Research On the Influence Mechanism of The Linkage Between Institutions and The Markets on Regional Digital Transformation from An Fsqca Perspective

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Abstract. In the wave of global digitalization, regional digital transformation has become the core force in promoting economic development and social change in various countries. Based on the grouping perspective, this study aims to explore the mechanism of institutions and markets linkages on regional digital transformation. Using the fuzzy-set qualitative comparative analysis (fsQCA) method, this study begins with the statistical data at the provincial level in China in 2023. In this model, regional digital transformation is the outcome variable, while institutions (fiscal expenditure intensity, intellectual property intensity, human resource allocation) and the markets (product market, capital market, labor market) serve as the antecedent variables. The research findings demonstrate that:(1) No single condition can determine regional digital transformation. (2) High intellectual property intensity is a core condition for achieving high regional digital transformation in all configurations. (3) There are five linkage pathways between institutions and markets, and different pathways are applicable to regions with different resource allocation and development conditions. The research results are reliable after the robustness test. This study's configuration model enhances theoretical insights into regional digital transformation mechanisms, offering practical guidance for government policy and strategic business adjustments.

Keywords: Regional Digital Transformation, Institutions, Markets, FsQCA.

1. Introduction

Regional digital transformation is pivotal in today's globalized economy and a focal point for development and change worldwide. As the world's second-largest economy, China plays a crucial role in global digital competition, offering valuable insights for other nations. The “Digital China” strategy offers a macro framework guiding the country's regional digital transformation, highlighting its importance in fostering high-quality economic growth.

Research on regional digital transformation factors is well-documented. Bob Hinings et al. (2018) [1] have explored the impacts of digital transformation on policy, practice, and research from an institutional perspective. Yang Shuyan et al. (2023) [2] found that different institutional pressures have varying degrees of impact on digital transformation. Xin Jin and Yizhu Wu (2024) [3] have examined the impact mechanisms of regional digital transformation from the perspective of institutional environment. Meanwhile, Xu Dong et al. (2024) [4] have analyzed the important role of marketization in the digital economy process. Yuxin Wang et al. (2025) [5] revealed that market accessibility significantly influences the location choices of digital firms, affecting regional digital economy development. Aiqin Zhang et al. (2025) [6] found that the improvement of marketization levels can influence the peer effects of regional digital transformation.

Existing studies focus on the impacts of individual factors, which may lead to dual deficiencies in theory and practice. Theoretically, a unipolar institutional drive can easily overshadow the dynamic feedback mechanisms of the market, while a market-dominant paradigm may neglect the regulatory role of institutions on innovative factors. Practically, rigid policy supply can easily cause resource misallocation due to supply-demand mismatches, and spontaneous market allocation may exacerbate regional imbalances due to insufficient public investment.

This study is based on a configurative perspective, aiming to analyze the impact of institutions and markets linkages on regional digital transformation. It first constructs an analytical framework with six core conditions by deconstructing the coordination between institutions and markets. Secondly, selecting provincial data from 2023, the fuzzy-set qualitative comparative analysis (fsQCA) method is used to identify configurative paths. Through necessity analysis, configurative path deconstruction, case comparisons, and robustness test for progressive argumentation, it reveals the mechanisms behind each path. It then forms transformation strategies tailored to different regional characteristics using typical provincial cases. Finally, the study concludes with the theoretical and practical contributions and future research directions.

2. Research Background

Regarding the factors influencing regional digital transformation, they can be categorized into two dimensions: institutions and markets.

2.1. The Impact of Institutions on Regional Digital Transformation

According to existing research, the institutional factors influencing regional digital transformation can be categorized into three aspects: fiscal expenditure intensity, intellectual property intensity, and human resource allocation. Fan Yang and Tajul Ariffin Masron (2024) [7] focused on traditional banks, selecting data from 116 banks between 2014 and 2021. They employ the dynamic panel Generalized Method of Moments model for analysis and suggest that governments need to provide financial assistance to reduce the initial investment costs associated with digital transformation. Cheng Li and Yewen Wang (2024) [8] processed data from A-share listed companies between 2007 and 2021 using the entropy-weighted TOPSIS method and selected a benchmark regression model for analysis. They found that factors such as regional intellectual property protection can have an impact on digital transformation. Xin Wang et al. (2024) [9] employed the entropy weight-TOPSIS method to evaluate and analyze the main driving factors in the Yangtze River Delta region from 2017 to 2022 Their research revealed that human resources play an important role in promoting the high-quality development of digital industries.

