

Article

How Business–Government Relationships Drive Digital Innovation and Entrepreneurship: A Study of 292 Cities in China Using NCA and TDQCA

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Abstract: Innovation is the driving force for achieving sustainable economic development, and healthy business–government relationships are the foundation and guarantee for promoting the sustainability of digital innovation and entrepreneurship. However, current academic research on the impact of business–government relations on digital innovation and entrepreneurship often neglects the configurational effects of various factors. Therefore, this study constructed an analytical framework from the new dimension of “close” and “clean” business–government relationships, selected 292 Chinese cities as research subjects, and employed the Necessary Condition Analysis (NCA) and Time-Differencing Qualitative Comparative Analysis (TDQCA) methods. From a configurational perspective, it explored the relationship between business–government relations and digital innovation and entrepreneurship. The results showed the following: Firstly, the various business–government relationship factors did not have a single linear impact on digital innovation and entrepreneurship, and configuration was more crucial than a single factor. Secondly, based on the integration of research findings and the theoretical framework, five successful configurations were proposed. However, these configurations possess certain adaptability and need to be tailored to local conditions. Thirdly, analyzing the three “non” condition variables in these five configurations, including “clean” business–government relationships, government efficiency, and new infrastructure, also contributed to enhancing the sustainability of digital innovation and entrepreneurship outcomes. Additionally, the study analyzed the implications of these critical configurations for five key stakeholders: government, enterprises, research institutions and academia, policymakers, and the public. Specifically, the government can implement policies tailored to local conditions to promote the sustainable development of digital innovation and entrepreneurship. These policies include increasing investment in digital infrastructure, simplifying approval processes, and enhancing the efficiency of government services.

Keywords: business–government relationship; digital innovation and entrepreneurship; TDQCA; configuration analysis; sustainable development



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1. Introduction

In recent years, in response to domestic and international calls for economic improvement, the Chinese government has launched large-scale reforms to optimize the business environment, aiming to create cleaner and closer business–government relations. This effort utilizes the dual advantages of the government and the market, significantly impacting many aspects of economic and social life. Concurrently, China has become a major player in digital transformation. Statistics from 2017 to 2021 show significant progress in network infrastructure, digital technology, and the digital industry, with China’s digital economy exceeding USD 6.5 trillion in 2021, accounting for nearly 40% of the GDP. The diverse development scenarios across Chinese cities provide a typical sample with data availability

and diversity. Thus, to address the research questions, this study was conducted within the Chinese context.

Innovation is a crucial force driving sustainable development and has gradually become the focal point of the development strategies of major countries worldwide. The 2023 Global Innovation Index by the World Intellectual Property Organization (WIPO) ranked China 12th, noting it as the only middle-income economy among the top 15. This positioning reflects a significant enhancement in national innovation capacities that not only guide the trajectory toward high-quality innovative entrepreneurship but also stimulate robust entrepreneurial activity. Amidst rapid digital and technological advancements, digital innovation and entrepreneurship have evolved, integrating digitalization with traditional innovation processes [1]. This integration is altering the boundaries, processes, and models of conventional entrepreneurship, necessitating a fresh perspective on the role of digital technologies in fostering innovative entrepreneurial activities [2]. To profoundly seize digital development opportunities, the Chinese government issued the “14th Five-Year Plan for Digital Economy Development” in 2022, specifying the requirements for the development of China’s digital economy. Digital innovation and entrepreneurship require attention to the variations in digital technology across different cultural, institutional, and regional contexts [3]. As a pioneer in the development of a digital economy, China has seen the emergence of digital innovation and entrepreneurship models, such as poverty alleviation, through e-commerce and Taobao villages. However, the existing studies on China’s context still lag behind these practices.

In the era of the digital economy, digital transformation is an inherent requirement for promoting digital innovation and entrepreneurship, and corporate digital transformation cannot proceed without government guidance and support. The use of digital technology can effectively reduce the time, search costs, and coordination costs related to traditional bureaucratic procedures in business–government interactions [4], as well as the implicit costs that enterprises bear, such as learning, compliance, and psychological costs [5]. Thus, establishing and maintaining healthy business–government relations is crucial for developing digital innovation and entrepreneurship. Business–government relations typically refer to the interactions between government and businesses in fulfilling administrative and economic functions [6]. Healthy business–government relations are key in maintaining a fair and just market environment. As China’s economy enters a high-quality development phase, business–government relations are experiencing a dynamic evolution, with the new “close” and “clean” business–government relationship gradually replacing traditional relations. The “close” business–government relationship requires the government to engage with enterprises in an open and sincere manner, genuinely solving practical problems for them. The “clean” business–government relationship requires the government to maintain a clear and upright relationship with enterprises, avoiding any misuse of power or monetary transactions. This new relationship serves as essential institutional support for implementing development strategies for the digital economy [7]. Through business–government interactions, the government gains deep insights into market demands and technology trends, formulating policies that are more conducive to digital innovation and entrepreneurship. A fair policy environment encourages technological innovation, while intellectual property protection in digital innovation and entrepreneurship is crucial. Formulating strict regulatory policies is a prerequisite for digital innovation and a significant step in optimizing business–government relations and enhancing government trust. Therefore, the different elements of business–government relations and how they systematically affect digital innovation and entrepreneurship, as well as the coupling and overall efficiency of different elements, are worthy of further study. Configurational theorizing is suitable for studying such institutional complexity and multifactorial concurrent causality issues [8]. Thus, this study combines configurational theory, starting from significant phenomena (business–government relations and digital innovation and entrepreneurship), and it explores the configurational factors leading to the

outcome (digital innovation entrepreneurship) and whether individual factors may cause bottlenecks in digital innovation and entrepreneurship.

Despite the critical role of these interactions, academic research directly addressing the impact pathways of business–government relationships on digital innovation and entrepreneurship remains scarce. This study employs Necessary Condition Analysis (NCA) and Time-Differencing Qualitative Comparative Analysis (TDQCA) to explore the necessary and sufficient causal relationships among various factors influencing business–government relationships and their impact on digital innovation and entrepreneurship. Traditional quantitative methods are often inadequate for analyzing such complex phenomena. For example, the regression method typically uses linear models to determine the independent effects of various factors in business–government relationships on corporate strategy, innovation, and entrepreneurship [9,10]. TDQCA offers advantages by examining configurational relationships, handling causal asymmetry, and incorporating temporal dynamics. This approach helps control for time-invariant factors, assess policy implementation effects, and reveal nonlinear relationships. NCA complements this by identifying critical factors necessary for fostering digital innovation. This methodological combination provides a more nuanced and dynamic analysis of the complex interplay between business–government relationships and digital innovation, particularly suited to the Chinese context, with its rapid policy changes and regional variations. In sum, NCA and TDQCA are especially appropriate for this research, as they can capture the intricate and often nonlinear relationships between government policies, business environments, and digital innovation outcomes across China’s diverse regions. Moreover, these methods allow for more precise identification of the necessary conditions and sufficient configurations for successful digital innovation and entrepreneurship, enabling the development of tailored policy recommendations for different regional contexts. The research aims to uncover what configurations of business–government relationship factors emerge from their interactions, the extent to which these elements are necessary for achieving high outcomes in digital innovation and entrepreneurship, and which configurations can produce them.

