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Has the Belt and Road Initiative Enhanced Economic Resilience in Cities Along Its Route?

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Abstract

Amid an increasingly complex and uncertain global landscape, geopolitical tensions and frequent trade frictions have emerged as critical external risks threatening the economic stability and sustainable development of Chinese cities. Enhancing cities' economic resilience has become a key challenge in advancing China's high-quality development agenda. As a major national strategic initiative, the Belt and Road Initiative (BRI) is expected to offer new development opportunities and pathways for risk mitigation, particularly for cities situated along its domestic routes. This paper examines whether and how the BRI affects the economic resilience of these cities and further explores the moderating role of local governance capacity in policy implementation. To this end, an empirical strategy combining the entropy weighting method and the difference-in-differences (DID) approach is employed to systematically assess the impact of the BRI on urban economic resilience at the city level. The key findings are as follows: (1) The findings show that the BRI has an enhancing effect on the economic resilience of cities along the routes, but governance is very weak, and urban resilience improves by 0.0045 units on average. Our findings imply that, while the BRI appears to be on the correct path, enhanced governance is necessary to implement city-specific planning approaches effectively. (2) The results of the moderating effect indicate that local governance capacity significantly amplifies the impact of the BRI on urban economic resilience, underscoring the critical role of institutional strength in the policy transmission process. (3) The heterogeneity analysis reveals significant regional disparities in policy effectiveness: while the BRI significantly improves economic resilience in eastern and central cities, it exerts a suppressive effect in western regions. This divergence is closely associated with variations in local governance capacity. In contrast, cities with stronger governance capabilities are more likely to experience positive outcomes, as confirmed by the significant moderating effect of local governance capacity. This study contributes to the growing literature on the spatial implications of national development strategies by empirically examining how the BRI reshapes urban economic resilience across regions. It offers important policy insights for enhancing the spatial governance of cities, particularly in aligning strategic infrastructure investment with differentiated local capacities. The findings also provide a valuable reference for land-use planning and regional development policies aimed at building resilient urban systems under conditions of global uncertainty.

Keywords: Belt and Road Initiative; urban economic resilience; difference-in-differences model; entropy weighting method; urban planning

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1. Introduction

Against the backdrop of intensifying geopolitical conflicts and the deepening China–U.S. trade tensions, the global landscape is gradually shifting from a liberal, open-market system toward a resilient policy paradigm that prioritizes national economic interests and security [1–3]. This increasingly complex and uncertain external environment is profoundly reshaping the operational mechanisms and developmental trajectories of cities; the core of future urban development will no longer focus solely on economic expansion, but will place greater emphasis on sustainability in current situations. This shift has prompted academics and policymakers to devote considerable attention to the concept of urban economic resilience [4–6]. Economic resilience captures how effectively an economy can withstand external disruptions and promptly restore its original trajectory [7]. A growing body of research has focused on how such systems respond to disruptions and adapt in the face of unexpected disturbances [8,9]. While theoretical research on resilience mechanisms has continued to deepen, practical paths have yet to be systematically assessed at the national level. As a strategic plan to cope with global uncertainty and regional development imbalances, Chinese government leader Xi Jinping proposed the Belt and Road Initiative (BRI) in 2013, which aims to enhance the stability and resilience of urban systems in the face of shocks through regional coordination and connectivity, and to build a new pattern of cross-regional synergistic development [10,11]. The initiative is designed to promote infrastructure-based connectivity at the international level, while also serving as a catalyst for coordinated economic development within the regional context. In 2024, China's total value of goods trade reached CNY 43.85 trillion, marking a year-on-year increase of 5%. Notably, trade with BRI partner countries accounted for 22.07 trillion yuan, up by 6.4% from the previous year and surpassing 50% of China's total trade volume for the first time [12]. This milestone highlights the growing strategic importance of the BRI in China's overall economic development agenda. However, despite the BRI's remarkable momentum in driving economic growth and trade expansion, it remains unclear whether the initiative has translated into improved economic resilience at the city level along its corridors. Existing studies have primarily examined the impact of the BRI on technological innovation, infrastructure investment, and environmental pollution [13–15]. However, its potential influence on the structural resilience of urban economies remains insufficiently explored. Filling this research gap holds substantial theoretical and practical significance, particularly in light of the escalating frequency and intensity of global external shocks. This study seeks to address a central question: has the BRI effectively enhanced the economic resilience of participating cities? To be more specific, this study not only assesses the impact of this national-level strategy on the economic resilience of cities, but also examines the role of local governance capacity in influencing the effects of policy transmission through moderating effects. In addition, heterogeneity analysis will be conducted to explore regional- and city-level variations in policy outcomes, thereby enriching the understanding of the underlying mechanisms.