2.2. The Impact of Markets on Regional Digital Transformation

Drawing on existing research, markets factors on regional digital transformation can be categorized into three dimensions: product market, capital market, and labor market. Ruiqing Hao et al. (2024) [10] constructed a supply chain network risk monitoring model and conducted a mathematical analysis. They found that upgrading the supply chain for complex products can enhance product market competitiveness, thereby promoting the digital transformation of complex product manufacturing. Zhuoya Du and Qian Wang (2024) [11] utilized the moderating effect model and threshold regression model to study Chinese A-share listed companies from 2001 to 2020. They found that the capital market has a positive impact on digital transformation. Sumit Gupta and Sandeep Jagtap (2024) [12] conducted a study on Indian food SMEs using a literature review and the Decision-Making Trial and Evaluation Laboratory method. They identified key challenges in the digital transformation process and found that factors such as a skilled labor force play a crucial role in catalyzing the digital transformation process.

To summarize, current research indicates that fiscal expenditure intensity [7], intellectual property intensity [8], and human resource allocation [9] are key factors in the institutional impacts on regional digital transformation. Meanwhile, research on the market factors can be divided into three aspects: product market [10], capital market [11], and labor market [12]. However, most existing studies are confined to analyzing single antecedent variables. As the economy and society develop with high quality, regional digital transformation is increasingly influenced by the interactive effects of multiple complex factors. Therefore, exploring the antecedent conditions of multi-factor linkage has become an inevitable trend in research. Given that the process of regional digital transformation is the result

of the linkage of multiple complex factors, fsQCA, with its unique advantages in revealing multi-causal complex relationships, provides a new perspective for the research and deepens the understanding of the intrinsic mechanisms of regional digital transformation.

3. Research Methods

3.1. Model

This study sets regional digital transformation as the outcome variable, with institutions and markets as the antecedent variables. Institutions are further divided into three dimensions: fiscal expenditure intensity, intellectual property intensity, and human resource allocation. Markets are divided into three aspects: product market, capital market, and labor market. As shown in Figure 1, institutions and markets jointly influence regional digital transformation in the form of configurations.

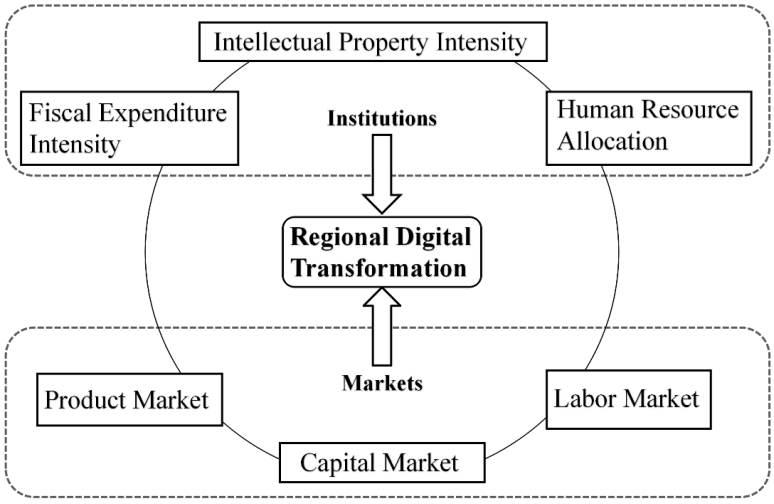

Figure 1. Configurational Model

3.2. Methods

This study adopts fsQCA to carry out the research, mainly based on the following considerations: Firstly, the antecedent variables in this study are derived from cross-sectional data of 31 provinces from the National Bureau of Statistics in 2023. The sample size is relatively small. Unlike Structural Equation Modeling requiring large samples, fsQCA can yield reliable research results in small-sample studies while preserving case heterogeneity (Klaus Ulrich et al., 2024) [13]. Secondly, fsQCA excels in analyzing causal complexity through set-theoretic relationships (Hande Karadağ et al., 2024) [14]. Traditional regression focuses on net effects of isolated variables, whereas fsQCA reveals how institutions and markets form synergistic configurations to drive regional digital transformation through nonlinear interactions. Finally, relative to crisp-set QCA and multi-value QCA, fsQCA introduces the concept of fuzzy sets to represent partial membership degrees, which can better align with the continuous gradations observed in real-world phenomena.