2. Theoretical Basis and Dimensions for Analysis

2.1. Theoretical Basis

In the context of the rapid development of the digital economy and digital industry, digital innovation and entrepreneurship represent the key economic activities, where digital technologies are transformed into new values and dynamics. The digital dividends generated serve as sources of high-quality national economic development. Digital innovation refers to embedding digital content within innovative processes, coupling digital and physical components to provide novel products and services. Digital entrepreneurship involves creating digital products or services to identify and develop opportunities, with some or all of the entrepreneurial content being manifested digitally. Although the former emphasizes technological innovation and development processes more, and the latter emphasizes the integration models of digital technology and entrepreneurial opportunities, they can mutually transform and promote each other [11]. Digital innovation and entrepreneurship are characterized by the datafication of elements, the diversification of agents, and the fuzziness of processes [12]. Therefore, this study posits that digital innovation and entrepreneurship embed digital technology into innovative products and services, enhancing the vitality of enterprise entrepreneurship.

A healthy business–government relationship plays a crucial role in corporate innovation and entrepreneurial activities, as well as in the sustainability of innovation and entrepreneurship [13]. Western scholars believe that business–government relationships are formed based on mutual benefit [14–16], promoting local economic sustainability, allowing businesses to receive government subsidies and tax incentives, and enabling officials to achieve political promotion [17,18]. Chinese scholars, however, delve deeper into the dimensions of “closeness” and “cleanliness” to analyze the connotations, significance, and influencing factors of business–government relationships [19]. They argue that interactions

between the government and enterprises should be “close but measured” and “clean and proactive” [20]. Therefore, the new “close” and “clean” business–government relationships help facilitate two-way information communication between the government and enterprises, creating an environment conducive to digital innovation and entrepreneurship [21]. Based on this, this study also explores the impact of business–government relationships on digital innovation and entrepreneurship in Chinese cities from the dimensions of “closeness” and “cleanliness”.

2.2. *The Relationship between Elements of Business–Government Relationships and Digital Innovation and Entrepreneurship*

2.2.1. Government Transparency

Government transparency refers to the public release and disclosure of relevant government information [22]. The application of digital technology helps enhance government transparency [23,24], ensuring the efficiency and accuracy of government information disclosure, and enabling digital innovators and entrepreneurs to obtain information more quickly and conveniently. Government transparency helps enhance credibility and execution, establish a fair and just market environment, provide more stable and sustainable institutional guarantees for digital innovation and entrepreneurship, and reduce the risk of failure.

2.2.2. Government Integrity

A clean government can provide digital innovators and entrepreneurs with a fairer, more transparent, and predictable business environment. Corruption often leads to entrepreneurs investing too many resources in market access and production permits, negatively impacting the sustainability of innovation and entrepreneurship [25–27]. However, some scholars believe that corruption is an equilibrium result of the existing institutional environment [28], where appropriate rent-seeking can serve as an informal means to obtain relevant innovation resources and overcome market entry barriers, thereby promoting corporate innovation [29]. Therefore, the impact of government integrity on digital innovation and entrepreneurship is not a simple linear relationship and should be discussed according to different scenarios.

2.2.3. Government Services

Enhancing government service capabilities helps improve governance efficiency and business–government relationships. The “Internet + Government Services” initiative is a critical tool for achieving high-quality development in the digital economy [30]. It helps reduce institutional transaction costs, identify market risks, and lower the costs associated with digital innovation and entrepreneurship [31]. Efficient government services provide enterprises with more precise policy support and guidance, accelerating the flow of resources in the field of digital innovation and entrepreneurship, and contributing to the continuous cultivation of small and medium-sized enterprises.

2.2.4. Government Efficiency

Government effectiveness significantly impacts innovation and entrepreneurship by promoting functional transformation, improving institutional systems, enhancing administrative decision-making efficiency, and ensuring sustainable market development [32–34], thereby boosting the confidence and vitality of innovators and entrepreneurs. Digitalization is key to enhancing government effectiveness, breaking through the traditional vertical operation and single-department internal circulation models of administration, and promoting intensive construction, interconnection, and coordinated linkage of government application systems across various fields [35].

2.2.5. New Infrastructure

With the vigorous development of the digital economy, traditional infrastructure construction has gradually shifted to digitally driven, new infrastructure construction. New infrastructure has multiple effects, such as knowledge spillover, factor optimization, and industrial creation. Building internet platforms breaks the constraints of traditional innovation and entrepreneurship models, improves the efficiency and sustainability of digital innovation and entrepreneurship [36], and provides stronger foundational support, diversified and personalized application scenarios, and market spaces for digital innovation and entrepreneurship [37].

2.3. Theoretical Model

The influence of business–government relationships on digital innovation and entrepreneurship is complex. Many fields’ mature theories and analytical frameworks can partially explain the rationality of its elements and their relationships and mechanisms, including but not limited to new structural economics [38], collaborative governance theory, and technology policy economics [39]. Relying on a single theoretical perspective and relatively simple “more is better” linear models can be risky, as phenomena become increasingly complex and multifaceted [40–43]. More scholars realize the need to systematically understand the causes of digital transformation phenomena and develop theoretical frameworks with an ecosystem perspective, such as digital ecosystem dynamics [44], digital business ecosystem theory [45], socio-technical systems theory [46], and the TOE (Technology, Organization, and Environment) analysis framework. These emphasize the relationships between different elements and their interactive, dynamic, systemic, and contingent effects on the target object, providing guidance for comprehensively analyzing the impact of business–government relationships on digital innovation and entrepreneurship based on existing results.

Furthermore, configurational theory and the accompanying Qualitative Comparative Analysis (QCA) method provide an epistemological and methodological basis for integrating existing theories. Configurations emerge when attributes match and form a coherent pattern, and each configuration is governed by one or more central “logics” that coordinate the interactions among various attributes [8]. The same factors can lead to different outcomes depending on their coordination or arrangement with other factors [47]. The role of different factors depends on their compatibility with other elements and the context, and there is no single optimal primary solution or combination. QCA links combinatory, equifinal, asymmetric causal relationships with the emergent nonlinear relationships in complexity theory, which can be used to establish and test holistic configurational theories in research, clarify contradictions in existing empirical findings, and distinguish these from traditional regression methods [48] (detailed similarities and differences are shown in Table 1). TDQCA, as a recent advancement in QCA methodology, further enhances its analytical capabilities by incorporating temporal dynamics, offering significant advantages over traditional regression methods in policy effect analysis by addressing endogeneity concerns and capturing nonlinear, configurational changes in complex systems over time.

Table 1. Comparison between the QCA method and traditional regression method.

Aspects	Traditional Regression Method	QCA Method
Research Question	Net-Effect Question	Configurational Question
Pathway to Causal Realization	Correlation	Set-Theoretic Relationship
Assumptions of Causal Relationships	Causal Monotonicity	Causal Complexity
Form of Logical Reasoning	Deductive Reasoning	Abductive Reasoning
Mathematical Basis	Statistics	Set Theory
Sample Size for Research	Large Sample	No Restrictions

As outlined above, a systemic and holistic research method for optimizing digital innovation and entrepreneurship is still lacking. Moreover, according to the “2022 China City Business–Government Relationship Evaluation Report”, the current state of business–government relationships in China still exhibits a significant hierarchical pattern, which has a complex impact on high-quality economic development, business environment optimization, and digital innovation and entrepreneurship activities. The complex systems view considers the relationships among elements to be nonlinear, dynamic, and random. Combining a systematic review of existing research, this study also analyzes business–government relationships from the dimensions of “closeness” and “cleanness”. “Closeness” primarily encompasses governmental services, government efficiency, and new infrastructure, while “cleanness” mainly includes government transparency and government integrity. These five elements are interdependent but concurrently synergistic, and they need to be matched in coordination, not in isolation. Therefore, how different business–government relationships manifest diverse configurational patterns, thereby forming varied pathways for digital innovation and entrepreneurship in different cities, is an urgent and important research topic. Using a configurational perspective and complex systems view, this study analyzes the configurational effects of business–government relationships on optimizing digital innovation and entrepreneurship and reveals the interactive relationships among different elements of business–government relationships. Based on this, the theoretical framework of this study was constructed using the NCA and TDQCA models, as shown in Figure 1.

