sectional distribution and degree of consistency in the structure of local fiscal S&T expenditure during the sample period, Table 2 reports the levels of compliance consistency and convergence consistency among local governments in different periods. In terms of the overall trend, the overall level of local government compliance consistency rose markedly, while the level of convergence consistency declined slightly.

The gradual increase in compliance consistency indicates that the overall S&T expenditure structure of local governments has been moving closer to that of the central government. Specifically, the mean compliance consistency of local governments was 0.48 in 2015, indicating a relatively low overall similarity between local and central S&T expenditure structures. By 2022, the mean compliance

consistency had risen to 0.61. In provinces such as Sichuan and Gansu, the structure of fiscal S&T expenditure became highly consistent with that of the central government, with compliance consistency values above 0.9. In addition, the overall level of convergence consistency among local governments remained relatively high but exhibited a slight downward trend, suggesting that local governments' S&T expenditure structures have gradually shifted from a state of high homogeneity toward greater differentiation. Specifically, the mean convergence consistency of local governments was 0.82 in 2015 and declined slightly to 0.79 in 2022.

Province	Follow consistency		Convergence consistency		Province	Follow consistency		Convergence consistency	
	2015	2022	2015	2022		2015	2022	2015	2022
Anhui	0.90	0.15	0.79	0.63	Liaoning	0.74	0.69	0.57	0.90
Beijin	0.54	0.89	0.97	0.76	Neimenggu	0.32	0.80	0.30	0.85
Fujian	0.51	0.81	0.97	0.83	Ninxia	0.15	0.15	0.60	0.60
Gansu	0.24	0.90	0.89	0.86	Qinhai	0.39	0.67	0.92	0.72
Guangdong	0.78	0.64	0.88	0.75	Shandong	0.68	0.61	0.56	0.90
Guangxi	0.68	0.36	0.96	0.81	Shanxi	0.88	0.43	0.80	0.66
Guizhou	0.43	0.80	0.94	0.65	Shanxi	0.16	0.60	0.83	0.72
Hunan	0.31	0.53	0.86	0.71	Shanghai	0.21	0.56	0.85	0.82
Hebei	0.59	0.76	0.97	0.90	Sichuan	0.26	0.91	0.48	0.86
Henan	0.67	0.37	0.88	0.83	Tianjin	0.48	0.37	0.95	0.78
Heilongjiang	0.47	0.73	0.90	0.83	Xizang	0.14	0.10	0.85	0.60
Hubei	0.12	0.15	0.81	0.59	Xinjiang	0.65	0.88	0.89	0.87
Hunan	0.62	0.79	0.89	0.91	Yunnan	0.30	0.66	0.92	0.74
Jilin	0.56	0.83	0.84	0.86	Zhejiang	0.62	0.64	0.75	0.64
Jiangsu	0.62	0.68	0.98	0.86	Chongqing	0.28	0.70	0.91	0.93
Jiangxi	0.43	0.71	0.82	0.99					

Table 2 Conformity of local government's expenditure structure on S&T

Note: Because some provincial data are missing for both 2013 and 2014, this paper uses 2015 as the initial year for comparative analysis.

3.2 Descriptive Statistics and Correlation Analysis

Table 3 reports the descriptive statistics and correlation analysis of the variables. First, the mean number of invention patents granted per 10,000 persons is 2.59, and the level of innovation varies substantially across regions. Second, the mean of compliance consistency is 0.51 with a standard deviation of 0.24, whereas the mean of convergence consistency is 0.79 with a standard deviation of 0.13. This indicates that compared with the central government's S&T expenditure structure, local governments are more consistent with the average S&T expenditure structure of peer governments, and there is less interregional variation in that respect. Finally, the variance inflation factors (VIFs) for the regression equation range from 1.02 to 2.47, all below 5, indicating that there is no serious multicollinearity problem.

variable	1	2	3	4	5	6	7	8	9
1 <i>Innovation</i>	1								
2 <i>Compliance</i>	0.165***	1							
3 <i>Convergence</i>	-0.048	0.159***	1						
4 <i>Turnover</i>	-0.083	-0.033	0.059	1					
5 <i>Gdp</i>	0.784***	0.109*	-0.121**	-0.113**	1				
6 <i>Industry</i>	-0.489***	-0.076	-0.065	0.075	-0.309***	1			
7 <i>HC</i>	0.520***	0.041	0.042	-0.027	0.560***	-0.335***	1		
8 <i>Fiscal</i>	0.318***	-0.232***	-0.202***	-0.083	0.342***	-0.390***	0.110*	1	
9 <i>Market</i>	0.832***	0.011	-0.117**	-0.109*	0.610***	-0.535***	0.579***	0.439***	1
Min	0.10	0.04	0.24	0	2.31	0.16	31.88	0.59	0.39
Max	40.35	0.96	0.99	1	19.05	0.57	275.54	7.12	28.98
Std.	4.62	0.24	0.13	0.46	3.05	0.08	45.58	0.92	4.43
Mean	2.59	0.51	0.79	0.30	6.37	0.41	123.33	1.59	3.94
Obs.	310	285	285	310	310	310	310	310	310