3.3. Data Selection Strategy

The selection of 2023 provincial cross-sectional data in this study is grounded in dual theoretical considerations. First, as the mid-term implementation phase of China's 14th Five-Year Plan for Digital Economy (2021-2025), this temporal node enables a systematic evaluation of the institutions and markets linkage mechanisms under stabilized policy effects. Second, the post-pandemic period (2020-2022) exhibited nonlinear transitions in regional digital transformation, whereas 2023 provides a normalized observation window minimizing exogenous distortions. This strategic temporal framing ensures methodological validity in capturing structural relationships rather than transient anomalies.

3.4. Variables

3.4.1 Outcome Variable

This study takes the 31 provinces as research objects and selects regional digital transformation as the outcome variable. Referring to Yang Hong et al. (2024) [15], a quantitative assessment of regional digital transformation was conducted. Drawing on the data processing methods of Fan Yang and Tajul Ariffin Masron [7], the study de-dimensionalizes the data and further processes it using the entropy weight method.

The regional digital transformation includes three indicators: the number of internet broadband subscribers, R&D (Research and Development) expenditure, and digital technology market transaction volume, all of which are positive indicators and can be dimensionlessly processed using the following formula:

$$X_{ij}^{1} = \frac{X_{ij} - min(X_{1j,\ldots\ldots,X_{31j}})}{max(X_{1j,\ldots\ldots,X_{31j}}) - min(X_{1j,\ldots\ldots,X_{31j}})} \tag{1}$$

Where i represents each province, j represents each indicator, $max(X_{1j,\ldots\ldots,X_{31j}})$ indicates the maximum value of the j-th indicator among the 31 provinces, $min(X_{1j,\ldots\ldots,X_{31j}})$ indicates the minimum value of the j-th indicator among the 31 provinces. X_{ij} represents the original data of the j-th indicator for the i-th province, and after standardization processing, the result is X_{ij}^{1}. Since Tibet score is 0 after standardization, in order to avoid the mathematical singularity of $ln(0)$ in the entropy weight calculation, this study uses the minimum value replacement method (Huang Peng, 2015) [16] by replacing 0 with 0.00001to correct the zero value.

It is possible to calculate the proportion of the value for the i-th province's j-th indicator $P_{ij} = \frac{x_{ij}^{1}}{\sum_{i=1}^{31} x_{ij}^{1}}$ $(i = 1,2...,31; j = 1,2,3)$ and $k = \frac{1}{ln(31)}$ $(k > 0)$, derive the entropy value $e_j = -k * \sum_{i=1}^{m} P_{ij} * ln(P_{ij})$ $(e_j \geq 0)$, along with the variation index $d_j = 1 - e_j$ and the entropy weight $w_j = \frac{d_j}{\sum_{j=1}^{3} d_j}$. Subsequently, a comprehensive assessment for the i-th province can be conducted using $Z_i = \sum_{j=1}^{n} w_j * P_{ij}$.

3.4.2 Antecedent Variables

This study takes the two dimensions of institutions and markets as antecedent variables. Institutional drivers are key engines for regional digital transformation. Referring to the research approach of Liu Jinjin and Gu Shuang (2024) [17], this study divides institutions into three dimensions: fiscal expenditure intensity, intellectual property intensity, and human resource allocation. Despite the increasing importance of emerging technologies such as cloud computing, product market, capital market, and labor market remain irreplaceable core elements in regional digital transformation. This study draws on the methodology of Yu Donghua and Huang Nian (2024) [18], selecting three single indicators from the Fan Gang Index (2003) [19] for measurement. In cases where some statistical data are cut off, the estimation method of Yu Donghua and Huang Nian (2024) [18] is also referred to. See Table.1 for details.