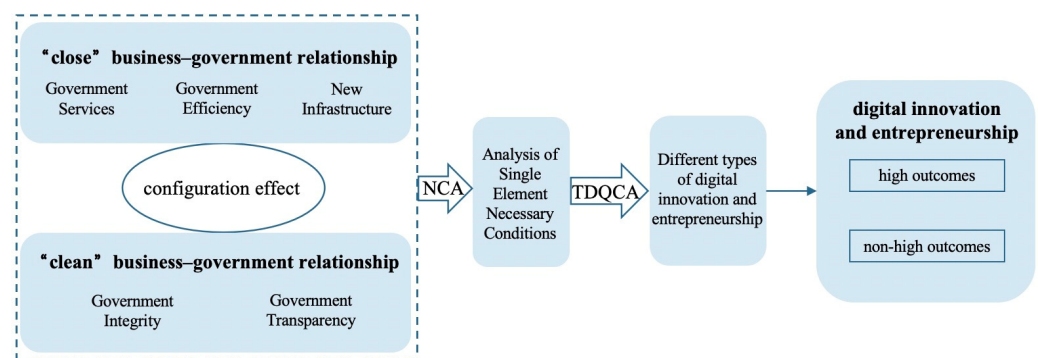


Figure 1. Theoretical framework.

3. Methodology

3.1. Research Methodology

NCA is a specialized method for analyzing necessary relationships [49], and it is primarily applicable to dissecting the effects of elements on outcome variables (bottleneck level), i.e., the extent to which a necessary condition exists for the outcome. The QCA method, a set-theoretic approach based on Boolean algebra, is dedicated to analyzing the set relations between element configurations and outcome variables as a whole. It explores the multiple concurrent configurations when desired outcomes occur and addresses the causal complexity inherent in social phenomena [50]. Therefore, the NCA and QCA methods can complement each other’s strengths, and their combination reflects greater scientific rigor in research. This study first used the NCA method to analyze whether any single factors in business–government relationships act as “neck-cinching” determinants of digital innovation and entrepreneurship outcomes. The influence of business–government relationships on digital innovation and entrepreneurship represents a typical multi-factor, dynamic, and complex system issue, with different logical combinations of causal relationships. Focusing solely on the net effect of individual variables is insufficient to explain the complex causal relationships formed by interdependent variables and their configurations [51]. Using the QCA method helps explore the configurational mechanisms of action of different combinations of factors related to business–government relationships on digital innovation and

entrepreneurship, thus refining typical and diverse paths for reform in digital innovation and entrepreneurship.

However, many studies using QCA generally overlook the temporal dimension, creating a time-blind spot in the traditional QCA approach, which ignores the influence of time on conditional configurations [52]. TDQCA is an effective tool for analyzing dynamic changes [53]. By directly comparing differences, it can better capture the dynamic relationships between variables [54]. Therefore, to adequately consider the temporal aspect, this study employed the TDQCA method, embodying a cross-time comparative mindset. This approach differentiates conditional and outcome variables between two time periods to form increment-based differential data, representing the situations before and after optimization. The distance in values between data points from two time periods is used to gauge the degree of impact of conditional variables and the actual effects of outcome variables [55]. TDQCA allows for the examination of how configurations of factors evolve over time, capturing the dynamic nature of policy implementation and its effects on innovation outcomes. This method is particularly suited to the Chinese context, where rapid changes in the business environment and varying regional policies necessitate an approach that can account for both complexity and temporal variation. Additionally, TDQCA helps mitigate concerns about endogeneity and unobserved heterogeneity that often plague studies of business–government relationships, thereby providing more robust insights into the causal mechanisms at play. In summary, the detailed operational steps of the NCA and TDQCA methods in this study are shown in Figure 2.

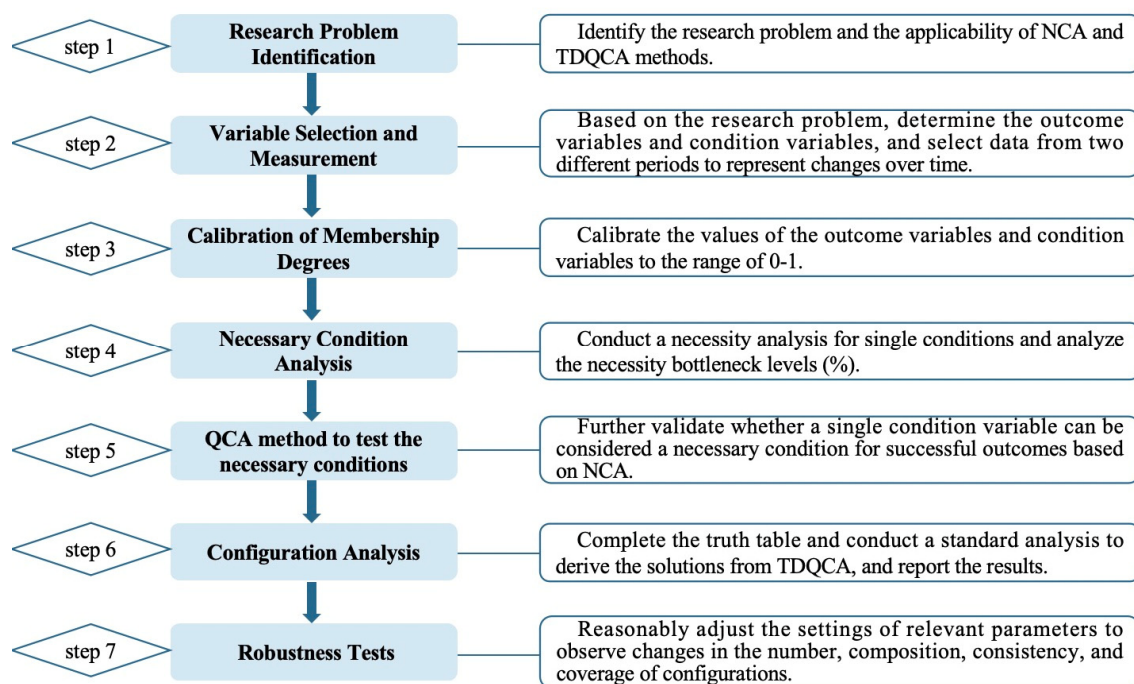


Figure 2. Operational steps of the NCA and TDQCA methods.

Moreover, initially developed for small- to medium-sample research scenarios, QCA is also capable of handling thousands of cases in large-sample studies, where traditional random sampling strategies or purposive sampling methods can be applied, thus extending the research context to larger sample populations. Therefore, this study expanded the sample size, selecting 292 prefecture-level cities in China as research subjects, which allowed the use of any value between 0 (non-membership) and 1 (full membership) to calibrate the degree of partial membership of a set. This is better suited for analyzing conditional variables that vary in degree or level [56].