The academic contributions of this study are as follows: First, this study investigates the impact of the BRI on urban economic resilience from a novel policy perspective. By employing panel data at the city level, it provides empirical evidence that helps fill the existing gap in the literature regarding the relationship between the BRI and urban resilience. Second, the study introduces local governance capacity as a moderating variable to examine how the effectiveness of the BRI in enhancing urban resilience varies with governance conditions. This approach contributes to a deeper understanding of the underlying mechanisms through which the BRI influences urban resilience outcomes. Third, by analyzing the heterogeneous effects of the BRI across different city types and regional contexts, the study offers nuanced theoretical insights. These findings not only support regionally tailored policy recommendations within China but also provide valuable references for other countries along the BRI in formulating differentiated strategies to strengthen urban resilience in line with local conditions.

Following this introduction, Section 2 offers a review of relevant studies and establishes both the theoretical foundation and the hypotheses of this research. Section 3 introduces the empirical strategy and data sources. Section 4 presents the main findings and discusses their implications. Section 5 concludes with a summary of key insights and policy recommendations.

2. Literature Review and Research Hypotheses

2.1. The Impact of the BRI on Urban Economic Resilience

The term resilience is derived from the Latin word resilience, meaning “to rebound” or “to spring back,” and was originally used to describe a system’s ability to return to its original state after experiencing a disturbance [16]. Although initially rooted in ecological science, the concept of resilience has attracted growing attention in economics since Holing (1973) introduced it to describe the dynamic behavior of ecosystems [17]. Subsequently, scholars such as Martin (2011) have further elaborated its applicability to regional and economic systems [18]. In the academic literature, resilience is increasingly conceptualized as a system’s capacity to withstand external shocks, adapt to evolving conditions, and engage in structural transformation when required [19]. Given its emphasis on systemic adaptability and transformation, the concept has been increasingly adopted in urban studies to assess how cities respond to economic, environmental, and institutional disruptions. Urban resilience (UR) denotes a city’s capacity to withstand external shocks, rebound quickly, and adjust to ongoing pressures on its economic, technological, and infrastructural systems [20,21]. Academic research on urban resilience has mainly focused on assessing the ability of urban systems to cope with risks [22,23]. Compared with other related studies, urban resilience research emphasizes more adaptability and foresight and breadth [24]. As a result, resilience is widely regarded as an important goal and normative vision that modern urban development should pursue under the ever-increasing uncertainty of the global economy. At present, the evaluation framework for urban resilience has become increasingly mature, with quantitative methods based on indicator systems being widely adopted. Existing research approaches can be broadly categorized into two types. The first focuses on assessing resilience within a single dimension [25], such as ecological resilience and social resilience [26,27]. The second adopts a multidimensional perspective, selecting indicators from economic, social, and infrastructural aspects to conduct comprehensive assessments of urban resilience [28].