Table.1. Regional Digital Transformation Indicator System

Primary Indicator	Secondary Indicator	Measurement Method	Reference	Location of Data
Institutions	Fiscal Expenditure Intensity	the proportion of government general budgetary expenditure to GDP	Ding Yixia and Guo Junhua (2023) [20]	"China Statistical Yearbook"
	Intellectual Property Intensity	the ratio of technology market transaction volume to GDP	Li Bo-xin et al. (2019) [21]	"China Statistical Yearbook"
	Human Resource Allocation	the proportion of regular undergraduate and associate degree students per ten thousand people	Liu Jinjin and Gu Shuang (2024) [17]	"China Statistical Yearbook"
Markets	Product Market	the degree of product market development	Fan Gang (2003) [19]	"China Statistical Yearbook"
	Capital Market	the proportion of non-state-owned economic investment in the total fixed asset investment	Yu Donghua and Huang Nian (2024) [18]	"China Fixed Asset Investment Statistical Yearbook" and "China Statistical Yearbook"
	Labor Market	the proportion of employment in non-state-owned units out of the total employment		"China Population and Employment Statistics Yearbook" and "China Statistical Yearbook"
Regional Digital Transformation		Number of internet broadband subscribers, R&D expenditure, and digital technology market transaction volume	Yang Hong et al. (2024) [15]	"China Statistical Yearbook"

4. Research Findings

4.1. Variables Calibration

The variables calibration of fsQCA is to convert the original data of the continuous type into the membership score of the fit set theory, thereby facilitating the exploration of complex causal relationships between conditions combinations and outcomes (Cong Cheng and Zefeng Miao, 2025) [22]. This study selected 75% (full membership), 50% (crossover point), and 25% (full non-membership) as the calibration points. The specific calibration results are presented in Table.2.

Table.2. Variable's calibration results

Variables Name	Full Membership	Crossover Point	Full Non-Membership
Fiscal Expenditure Intensity	0.297	0.218	0.183
Intellectual Property Intensity	0.051	0.026	0.007
Human Resource Allocation	1.124	0.957	0.841
Product Market	6.568	5.169	2.284
Capital Market	0.641	0.562	0.445
Labor Market	0.929	0.924	0.898

4.2. Necessary Conditions Analysis

In fsQCA, the analysis of necessary conditions can be used to assess the necessity of individual antecedent conditions for a particular outcome. According to the data analysis in Table.3, the

necessity levels of all conditions for regional digital transformation are below 0.9, indicating that no single condition can play a decisive role (Weili Yin,2022) [23].

Table.3. Necessary Conditions Analysis of Regional Digital Transformation

Antecedent	High Regional Digital Transformation		Non-High Regional Digital Transformation	
	Consistency	Coverage	Consistency	Coverage
High Fiscal Expenditure Intensity	0.236	0.246	0.835	0.892
Non-High Fiscal Expenditure Intensity	0.896	0.841	0.294	0.283
High Intellectual Property Intensity	0.842	0.815	0.273	0.271
Non-High Intellectual Property Intensity	0.247	0.249	0.813	0.841
High Human Resource Allocation	0.578	0.545	0.537	0.519
Non-High Human Resource Allocation	0.490	0.508	0.529	0.562
High Product Market	0.806	0.810	0.275	0.283
Non-High Product Market	0.287	0.278	0.816	0.812
High Capital Market	0.686	0.683	0.400	0.408
Non-High Capital Market	0.406	0.397	0.690	0.692
High Labor Market	0.798	0.771	0.327	0.324
Non-High Labor Market	0.301	0.304	0.769	0.796

4.3. Configurational Analysis

Given that a single condition cannot serve as a necessary factor for regional digital transformation, configurational analysis is effective in uncovering the impact of condition combinations on outcomes in the face of complex causal relationships. Therefore, this study constructs a truth table, setting the case frequency threshold at 1 and the consistency threshold at 0.85, and requiring the PRI consistency to be greater than 0.7 (Zeyan Miao and Guohao Zhao,2023) [24]. The configurational path analysis is conducted based on these criteria.

During the research process, fsQCA software was used to perform the calculations, and the solutions were obtained. Among these solutions, the intermediate solution reveals the configurational paths, while the parsimonious solution identifies the core conditions. After analysis, five configurational paths were eventually obtained, with the specific configurational results presented in Table.4.