3.2. Operationalization of Variables and Data Source

This paper chose 2017 and 2021 as the two timepoints for research. From 2017 to 2021, China's digital economy grew from 27.2 trillion yuan to 41.5 trillion yuan [57]. The internet penetration rate increased from 55.8% in 2017 to 70.4% in 2021, and by the end of 2021, the number of 5G base stations reached 1.425 million [58]. The government issued a series of policy documents to support the development of the digital economy, such as the "14th Five-Year Plan for Digital Economy Development", providing clear directions and policy guarantees for digital innovation and entrepreneurship [57]. Additionally, venture capital investments in digital innovation and entrepreneurship significantly increased, with internet-related industries reaching a historical high in 2020 [59]. Therefore, selecting the two timepoints of 2017 and 2021 not only ensured data continuity but also reflected the scientific and rational nature of policy implementation cycles and technology development stages.

3.2.1. Outcome Variable

Digital innovation and entrepreneurship refer to the integration of digital technology into business innovation and entrepreneurship within the context of digital economy development. Therefore, this study focused on enterprises, measuring the extent of digital innovation and entrepreneurship from six dimensions: business entry, outside investment, venture capital, patent, trademark, and copyright. Data were sourced from the Index of Regional Innovation and Entrepreneurship in Digital Economy in China (IRIEDEC) [60]. Adhering to principles of objectivity, efficiency, and multidimensionality, the mean values of these six secondary indicators were assigned to the primary indicator. Subsequently, the scores for the optimization effects in various prefecture-level cities were represented by the frontier distance of the differences between the 2017 and 2021 data. The formulas were as follows:

$$X = \frac{1}{6} \sum_{i=1}^6 x_i, i = 1 \text{ to } 6 \quad (1)$$

$$Y = X_{2021} - X_{2017} \quad (2)$$

$$Z = \frac{Y_j - Y_{\min}}{Y_{\max} - Y_{\min}}, j = 1 \text{ to } 292 \quad (3)$$

In Formula (1), X represents the primary indicator. In Formula (2), Y represents the difference between the primary indicators of 2017 and 2021. In Formula (3), Z represents the frontier distance of the difference.

3.2.2. Conditional Variable

The conditional variables primarily included the following five factors:

1. Government transparency. International research on government transparency mainly includes two types. On the one hand, transparency is regarded as part of the government's independent events and processes, with research mainly focusing on the transparency of the decision-making process, policy content, and policy outcomes [61]. On the other hand, the focus is mainly on specific government administrative activities, with research conducted from the perspectives of financial or budget transparency, administrative transparency, and political transparency [62,63]. This study draws on this theory, obtaining data from two dimensions: fiscal transparency and the information disclosure index. Fiscal transparency data were sourced from Tsinghua University research reports [64,65], and the information disclosure index was obtained from the China Open Forest Index website [66].
2. Government integrity. Integrity, which is crucial for corruption prevention systems and the core of the new "close" and "clean" business–government relationships [67], was depicted through the cost of food safety certificate brokerage and the Baidu corruption index, with data from the "China City Business–Government Relationship Evaluation Report" [68,69].

3. Government services. This mainly measures various services provided by the government to businesses, with this study selecting financial services and market intermediary services as representatives. Data were sourced from the “China City Business–Government Relationship Evaluation Report” [68,69].
4. Government efficiency. This study divided government efficiency into two dimensions: government size and e-government level. Government size, a significant indicator of government efficiency [70], is represented by the ratio of general public budget expenditure to GDP [71], and the efficiency of e-government reflects the convenience with which businesses can access government services. The data were sourced from the “China Urban Business Environment Database 2023” [72].
5. New infrastructure. New infrastructure construction integrates digitization into traditional infrastructure, providing platform support and diversified and personalized application scenarios for digital innovation and entrepreneurship. This study primarily measured transportation, internet, and research levels. Transportation services are composed of the annual freight and passenger volumes of each city, measuring the actual quantity of goods and passengers transported by various means of transport over a certain period. Data were sourced from the “Statistical Yearbooks” of various cities. The internet level was gauged by the proportion of internet broadband access in households with respect to the registered population, and data were sourced from the “China Urban Statistical Yearbook”. The research level was measured by the proportion of science and technology expenditure with respect to the registered population, and data were also sourced from the “China Urban Statistical Yearbook”.

Similar to the operationalization of the outcome variable, the mean values of the secondary indicators for each conditional variable were assigned to their primary indicators. Subsequently, the increments for each prefecture-level city were represented by the frontier distance of the differences between the 2017 and 2021 data.

3.3. Calibration of Membership Degrees in Fuzzy Sets of Variables

It is worth noting that calibration refers to the process of assigning set membership to cases. Specifically, researchers need to calibrate variables into sets based on existing theoretical knowledge and case contexts. The calibrated set membership ranged from 0 to 1. To calibrate the values of outcome variables and conditional variables to the range of 0–1, anchor points (complete membership, crossover point, and complete non-membership) were selected based on judgment criteria from existing research [73], the consensus in the practical field, and the statistical distribution of actual values (such as discontinuities and percentiles). The 95th and 5th percentiles were chosen as the anchor points for complete membership and complete non-membership, respectively, while the crossover point was uniformly set as the median of the data between “complete membership” and “complete non-membership”. The results are shown in Table 2.

Table 2. Description and calibration of variables.

Outcome Variable and Conditional Variables	Full Membership	Crossover Point	Full Non-Membership
Digital Innovation and Entrepreneurship	0.84	0.46	0.22
Government Transparency	0.77	0.44	0.14
Government Integrity	0.72	0.53	0.28
Government Services	0.75	0.56	0.27
Government Efficiency	0.76	0.49	0.20
New Infrastructure	0.63	0.51	0.36

4. Results

4.1. Necessary Condition Analysis

The Necessary Condition Analysis (NCA) method not only analyzes whether a factor is a necessary condition for the outcome but also further examines the degree of the necessity effect of that factor. The value of the necessity effect (d) ranges from 0 to 1, with larger values indicating stronger effects. Specifically, when d is less than 0.1, it is considered a low-level effect; when $0.1 \leq d < 0.3$, it is a moderate effect; when $0.3 \leq d < 0.5$, it is a large effect; when $d \geq 0.5$, it is a very large effect [74]. Moreover, generating functions for upper regression (CR) and upper envelope analysis (CE) were employed based on the different natures of conditional variables and outcome variables—for continuous and discrete variables, respectively—as shown in Table 3. The results indicated that although the effect values of the elements of business–government relationships were higher than 0.1, their p -values were greater than 0.05, indicating insignificance. Therefore, individual elements are not necessary conditions for high digital innovation and entrepreneurship effects. Additionally, the bottleneck level refers to the minimum level (%) that a single conditional factor needs to achieve to achieve a certain level (%) of the outcome [75]. As shown in Table 4, to achieve a 60% level of digital innovation and entrepreneurship effects, a 6.8% level of government transparency, a 6.5% level of government services, and a 14.4% level of government integrity are required, while the other two elements of business–government relationships do not present bottleneck levels.

Table 3. NCA of single necessary conditions.

Conditional Variables	Method	C-Accuracy	Ceiling Zone	Scope	Effect Size	p -Value
Government Transparency	CR	94.2%	0.107	1	0.107	0.064
	CE	100%	0.077	1	0.077	0.181
Government Integrity	CR	99%	0.129	1	0.129	0.277
	CE	100%	0.159	1	0.159	0.129
Government Services	CR	99.3%	0.099	1	0.099	0.510
	CE	100%	0.113	1	0.113	0.375
Government Efficiency	CR	98.3%	0.069	1	0.069	0.658
	CE	100%	0.074	1	0.074	0.562
New Infrastructure	CR	100%	0.065	1	0.065	0.885
	CE	100%	0.130	1	0.130	0.636

Notes: CR refers to ceiling regression, and CE refers to ceiling envelopment. CR is apt for continuous variables, aligning with the data characteristics in this paper. CE is well suited for variables featuring less than five categories. Both are applied in this research to ensure a comprehensive comparison of result robustness. The p -value was obtained by a permutation test with a re-sample count of 10,000 in the NCA.