Nevertheless, despite these developments, investigations of urban resilience within the BRI framework remain scarce. Research that assesses the BRI’s effects on urban development from an urban-resilience standpoint is conspicuously limited. Although a few studies have directly investigated the BRI’s influence on urban resilience, a substantial body of work examined its beneficial effects on city-level economic growth, infrastructure enhancement, and technological advancement. These domains are widely recognized as critical foundations for enhancing urban resilience. First, in terms of economic development, studies have shown that the BRI has enhanced the vitality of cities along its routes by expanding investment, broadening trade networks [10,29]. The inflow of capital and improved market connectivity brought about by BRI-related projects have strengthened cities’ resource bases and economic flexibility, enabling them to better absorb external shocks. Second, through the BRI, China can secure strategic infrastructure, ports, and transport routes, thereby enhancing its ability to participate directly in global affairs and thus contribute to the geopolitical balance of power in key regions [30]. More importantly, upgraded infrastructure contributes to the stability of urban systems, providing critical support for maintaining functionality in the face of natural disasters or economic volatility—both core components of urban resilience. Third, in the area of technological innovation, the BRICS Initiative has fostered industry progress and technological innovation through policy support. Existing research shows that the Initiative has helped firms to strongly assist in upgrading their innovation capacity [31,32].

In summary, although the BRI was not originally intended to enhance urban resilience, it has contributed to the development of resilient cities by strengthening economic foundations, improving infrastructure, and promoting industrial upgrading. Based on this, the following research hypothesis is proposed:

Hypothesis 1. *Participation in the BRI enhances the economic resilience of corridor cities.*

2.2. Local Governance Capacity

China adopts a governance structure characterized by centralized political authority and relatively decentralized control over economic affairs [33]. To promote socioeconomic development, governments at various levels typically formulate development goals through planning documents and policy programs, and delegate implementation responsibilities to subordinate governments [34]. Although China has a top-down hierarchical appointment system, local officials are usually appointed by higher levels of government and have strong executive motivation and willingness to respond to policies [35,36]. This incentive structure has largely facilitated the effective transmission of national strategic goals to the local level. However, this incentive is not always sufficient and sustainable. When central incentives are weakened or local policy recognition is insufficient, the effectiveness of governance may depend more on the local government's own governance capacity, including its ability to integrate policies, coordinate resources, and implement systems. Therefore, in the implementation of the BRI, local governance capacity is not only the basic guarantee for the implementation of policies but may also play a more critical moderating role when incentives from higher levels are insufficient. Building on this logic, recent studies further argued that local governance capacity is not only essential for routine policy implementation but also constitutes a critical institutional asset for achieving vertical coordination and responding effectively to complex crises within a multilevel governance framework. A multilevel governance system can operate efficiently in crisis situations only if local governments have the three core governance assets of power, governance capacity, and political legitimacy, and are able to achieve effective vertical integration with the policy objectives of higher levels of government [37]. Thus, local governance capacity is not only reflected in the efficiency of resource integration and policy implementation at the local level, but also in its role in facilitating policy synergies and crisis response mechanisms in the national–local relationship.

Therefore, governance capacity not only influences the effectiveness of policy implementation but also acts as a moderating variable that shapes the extent to which the BRI enhances urban resilience across different regions. Specifically, cities with strong governance capacity are more likely to attract BRI-related project funding, infrastructure investments, and strategic resources, and are better equipped to integrate these inputs to strengthen the robustness and adaptability of their urban systems. Conversely, cities with weaker governance capacity may experience inefficiencies in resource utilization and project implementation, thereby undermining the potential resilient effects of the BRI.

In summary, local governance capacity may moderate the relationship between the BRI and the economic resilience of participating cities. Accordingly, the following hypothesis is proposed:

Hypothesis 2. *The level of local governance positively moderates the impact of the BRI on the economic resilience of cities along the route.*