Table.4. Configurational Conditions for High Regional Digital Transformation

Configurational Conditions	Path 1	Path 2	Path 3	Path 4	Path 5
Fiscal Expenditure Intensity	⊗	⊗	⊗	•	•
Intellectual Property Intensity	●	●	●	●	●
Human Resource Allocation	•	●		⊗	⊗
Product Market	●		●	●	⊗
Capital Market		⊗	•	●	●
Labor Market		⊗	●	⊗	●
Raw Coverage	0.385	0.144	0.417	0.076	0.071
Unique Coverage	0.108	0.064	0.141	0.015	0.025
Consistency	0.982	0.982	1.000	0.991	0.940
Solution Coverage	0.805				
Solution Consistency	0.903				

Note: ●indicates the presence of a core condition, •indicates the presence of a peripheral condition, ⊗indicates the absence of a core condition, ⊗indicates the absence of a peripheral condition, and a blank space indicates that the condition is optional.

Table.4 presents five configurational paths for high regional digital transformation. The consistency levels of all paths are above 0.9, which, according to Zeyan Miao and Guohao Zhao (2023) [24], indicates that these configurations have high credibility in explaining high regional digital transformation. The solution consistency is 0.903, meaning that in 90.3% of cases, these configurations can stably lead to high regional digital transformation, reflecting the high stability and reproducibility of the paths. The coverage is 0.805, suggesting that the identified configurations can explain 80.5% of the cases of high regional digital transformation, indicating that the factors involved in the study are relatively comprehensive.

4.4. Discussion of Results

Horizontal studies have found that in all paths leading to high regional digital transformation, high intellectual property intensity consistently serves as a core condition. This suggests that high intellectual property intensity plays a key role in promoting the process of high regional digital transformation. In light of this, provinces need to focus on increasing the transaction volume of the technology market to promote the output of intellectual property achievements, thereby advancing the process of regional digital transformation.

Longitudinal analysis indicates that institutions and markets jointly influence the process of regional digital transformation. To more clearly reveal their differentiated linkage relationships in regional digital transformation, it is necessary to further analyze their impacts, which can be specifically divided into:

The Intellectual Property Intensity-Product Market-Driven Path (Path 1) features intellectual property intensity and the product market as core conditions, with human resource allocation as a peripheral condition and the absence of fiscal expenditure intensity. It demonstrates that provinces with low fiscal expenditure can achieve high regional digital transformation by leveraging intellectual property intensity and the product market, supported by human resource allocation. Representative provinces include Zhejiang, Shanghai, Shaanxi, Guangdong, and Liaoning. The differences between Zhejiang and Shanghai in industrial characteristics and talent attraction lead to divergences in regional digital transformation. Zhejiang's advanced private economy and Shanghai's diverse economic structure attract social capital to invest in regional digital transformation, with low fiscal expenditure intensity. In intellectual property intensity, Zhejiang incentivizes enterprises to increase R&D investment, led by companies like Alibaba in applied technologies. In contrast, Shanghai leverages the Shanghai Technology Exchange as a platform to promote the efficient trading and in-depth transformation of intellectual property, driving the healthy development of the regional copyright industry. In the product market, Zhejiang's product market is active, with fierce competition in e-commerce and manufacturing. Shanghai, as an international metropolis, has a more open and high-end product market. In human resource allocation, Zhejiang's vocational colleges continuously supply talent to the digital sector. Shanghai's international atmosphere and career opportunities attract overseas returnees and foreign professionals.

The Intellectual Property Intensity-Human Resource Allocation-Driven Path (Path 2) features intellectual property intensity and human resource allocation as core conditions, with the absence of fiscal expenditure intensity and the capital market. The labor market is also absent as a peripheral condition. It shows that even with low fiscal expenditure intensity and underdeveloped capital and labor market, high regional digital transformation can be achieved by enhancing intellectual property intensity and optimizing human resource allocation. Representative provinces include Beijing and Shaanxi. Due to differences in regional positioning and resource endowments, there are disparities between Beijing and Shaanxi. In the capital and labor markets, Beijing, as China's capital, features a dominant state-owned economy that limits private investment space. In Shaanxi, state-owned sectors like energy dominate, with underdeveloped private economies. Large state-owned enterprises absorb