Table 4. Analysis of bottleneck levels (%) of necessity for single conditions.

Digital Innovation and Entrepreneurship	Government Transparency	Government Integrity	Government Services	Government Efficiency	New Infrastructure
0	NN	NN	NN	NN	NN
10	NN	NN	NN	NN	NN
20	NN	NN	NN	NN	NN
30	NN	NN	NN	NN	NN
40	NN	0.2	NN	NN	NN
50	NN	7.3	NN	NN	NN
60	6.8	14.4	6.5	NN	NN
70	16.5	21.5	15.4	4.5	6.0
80	26.3	28.6	24.2	16.7	16.0
90	36.0	35.7	33.0	28.9	26.0
100	45.7	42.8	41.8	41.8	36.0

Note: CR method was used; NN represents not necessary.

This study further used the QCA method to test the necessary conditions. Scholars typically assess each condition (or condition configuration) based on consistency and coverage. If the consistency threshold is 0.9 or higher, the condition or condition configuration can be used to explain the outcome phenomenon. A higher coverage value indicates a stronger explanatory power of the condition or condition configuration for the outcome. According to the results of the analysis of the necessary conditions for high digital innovation and entrepreneurship effects shown in Table 5, the consistencies of high government transparency, high levels of government services, high government efficiency, high government integrity, and high levels of new infrastructure were all below the critical value of 0.9, indicating that these five factors cannot independently serve as necessary conditions for optimizing high digital innovation and entrepreneurship effects. Additionally, the consistencies of low government transparency, low levels of government services, low government efficiency, low government integrity, and low levels of new infrastructure were also below the critical value of 0.9, indicating that these five factors cannot independently serve as necessary conditions for optimizing low digital innovation and entrepreneurship effects. This indicated complex nonlinear trade-off effects among government transparency, government services, government efficiency, government integrity, new infrastructure, and the optimization of digital innovation and entrepreneurship. In other words, the optimization effects of digital innovation and entrepreneurship do not rely on a single factor but require comprehensive consideration of the synergistic effects of various factors.

Table 5. Analysis of necessary conditions.

	High Outcomes		Low Outcomes	
	Consistency	Coverage	Consistency	Coverage
Government Transparency	0.63	0.65	0.67	0.68
~Government Transparency	0.69	0.68	0.66	0.64
Government Integrity	0.67	0.66	0.69	0.67
~Government Integrity	0.66	0.68	0.65	0.66
Government Services	0.67	0.66	0.68	0.67
~Government Services	0.66	0.67	0.66	0.67
Government Efficiency	0.66	0.66	0.65	0.65
~Government Efficiency	0.65	0.65	0.66	0.66
New Infrastructure	0.72	0.68	0.74	0.69
~New Infrastructure	0.67	0.72	0.65	0.70

Note: The symbol “~” indicates the absence of the condition.

4.2. Configuration Analysis

Sufficiency analysis of conditional configurations refers to the exploration of whether the set represented by multiple conditions is a subset of the outcome set from a set-theoretical perspective. In this study, the original consistency threshold was set to 0.8. To prevent a configuration from being a subset in both the outcome and its negation, the PRI consistency threshold should not be below 0.5 [76]. Integrating this with the actual results, the PRI consistency threshold was set to 0.58. Considering the large sample size in this study, the case frequency threshold was set to 2 [77]. The truth table lists all potential causal combinations and the relationship strength of cases with a given condition configuration. The truth table generates three types of solutions (complex, parsimonious, and intermediate), with the intermediate solution providing the most useful method based on counterfactual reasoning, determining the condition configurations and number of configurations that lead to the outcome [54]. This study conducted a fuzzy-set truth table analysis, mainly employing the intermediate solution for analysis. Table 6 shows the five conditional configurations identified, with a solution coverage of 0.63, meaning that five types of condition configurations could explain 63% of cases with optimized high digital innovation and entrepreneurship outcomes. The solution consistency was 0.79, indicating that in all cases that meet these five types of condition configurations, 79% exhibited

high optimization outcomes. The coverage and consistency of the solution are above the critical values.

Table 6. Intermediate solution for the effects of digital innovation and entrepreneurship.

Conditional Variables	1	2	3	4	5
Government Transparency	⊗	⊗	⊗	●	●
Government Integrity	⊗		⊗	⊗	●
Government Services	●	●		⊗	●
Government Efficiency		●	⊗	●	⊗
New Infrastructure			●	⊗	⊗
Raw Coverage	0.40	0.42	0.35	0.28	0.30
Unique Coverage	0.01	0.06	0.04	0.04	0.04
Consistency	0.85	0.83	0.86	0.91	0.83
Solution Coverage	0.63				
Solution Consistency	0.79				

Note: The presence of a core condition is indicated by ●. The absence of a core condition is indicated by ⊗.

According to the configuration naming guidelines [78], this study named these five configurations as follows: the government service-driven type, the government service and efficiency dual-wheel-drive type, the new infrastructure-driven type, the government transparency and efficiency dual-wheel-drive type, and the “clean” business–government relationship and government service dual-wheel-drive type. Table 7 provides a comparative analysis of configurations associated with high digital innovation and entrepreneurship outcomes, encompassing the configuration views, explanations, and case diagrams [79]. Below, each condition configuration affecting digital innovation and entrepreneurship outcomes is analyzed in detail.

Configuration 1 is of the government service-driven type. Configuration 1 identifies high government service, non-high government transparency, and non-high government integrity as core conditions that can produce high digital innovation and entrepreneurship effects. Typical cities in this successful configuration include Chifeng, Qitaihe, Tongchuan, Sanya, and others (as shown in Table 7). These cities are mostly economically less developed, with underdeveloped market mechanisms and a relatively strong officialdom mentality. Enterprises often achieve digital innovation and entrepreneurship resources more efficiently through a certain degree of bribery. Additionally, with the continuous optimization of the business environment in various cities in China, the quality of government services has significantly improved, ensuring the sustainability of digital innovation and entrepreneurship. In 2021, Chifeng optimized service processes for 6338 items across 1366 service windows, launching 10,092 “Internet + Government Services” items, providing comprehensive and full-process services for innovators and entrepreneurs. However, in Chifeng’s public resource-trading sector, a corruption case involving expert reviews had 700 implicated personnel and an involved amount of 4.4 billion RMB. This configuration supports the view that the optimization of government services promotes digital innovation and entrepreneurship [23]. It further confirmed that government integrity is not necessarily positively correlated with digital innovation and entrepreneurship. In certain scenarios, moderate corruption may actually help reduce bureaucratic red tape when dealing with government departments, thereby enhancing innovation efficiency [37].

Table 7. Comparative analysis of configurations of high outcomes.

Configuration Name	Configuration View	Configuration Explanation	Case Diagram
Government service-driven type		~Government transparency & ~Government integrity & Government services → high digital innovation and entrepreneurship outcomes	
Government service and efficiency dual-wheel-drive type		~Government transparency and ~Government efficiency and Government services → high digital innovation and entrepreneurship outcomes	
New infrastructure-driven type		~Government transparency and ~Government integrity and ~Government efficiency and New infrastructure → high digital innovation and entrepreneurship outcomes	
Government transparency and efficiency dual-wheel-drive type		Government transparency and ~Government integrity and ~Government services and Government efficiency and ~New infrastructure → high digital innovation and entrepreneurship outcomes	
“Clean” business–government relationship and government service dual-wheel-drive type		Government transparency and Government integrity and Government services and ~Government efficiency and ~New infrastructure → high digital innovation and entrepreneurship outcomes	

Note: The symbol “~” indicates the absence of the condition.