Table 3 Descriptive statistical results and correlation analysis of main variables

Note: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

3.3 Baseline Regression Results

The baseline regression results are reported in Table 4. Models (1) and (2) in Table 4 test the innovation effects of compliance consistency and convergence consistency, respectively. The results show that compliance consistency has a significantly positive effect on regional innovation ($\beta=1.79$, $p<0.01$). For convergence consistency, the coefficient on the linear term is significantly positive ($\beta=12.86$, $p<0.01$), whereas the coefficient on the quadratic term is significantly negative, providing preliminary support for an inverted U-shaped relationship between convergence consistency and regional innovation. Therefore, Hypotheses 1 and 2 receive preliminary support.

Next, on the basis that the quadratic term of convergence consistency is significantly negative, this paper further employs a U-Test to determine whether an inverted U-shaped relationship indeed exists. The results are reported in Table 5. The slope on the left side of the interval is 9.08 ($p<0.01$), the slope on the right side is -3.01 ($p<0.1$), and the turning point is 0.80, which lies within the sample interval. Thus, Hypothesis 2 is further supported.

Finally, Models (3) and (4) in Table 4 introduce local official turnover as a moderating variable to examine its influence on the relationship between structural consistency in local fiscal S&T expenditure and regional innovation. Model (3) shows that the coefficient on the interaction term between local official turnover and compliance consistency is significantly negative ($\beta=-1.25$, $p<0.1$), indicating that local official turnover weakens the positive relationship between compliance consistency and regional innovation. Hypothesis 3 is therefore supported. Model (4) shows that the coefficient on the interaction term between local official turnover and the quadratic term of convergence consistency is negative but insignificant, indicating that local official turnover does not significantly affect the inverted U-shaped relationship between convergence consistency and regional innovation. Hypothesis 4 is therefore not supported.

variable	(1)	(2)	(3)	(4)
Compliance	1.7878***		2.1840***	
	(0.6329)		(0.7536)	
Convergence		12.8633***		12.3849***
		(4.2163)		(4.6243)
Convergence_sq		-8.0144***		-7.4817**
		(3.0237)		(3.3612)
Compliance×Turnover			-1.2453*	
			(0.6560)	
Convergence×Turnover				0.4012
				(7.1222)
Convergence_sq×Turnover				-0.9432
				(4.9826)
Turnover			0.5562	0.2150
			(0.3525)	(2.4955)
GDP	1.4101***	1.4374***	1.3986***	1.4378***
	(0.3078)	(0.3152)	(0.3033)	(0.3168)
Industry	-0.6459	2.4987	-1.0144	2.4138
	(3.2238)	(3.7278)	(3.2858)	(3.7518)
HC	0.0105	0.0094	0.0086	0.0087
	(0.0085)	(0.0088)	(0.0088)	(0.0089)
Fiscal	-0.5692	-0.2175	-0.5020	-0.1987
	(0.8560)	(0.8843)	(0.8490)	(0.8882)
Market	0.4902***	0.5250***	0.4965***	0.5316***
	(0.1204)	(0.1279)	(0.1199)	(0.1295)
c	-8.8262***	-14.9596***	-8.6777***	-14.8248***
	(2.5981)	(3.9362)	(2.6302)	(3.9567)
Fixed time	Yes	Yes	Yes	Yes
Individual fixation	Yes	Yes	Yes	Yes
N	254	254	254	254
adj. R ²	0.9375	0.9374	0.9377	0.9367

Table 4 Basic regression results

Note: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Convergence	
	Lower Bound	Upper Bound
Interval	0.2359	0.9902
Slope	9.0820	-3.0079
t-value	3.2304	-1.5744
P> t	0.0007	0.0585
Extreme Point	Estimated value	95% confidence interval
	0.8025	[0.7246,1.1587]

Table 5 Results of the U-Test

3.4 Endogeneity Treatment

This paper adopts a Heckman two-stage model to correct for possible endogeneity. Since the degree of consistency strategy adopted by local governments is not random, factors such as the structure of local S&T resources and government officials' preferences may affect local governments' choice of consistency strategies.

Specifically, in the first stage, the full sample is divided into "compliant" and "non-compliant" groups, and "convergent" and "non-convergent" groups, according to whether local governments' compliance consistency and convergence consistency exceed the mean. The lagged degree of compliance consistency and convergence consistency is then used as the selection variable in probability models, and the inverse Mills ratio (IMR) is calculated. The results are shown in Models (1) and (2) of Table 6. In the second stage, the IMR is included in the main-effect models to correct for selection bias, and the results are reported in Models (3) and (4) of Table 6. The IMR is significant in both Models (1) and (2), indicating the presence of a degree of self-selection. After controlling for self-selection bias, the linear effect of compliance consistency and both the linear and quadratic effects of convergence consistency remain significant, and the results are consistent with the baseline findings.