significant labor, tightening the labor market. In fiscal expenditure intensity, Beijing's large economy attracts social capital, reducing fiscal spending. The regional economic imbalance in Shaanxi fragments fiscal funds, hindering high fiscal expenditure intensity. In intellectual property intensity, as a national innovation center, Beijing has strong intellectual property protection and a vibrant intellectual property market. Shaanxi's universities and research institutions excel in basic and frontier research. In human resource allocation, the Beijing-Tianjin-Hebei integration attracts talent, which boosts technological support and innovation. Shaanxi's participation in the Belt and Road Initiative offers global talent development opportunities.

The Intellectual Property Intensity-Product Market-Labor Market-Driven Path (Path 3) features intellectual property intensity, product market, and labor market as core conditions, with the capital market as a peripheral condition and the absence of fiscal expenditure intensity. It demonstrates that provinces with low fiscal expenditure intensity can achieve high regional digital transformation by enhancing intellectual property intensity, developing the product and labor market, and utilizing the capital market as a supporting factor. Representative provinces include Shandong, Hubei, Anhui, Guangdong, Zhejiang, and Hunan. Differences in industrial structure and development stages lead to distinct regional digital transformation characteristics in Shandong and Guangdong. Both Shandong and Guangdong feature dynamic private economies, with enterprises and social capital sharing burdens, enhancing the capital market and reducing fiscal expenditure intensity. In intellectual property intensity, Guangdong excels in high-tech sectors like electronics, with a vibrant technology market. Shandong, with a solid foundation in traditional industries like chemical engineering and machinery, achieves notable intellectual property outcomes. In the product market, Guangdong’s highly internationalized market holds significant positions in the global industrial chain. In contrast, Shandong has a comprehensive range of industries with its market mainly focused on the domestic sphere. In the labor market, Guangdong attracts high-end talents in emerging fields like finance, with a pronounced talent aggregation effect. Shandong’s small and medium-sized private enterprises absorb significant local labor, especially rural migrant workers.

Intellectual Property Intensity-Product Market-Capital Market-Driven Path (Path 4): This path features intellectual property intensity, product market, and capital market as core conditions, with the absence of human resource allocation. Peripheral conditions include fiscal expenditure intensity and the absence of labor market. This path shows that even with limited human resource allocation and labor market development, high regional digital transformation can be achieved by enhancing intellectual property intensity, developing the product and capital market, and leveraging fiscal expenditure intensity. Jiangxi Province exemplifies this path. Jiangxi Province has limited educational resources and lacks top-tier universities, restricting its local talent pool. As a central region, it hosts fewer foreign and non-state-owned enterprises, hampering labor market development. However, Jiangxi has leveraged fiscal spending to establish innovation platforms like the National Silicon-based LED Engineering Technology Research Center. This has accelerated the regional digital transformation of traditional industries and enhanced product competitiveness. The province has also set up industrial funds, optimized the business environment, and provided financing support to drive regional digital transformation. To address insufficiencies human resource allocation, Jiangxi can collaborate with universities outside the province and expand local universities to improve talent cultivation. Meanwhile, Jiangxi can attract private enterprises through mixed-ownership reform, promote upstream and downstream private supporting enterprises, and create more non-state-owned employment opportunities to invigorate the labor market.

Intellectual Property Intensity-Capital Market-Labor Market-Driven Path (Path 5): This path features intellectual property intensity, capital market, and labor market as core conditions, with the absence of human resource allocation. Peripheral conditions include fiscal expenditure intensity and the absence of product market. This path shows that high regional digital transformation can be achieved by enhancing intellectual property intensity, developing the capital and labor market, and leveraging fiscal expenditure intensity, even with limited human resource allocation and product market development. Hebei Province exemplifies this path. Hebei Province faces challenges in

human resource allocation, with talents outflow to Beijing and Tianjin, constraining the local talent pool. Its products are mostly mid-to-low-end, limiting market share and competitiveness. However, Hebei has leveraged fiscal policies to establish innovation platforms like the Xiong'an Innovation Research Institute, attracting research institutions and enterprises for collaborative innovation. The province has established industrial funds, optimized the business environment, and provided financing support to invigorate the capital market. Additionally, by strengthening vocational training and implementing supportive policies for employment and entrepreneurship, Hebei has fostered a favorable environment for regional digital transformation. To address the talent gaps, Hebei has iterated the "Yanjiao Talent Card" policy to attract talents to return to the region. Meanwhile, Hebei can enhance its product market competitiveness through technological upgrades, brand digitalization, market globalization, and industrial collaboration.