Configuration 2 is of the government service and efficiency dual-wheel-drive type. Configuration 2 identifies high government service, high government efficiency, and non-high government transparency as core conditions that can produce high digital innovation and entrepreneurship effects. Typical cities in this successful configuration include Baoji, Baiyin, Suqian, Liaoyang, and others (as shown in Table 7). Innovation and entrepreneurship resources are characterized by timeliness and exclusivity, and the autonomous exploration capabilities of enterprises are the fundamental reliance for sustainable innovation, entrepreneurship, and economic development. Therefore, enterprises with an autonomous exploration spirit can identify market opportunities ahead and gain a leading edge in

innovation and entrepreneurship. Although the government openness is relatively insufficient in these cities, enterprises with strong autonomy can gain an early advantage in digital innovation and entrepreneurship based on continuously optimized government services and efficiency. Suqian's Administrative Examination and Approval Bureau and other related government departments lack synchronization in policy interpretation, and the comprehensiveness and timeliness of government openness need improvement. To enhance government service awareness, Suqian has formulated a government service commitment list, actively addressing fragmented and decentralized service issues, and integrating relevant approval matters to improve administrative efficiency. This configuration confirms the role of optimizing government services and enhancing government efficiency in promoting digital innovation and entrepreneurship [25–27]. However, it also demonstrates that in the context of insufficient government transparency, enterprises can instead stimulate their own exploratory capabilities and proactively seize opportunities for innovation and entrepreneurship. This finding differs from traditional academic perspectives [30].

Configuration 3 is of the new infrastructure-driven type. Configuration 3 identifies high new infrastructure, non-high government transparency, non-high government integrity, and non-high government efficiency as core conditions that can produce high digital innovation and entrepreneurship effects. Typical cities in this successful configuration include Hanzhong, Yulin, Benxi, Puyang, and others (as shown in Table 7). Although the cleanliness between politics and business in these cities is relatively insufficient, it provides convenience for enterprises in bypassing bureaucratic procedures, obtaining government resources, and reducing policy uncertainty. Strengthening new infrastructure construction can significantly compensate for the lack of government efficiency from a technical perspective. Hanzhong, located in western China, seizes the opportunity of new infrastructure construction, continuously promoting 5G digital construction, successfully creating a gigabit city in China, and providing technical support for the sustainability of digital innovation and entrepreneurship. This configuration illustrates that the construction of new infrastructure provides the possibility for the establishment of internet platforms, ensuring the sustainability and efficiency of digital innovation and entrepreneurship at the technical level [29].

Configuration 4 is of the government transparency and efficiency dual-wheel-drive type. Configuration 4 identifies high government transparency, high government efficiency, non-high government integrity, non-high government services, and non-high new infrastructure as core conditions that can produce high digital innovation and entrepreneurship effects. Typical cities in this successful configuration include Chaoyang, Shaoyang, Panjin, and Fuyang (as shown in Table 7). Digital empowerment of government services and infrastructure construction relies heavily on government financial support. Due to relatively lagging economic development in these cities, they find it challenging to optimize and enhance new infrastructure and digital government services in a short time. Therefore, they consistently adhere to government openness, continuously reduce government size, deepen the construction of a law-based government, and improve market entity satisfaction to promote digital innovation and entrepreneurship. Fuyang fully advances the standardization and normalization of grassroots government openness, enhancing government transparency, strictly implements the requirement of no increase in personnel supported by fiscal funds, strengthens innovation in institutional management, strictly controls government size, and strives to reduce administrative costs. This configuration further proves the positive role of government transparency and efficiency in digital innovation and entrepreneurship, and that a certain degree of corruption acts as a “lubricant” for enterprise innovation [27,30]. However, it also highlights that extensive development of new infrastructure is not suitable for all cities. For economically underdeveloped regions, this undoubtedly represents a significant financial expenditure, with the input–output ratio being difficult to balance.

Configuration 5 is of the “clean” business–government relationship and government service dual-wheel-drive type. Configuration 5 identifies high government transparency, high government integrity, high government service, non-high government efficiency, and non-high new infrastructure as core conditions. Typical cities in this successful configuration include Shaoguan and Zaozhuang (as shown in Table 7). The construction cost of new infrastructure is relatively high, and these cities promote digital innovation and entrepreneurship through more cost-effective measures, such as optimizing government services and improving the cleanliness of business–government relations. Shaoguan has established the Government Services Data Management Bureau, promoting the integration of government service items online, and in some areas, promoting the deep integration of government services and e-commerce. It has set up a party member pioneer post in government service centers to continuously enhance government credibility and transparency, bridging the gap between the government and enterprises. This configuration further supports the view that government transparency, government integrity, and government services have a positive impact on digital innovation and entrepreneurship [23,30,33]. It also demonstrates that although new infrastructure can provide hardware support for digital innovation and entrepreneurship, it must be adapted to local conditions.

4.3. Further Analysis

This paper further analyzed the research results by combining multiple theoretical perspectives, configurational theory, and a complex systems perspective.

First, the integration of multiple theoretical perspectives helped to comprehensively explain the impact of business–government relationships on digital innovation, entrepreneurship, and sustainability. The paper adopted theories such as new structural economics, collaborative governance theory, and technology policy economics to provide a theoretical foundation for understanding the different elements and interaction mechanisms within business–government relationships. For instance, Configuration 1 enhanced the quality of government services, optimizing the path for enterprises to obtain innovation resources. This aligns with collaborative governance theory, which emphasizes the role of multi-stakeholder cooperation and the improvement of government services in promoting innovation. Such a cooperative model can ensure the long-term sustainability of innovation and entrepreneurial activities.

Second, the application of configurational theory and TDQCA in this study revealed the impact of different combinations of factors on digital innovation, entrepreneurship, and sustainability. Through the QCA method, five successful configurations were identified, demonstrating how different combinations of factors influence digital innovation and entrepreneurship in various cities. For example, Configuration 2 showed how high government service and high government efficiency, despite lacking high government transparency, can promote digital innovation and entrepreneurship through the autonomous exploration capabilities of enterprises. This configurational analysis validates the multi-factor combinatory effect, and its nonlinear relationships emphasized in configurational theory, illustrating multiple pathways to achieving sustainable innovation and entrepreneurship in different environments.

Furthermore, the paper combined a complex systems perspective to analyze the configurational effects of business–government relationships from a dynamic systems perspective. The complex systems view considers the relationships among elements to be nonlinear, dynamic, and random [80]. By analyzing the five configurations, the paper demonstrated how different elements combine in various contexts to influence digital innovation, entrepreneurship, and their sustainability. For instance, Configuration 3 showed how new infrastructure construction can compensate for the lack of government efficiency, ensuring the sustainability of digital innovation and entrepreneurship from a technical perspective. This analysis further validated the effectiveness of the complex systems perspective in understanding business–government relationships, emphasizing the crucial role of technological support in achieving long-term sustainable development.

Lastly, the main idea of configurational research lies in the multidimensional synergistic effect [50]. The dimensions of “close” and “clean” in business–government relationships need to be matched in coordination rather than viewed in isolation. Through the analysis of five configurations, the paper specifically demonstrated the performance and synergistic effects of these elements in different cities. For example, Configuration 5 illustrated how high government transparency, high government integrity, and high government service collectively promote digital innovation and entrepreneurship, validating the multidimensional synergistic effect hypothesis in the theoretical framework and ensuring the long-term sustainability of innovation and entrepreneurial activities.