variable	(1)	(2)	(3)	(4)
<i>Compliance</i> $t-1$	4.3953***			
	(0.5100)			
<i>Convergence</i> $t-1$		0.9286***		
		(0.1725)		
<i>Compliance</i>			1.2656**	
			(0.5209)	
<i>Convergence</i>				14.7498***
				(4.7814)
<i>Convergence_sq</i>				-9.5843***
				(3.4606)
<i>IMR</i>			0.0441	0.6746*
			(0.2197)	(0.3894)
<i>c</i>	-1.2985	0.3990	-8.5552***	-14.6382***
	(0.8485)	(0.7111)	(2.9474)	(4.1131)
Control variable	Yes	Yes	Yes	Yes
<i>N</i>	254	254	223	223

Table 6 Results of the Heckman Two-Stage Model

Note: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

3.5 Robustness Tests

First, the dependent variable is replaced. Because measuring regional innovation solely by patent quantity captures the technological output of regional innovation but does not reflect its socioeconomic value, this paper supplements the measurement of regional innovation by using the city innovation index reported in the China City and Industrial Innovation Report. That index estimates patent value using a patent-renewal model and aggregates the results at the city level; it has been widely used in existing studies. In this paper, the city innovation indices are first aggregated to the provincial level and then divided by population to obtain a per capita provincial innovation index. Models (1)–(4) of Table 7 report the regression results after replacing the dependent variable, and the conclusions remain consistent with the main analysis.

Second, the lead period is changed. Considering the time lag in the effect of local governments'

behavioral consistency on regional innovation, the paper further leads the dependent variable by two periods instead of one, thereby capturing the innovation effects of compliance consistency and convergence consistency over a longer time horizon. Models (5)– (8) of Table 7 present the results after changing the lead period, and the conclusions remain unchanged.

variable	Innovation_index t+1				Innovation t+2			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Compliance	0.0844***		0.1071***		1.8448***		2.5423***	
	(0.0238)		(0.0276)		(0.5733)		(0.6576)	
Convergence		0.5629***		0.5534***		13.9210***		14.1659***
		(0.1831)		(0.2106)		(4.3231)		(4.7650)
Convergence_sq		-0.3652***		-0.3513**		-9.0987***		-9.0511***
		(0.1293)		(0.1504)		(3.0634)		(3.3731)
Compliance ×Turnover			-0.0625**				-	
			(0.0258)				1.8859***	
Convergence ×Turnover				-0.0065				-2.0622
				(0.3029)				(6.2874)
Convergence_sq ×Turnover				-0.0162				0.7988
				(0.2080)				(4.4521)
Turnover			0.0269**	0.0112			0.7287**	0.9037
			(0.0127)	(0.1094)			(0.3335)	(2.1822)
c	-0.4057***	-0.6836***	-0.3958***	-0.6775***	-	-	-	-
	(0.1000)	(0.1661)	(0.0992)	(0.1705)	8.0716***	14.8415***	7.6480***	14.7209***
Control variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed time	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual fixation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	223	223	223	223	223	223	223	223
adj. R ²	0.9284	0.9260	0.9300	0.9250	0.9579	0.9573	0.9597	0.9571

Table 7 Robustness test results

Note: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

4. Conclusions and Implications

From the perspective of organizational legitimacy, this paper investigates the relationships between compliance consistency and convergence consistency in the structure of local fiscal S&T expenditure and regional innovation, as well as the moderating effect of local official turnover, using sample data from 31 provincial-level administrative regions in China from 2013 to 2022 (excluding Hong Kong, Macao, and Taiwan).

The study draws the following conclusions. First, the overall level of compliance consistency in the structure of local fiscal S&T expenditure is lower than that of convergence consistency, indicating that compared with complying with the strategic goals of the central government, local governments are more inclined to obtain legitimacy by maintaining consistency with peer governments. Second, compliance consistency in the structure of local fiscal S&T expenditure has a significantly positive

effect on regional innovation, whereas convergence consistency has an inverted U-shaped relationship with regional innovation. Third, local official turnover negatively moderates the relationship between local government compliance consistency and regional innovation; that is, when local officials change, the positive effect of compliance consistency on regional innovation is weakened.

The practical implication of this study is that when designing strategies for the structure of S&T expenditure, local governments should recognize that compliance behavior and convergence behavior exert different effects on regional innovation. They should consider not only their own specific conditions but also the practices and experience of the central government and peer local governments, so as to adjust policy orientation in a timely manner and promote regional innovation. At the same time, when learning from or imitating the S&T experience of the central government or other regions, local governments need to take into account the impact of local official turnover and formulate different S&T expenditure strategies in light of periods of decision discontinuity caused by leadership succession, thereby maximizing innovation outcomes.

This study also has certain limitations, which provide directions for future research. First, due to data availability, the sample period covered by this study is relatively short, which may limit our understanding of long-term trends and cyclical factors. Future research may consider extending the sample period so as to provide richer empirical support. Second, when considering consistency strategies in the structure of local fiscal S&T expenditure, this study examines only the structure of expenditure across different types of activities. Future studies may extend the analysis to other dimensions, such as the structure of implementing entities responsible for fiscal S&T expenditure.

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