4.5. Robustness Test

Based on the current results of configurational analysis, to ensure the reliability of the conclusions, this study follows the approach of Zeyan Miao and Guohao Zhao (2023) [24] by conducting the robustness test through adjustments to the consistency threshold. While maintaining the frequency threshold at 1, the consistency threshold was increased from 0.85 to 0.9. After raising the consistency threshold by 0.05, the pathways through which institutions and markets influence regional digital transformation, as well as the consistency and coverage of the solution, remained unchanged. This indicates that the results have good robustness. As shown in Table.5.

Table.5. Robustness Test of Regional Digital Transformation

Configurational Conditions	Path 1	Path 2	Path 3	Path 4	Path 5
Fiscal Expenditure Intensity	⊗	⊗	⊗	•	•
Intellectual Property Intensity	●	●	●	●	●
Human Resource Allocation	•	●		⊗	⊗
Product Market	●		●	●	⊗
Capital Market		⊗	•	●	●
Labor Market		⊗	●	⊗	●
Raw Coverage	0.385	0.144	0.417	0.076	0.071
Unique Coverage	0.108	0.064	0.141	0.015	0.025
Consistency	0.982	0.982	1.000	0.991	0.940
Solution Coverage	0.805				
Solution Consistency	0.903				

Note: In this robustness test, the consistency threshold is adjusted to 0.9, with the frequency threshold remaining at 1.

5. Discussion

Based on the multidimensional analysis of the research findings, this study offers a deeper insight into regional digital transformation. The study's contributions will be examined from theoretical and practical standpoints.

5.1. Theoretical Contributions

At the theoretical level, this study constructs a configurational model of how institutions and markets influence regional digital transformation, analyzing the impact on regional digital transformation from a multifactorial perspective. By employing fsQCA, this study reveals the complex causal relationships between antecedent conditions in the institutional and market dimensions and the outcome variable. This approach deepens the theoretical understanding of the

underlying mechanisms of regional digital transformation and provides a new theoretical framework and analytical approach for future research in this area.

5.2. Practical Contributions

From a practical perspective, the findings of this study hold significant value for application. The analysis identifies multiple configurational paths to achieve high regional digital transformation. Local governments can refer to these paths based on their own resources and development conditions to stimulate the vitality of technology market transactions and formulate targeted policies. Enterprises can increase R&D investment, transform innovative achievements, optimize the efficiency of technology market transactions, and adjust their development strategies in line with the institutional and market environments of their regions. China should focus on the key factor of intellectual property intensity to enhance the quality and effectiveness of regional digital transformation. Meanwhile, this research also provides beneficial references for other developing countries and has certain reference value for other countries to achieve a comprehensive leap in digital development.

5.3. Limitations and Future Research

This study acknowledges two limitations. First, the reliance on 2023 cross-sectional data restricts longitudinal analysis of the institutions and markets linkage dynamics. Although strategically selected to capture mid-term policy effects and post-pandemic stabilization, the single-year observation cannot fully reveal temporal evolution patterns. Second, while fsQCA effectively identifies configuration paths, its static nature limits dynamic interpretation of the institutions and markets linkage mechanisms. Future research should extend the temporal scope to 2018-2023 panel data, applying Temporal QCA (tQCA) to trace dynamic configuration transitions.

6. Conclusion

This study takes institutions and markets as the entry point to analyze the impact of the configuration formed by six aspects-fiscal expenditure intensity, intellectual property intensity, human resource allocation, product market, capital market, and labor market on regional digital transformation. The research shows that no single factor can decide regional digital transformation, instead, high intellectual property intensity is key across all configurations. Also, there are five linkage paths between institutions and markets, each suitable for regions with different resource set-ups and development levels. It emphasizes that all regions need to strengthen intellectual property rights, increase technology market transactions, and promote regional digital transformation.

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