4.4. Robustness Tests

We conducted a robustness test on the configurations of high digital innovation and entrepreneurial effects. By increasing the case number threshold from 2 to 3 and the PRI consistency from 0.58 to 0.60 [81], the results of the robustness tests are presented in Table 8. Firstly, we increased the case number threshold from 2 to 3, and the results were consistent with the original configurations. Secondly, the PRI consistency was adjusted from 0.58 to 0.60, with the results showing a decrease in solution coverage from 0.63 to 0.51 and an increase in solution consistency from 0.79 to 0.84. However, the new configuration remained consistent with the original configuration, further underscoring the robust nature of the results.

Table 8. Robustness tests.

Conditional Variables	High Outcomes (the Frequency Threshold is 3)					High Outcomes (the PRI Consistency is 0.6)		
	1 *	2 *	3 *	4 *	5 *	1 **	3 **	4 **
Government Transparency	⊗	⊗	⊗	●	●	⊗	⊗	●
Government Integrity	⊗		⊗	⊗	●	⊗	⊗	⊗
Government Services	●	●		⊗	●	●		⊗
Government Efficiency		●	⊗	●	⊗		⊗	●
New Infrastructure			●	⊗	⊗		●	⊗
Raw Coverage	0.4	0.42	0.35	0.28	0.3	0.4	0.35	0.28
Unique Coverage	0.01	0.06	0.04	0.04	0.04	0.01	0.04	0.04
Consistency	0.85	0.83	0.86	0.91	0.83	0.85	0.86	0.91
Solution Coverage	0.63					0.51		
Solution Consistency	0.79					0.84		

Note: The presence of a core condition is indicated by ●. The absence of a core condition is indicated by ⊗. * represents the configurations obtained using the first robustness test method. ** represents the configurations obtained using the second robustness test method.

These robustness tests demonstrated that the configurations identified in our study were stable and reliable across different analytical thresholds. By confirming that the configurations held under varying conditions, we strengthened the credibility of our methodological approach and the validity of our research findings. These tests provide additional confidence that the identified configurations of high digital innovation and entrepreneurial effects are not artifacts of specific threshold settings, but rather reflect genuine and robust patterns in the data.

5. Discussion and Implications

5.1. Discussion

The analysis of five different configurations revealed the complex impact of business–government relationships on digital innovation and entrepreneurship. However, to provide a more comprehensive and balanced discussion, it is necessary to integrate alternative perspectives and potential criticisms to strengthen the overall argument and demonstrate a thorough understanding of the topic.

Configuration 1 demonstrated the pathway of optimizing enterprises’ access to innovation resources by improving the quality of government services. However, in environments

with low government integrity, this model may lead to unfair resource distribution, hindering the long-term sustainability of innovation and entrepreneurship. Additionally, this configuration may face practical challenges in economically underdeveloped regions, such as a lack of funding and technology.

Configuration 2 showed how high government service and high government efficiency can promote digital innovation and entrepreneurship, even in the absence of high government transparency. However, over-reliance on the autonomous exploration capabilities of enterprises may overlook the importance of government transparency in promoting fair competition and preventing systemic risks. The applicability and replicability of this model in different environments also need further verification.

Configuration 3 illustrated the role of new infrastructure construction in compensating for the lack of government efficiency. However, this high-cost infrastructure investment model may be unsustainable in economically underdeveloped regions. Furthermore, excessive reliance on infrastructure investment may neglect the importance of improving institutional and policy environments for fostering innovation and entrepreneurship.

Configuration 4 emphasized the positive role of high government transparency and efficiency in promoting innovation and entrepreneurship. However, promoting this model in economically underdeveloped regions may face financial constraints and implementation barriers. Particularly, the lack of new infrastructure may limit its long-term sustainability.

Configuration 5 demonstrated how high government transparency, integrity, and service can collectively promote digital innovation and entrepreneurship. Although this configuration showed good synergistic effects, its sustainability still needs further consideration in contexts where government efficiency and new infrastructure construction are insufficient.

Additionally, these five configurations focused on summarizing successful experiences from the perspective of the positive performance of conditional variables and did not delve into the conditions marked as “non”. The reason is that all five conditional variables have been shown to promote digital innovation and entrepreneurship outcomes in broader, more enduring practices and discussions. The low membership performance of these elements in specific spatiotemporal contexts was not sufficient to distill the “non” conditions as successful experiences. However, the “non” performances also hold unique theoretical and practical value [55]. Analyzing the “non” conditional variables in “strong effect” configurations can help discern the focus and sequence of digital innovation and entrepreneurship outcomes in specific contexts, thereby providing experiential references for the continuous enhancement of digital innovation and entrepreneurship outcomes.

Firstly, the role of “clean” business–government relationships. Is “clean” business–government relationships a lubricant or a stumbling block for innovation? This has been a contentious issue in theoretical circles. By using government transparency and government integrity as conditional variables, this study portrayed “clean” business–government relationships and found that, aside from Configuration 4, where strong government transparency contributed to digital innovation and entrepreneurship, and Configuration 5, where both strong government transparency and government integrity contributed, in other configurations and in the necessity analyses, an association between weak “clean” relationships and high digital innovation and entrepreneurship outcomes was generally shown. Practically, the level of cleanliness in business–government relationships is not directly related to the level of economic development; instead, cities with moderately high economic levels provide government rent-seeking opportunities due to marketization [82–84]. However, without timely and effective constraint mechanisms, this reduces the cleanliness of business–government relationships. Thus, to some extent, “clean” business–government relationships are not a prerequisite for high digital innovation and entrepreneurship, requiring a scientific assessment based on the specific circumstances of different cities in China and other relevant conditions.

Secondly, the role of government efficiency. Aside from Configurations 2 and 4, government efficiency did not demonstrate significant effects on the optimization of digital

innovation and entrepreneurship. The size of the government is an important factor in measuring governmental effectiveness. The question of whether a large government or a small government is more conducive to economic growth remains a highly debated topic in theory [70]. A larger government can encourage and promote the development of digital innovation and entrepreneurship by providing funding, facilities, and policy support. However, excessive expansion of government size can lead to over-intervention in the market, stifling the vitality of innovation and entrepreneurship. The relationship between government size and digital innovation and entrepreneurship is complex and multidimensional, necessitating a comprehensive consideration of various factors, such as resource allocation, policy formulation, and implementation by different local governments.

Thirdly, the role of new infrastructure. Except in Configuration 3, new infrastructure did not show significant effects on the optimization of digital innovation and entrepreneurship. Previous studies have often focused on the role of new infrastructure in promoting economic growth [85,86]. However, for cities with rapid economic development, the period of dividends from new infrastructure development has passed, and the marginal benefits are gradually decreasing. For cities in less advantageous geographical locations, the cost of building new infrastructure is substantial, and the investment does not proportionally match the output. Thus, the advantages brought by new infrastructure construction for digital innovation and entrepreneurship can only be realized in specific cities, requiring consideration of the cities' own resource endowments, geographical position, and future development directions.

5.2. Implications

Based on the five configurations derived from this study for optimizing business–government relationships and their related research conclusions, the impact on five key stakeholders—government, enterprises, research institutions and academia, policymakers, and the public—was further analyzed, as follows.

First, the government plays a crucial role in promoting digital innovation and entrepreneurship and optimizing business–government relationships. By advancing the new “close” and “clean” business–government relationships, the government can better adjust and implement policies, building a sustainable digital economy ecosystem [87,88]. For example, Configurations 1 and 2 emphasized enhancing government services and efficiency to promote digital innovation and entrepreneurship. The government needs to strengthen policy execution centralization and service quality to ensure the sustainability of innovation and entrepreneurship. Specific policies could include simplifying administrative approval processes, establishing “one-stop” government service centers, improving governmental efficiency, and reducing administrative burdens on enterprises. Additionally, the government can support the development of innovative enterprises through financial incentives and subsidies. Configuration 3 supplemented government efficiency through new infrastructure construction, further promoting the development of the digital economy. To this end, the government could increase investment and policy support for 5G networks, data centers, and other infrastructure, ensuring the sustainability of technological support.

Second, enterprises, particularly those engaged in digital innovation and entrepreneurship, will directly benefit from optimized business–government relationships. A fair, transparent, and efficient business environment will reduce administrative burdens and market entry barriers, promoting the long-term sustainable development of enterprises [89]. In Configuration 4, high government transparency and efficiency became key conditions, allowing enterprises to quickly access information and resources in a transparent and fair market environment, enhancing their innovation capabilities. In Configuration 5, emphasizing the “clean” business–government relationship and government service dual-wheel drive helped enterprises gain more policy support in a clean and transparent environment, enhancing market competitiveness.

Third, research institutions and academia will also benefit from this process. Optimized business–government relationships and the development of the digital economy

provide rich topics for academic research. Research institutions and scholars can delve into the relationships between business–government interactions, the digital economy, and innovation and entrepreneurship, providing theoretical and empirical support for policy-making. For example, Configurations 2 and 4 provided empirical cases on how enhancing government services and efficiency can promote innovation and entrepreneurship, driving continuous research and development in related fields. Furthermore, this research will promote cooperation and exchange between Chinese and international academia in related fields, jointly advancing the sustainable development of the global digital economy.

Fourth, for policymakers, this study provided practical experience and theoretical support for optimizing business–government relationships to promote digital innovation and entrepreneurship, offering significant policy reference value. Policymakers can learn from China’s successful experiences to innovate and adjust policies in their own countries/regions, enhancing policy implementation effectiveness and promoting long-term sustainable economic growth. For instance, Configuration 3 promoted innovation through new infrastructure, suggesting that policymakers can adopt locally suitable new infrastructure construction policies.

Fifth, the public, especially consumers and ordinary citizens related to the digital economy, will also benefit. In a more stable and sustainable digital economy environment, the public can enjoy the convenience and opportunities brought by innovation, improving their quality of life and enhancing their confidence in future economic development. By optimizing business–government relationships and enhancing government transparency, as described in Configuration 4, the public can enjoy a fairer and more just market environment, increasing their trust in the government and the market, thereby promoting overall sustainable societal development.

In summary, the results and recommendations of this study have significant impacts on various stakeholders, encouraging collective efforts to promote the healthy development of the digital economy and the sustainability of innovation and entrepreneurship. By integrating the five configurations for optimizing business–government relationships, this study further validated the combined roles of government integrity, transparency, service, efficiency, and new infrastructure. It provided practical solutions tailored to different regions and environments in China.

6. Conclusions, Limitations, and Contributions

This study employed TDQCA with a large N sample to conduct conditional configuration analysis on digital innovation and entrepreneurship. The combination of NCA and TDQCA provided a robust methodological framework that not only identified critical factors and their thresholds but also captured the dynamic, configurational nature of business–government relationships and their evolving impact on innovation outcomes, overcoming limitations of traditional linear methods in addressing complex, time-sensitive policy phenomena. The results showed that digital innovation and entrepreneurship outcomes were inseparably linked with various combinations of conditions, involving government transparency, government services, government efficiency, government integrity, and new infrastructure. No single factor can independently enhance the level of digital innovation and entrepreneurship. This study summarized five configuration paths of high digital innovation and entrepreneurship outcomes: the government service-driven type, the government service and efficiency dual-wheel-drive type, the new infrastructure-driven type, the government transparency and efficiency dual-wheel-drive type, and the “clean” business–government relationship and government service dual-wheel-drive type.

However, these five configurations were based on the results from Chinese samples, and while there is some potential for promotion in other countries/regions, there are also limitations. On one hand, the digital economy is rapidly developing worldwide. Configurations 1 and 3 strengthened the construction of new infrastructure and utilized information technology to optimize government services and enhance government efficiency, measures that empower and optimize business–government relationships through digital means.

These measures also enhance the sustainability of digital innovation and entrepreneurship, offering some value for promotion in other countries/regions and aligning with the overall global economic development trend. On the other hand, due to cultural and institutional differences, the Chinese government has strong centralization and execution capabilities in policy implementation. In contrast, other countries/regions (such as the United States and the European Union) may face more constraints from interest groups and legal procedures in policy formulation and implementation. Therefore, Configuration 5 not only relies on digital empowerment but also emphasizes top-down government guidance and support to optimize business–government relationships and enhance digital innovation and entrepreneurship, which may have greater limitations in promotion in other countries/regions. In summary, these five configurations are more suited to the Chinese context. To promote them in other countries/regions, it is necessary to adjust and optimize the relevant measures according to their actual situations to overcome the limitations posed by institutional and cultural differences.

Before discussing the contributions of this study, it is necessary to acknowledge some of its limitations. First, concerning the research methodology, although NCA and TDQCA methods can identify necessary and sufficient conditions, the parsimony of their data structure and analytical logic may imply challenges in definitively establishing causal relationships or may neglect the contextual nuances and intricacies within which causal mechanisms function. Future studies could adopt a mixed-methods approach, integrating quantitative techniques, such as instrumental variable analysis and natural experiments with qualitative methods, such as case studies or in-depth interviews, to bolster the validity and reliability of research outcomes. Second, about data sources, this study was based on available data, selecting only the years 2017 and 2021. Future studies could choose a broader time span to explore more significant optimization effects and pathways. Third, regarding the research subjects, this study selected 292 prefecture-level cities in China as its subjects, making the results relevant primarily to China, and they may have greater limitations in promotion in other countries/regions. Future research could select data from other countries/regions for targeted research. Last, concerning the selection of conditional variables, it was based on a systematic review of the literature, policy analysis, and principal theories; however, it might still overlook other relevant factors. Future studies should consider a wider range of factors related to business–government relationships.

The main contributions of this study are evident in three aspects. First, it enriched existing research findings by constructing an integrative analytical framework for business–government relationships to aid in digital innovation and entrepreneurship. Tailored to China’s unique context, it established five secondary factors influencing digital innovation and entrepreneurship from the perspective of business–government relationships, thus facilitating a better exploration and understanding of these influential factors. Second, this study introduced the Fuzzy Set Qualitative Comparative Analysis (fsQCA) method into the study of factors affecting digital innovation and entrepreneurship through business–government relationships to deepen the understanding of the emergence of complex causal relationships. Digital innovation and entrepreneurship activities involve complex concurrent combinations of variables. The fsQCA method surpassed regression analysis methods that struggle with issues such as inter-variable independence and problems related to autocorrelation and multicollinearity. Through ongoing dialogue between empirical data and theory, this study refined five conditional variables: government transparency, government services, government efficiency, government integrity, and new infrastructure. It constructed causal relationships affecting digital innovation and entrepreneurship and explained the core factors and their combinations from a set-theoretical perspective. Third, it employed the Time-Differenced Qualitative Comparative Analysis (TDQCA) method and used the differences between the years 2017 and 2021 to reflect the actual conditions. This approach somewhat compensated for the shortcomings of the QCA method in handling time and expanded the sample size to include 292 prefecture-level cities across China, allowing for more scientific exploration of the mechanisms behind the outcomes.

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