3. Data and Methodology

3.1. Research Region

The BRI, proposed by the Chinese government in 2013, is an important national strategy to enhance connectivity between cities and promote regional integration in China. Focused on 281 prefecture-level cities in China between 2003 and 2021, this paper evaluates how the BRI influences their economic resilience. The treatment group in this study consists of 143 prefecture-level cities, encompassing cities within the 18 provinces directly affected by the BRI, along with 26 important nodal cities identified based on policy relevance. The control group includes the remaining 138 prefecture-level cities across China that are not affected by the BRI, excluding cities with missing data. This study adopts a quasi-natural experimental design, setting 2013 as the policy launch year. The cities along the BRI include 18 provinces, including Shanxi, Gansu, Xinjiang, Guangdong, and Fujian, spanning both inland and coastal areas, reflecting the spatial coverage and regional heterogeneity of the initiative. In contrast, the 138 prefecture-level cities located outside of these provinces, which form the control group for this analysis, are not directly affected by the BRI. To facilitate a clearer understanding of the spatial classification used in this study, Figure 1 provides a visual representation of the distribution of the treatment and control cities under the BRI framework.

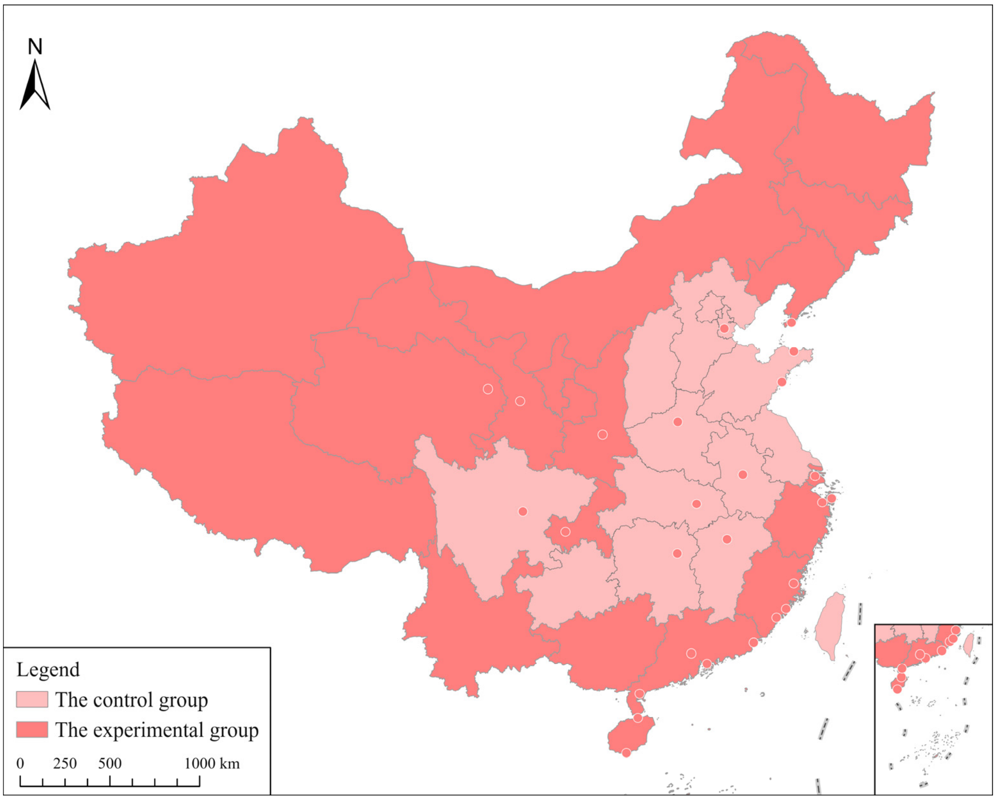

Figure 1. Distribution of cities along the BRI's domestic route in China. The dots on the figure represent the key nodal cities referenced in the Belt and Road Initiative. Note: Authors' creation based on data from the official website of the Ministry of Civil Affairs of the People's Republic of China.

3.2. Data Collection and Compilation

The empirical data originate from the China Urban Statistical Yearbook (2004–2022), alongside official yearbooks published by the corresponding provinces and cities. Missing values were checked and supplemented where possible to ensure data completeness.

3.3. Model Settings

3.3.1. Measuring Urban Economic Resilience Using the Entropy Method

Urban economic resilience is an extension and expansion of evolutionary resilience in the context of new geo-economics [38]. Combined with Nystrom's research, economic resilience is the ability of an economic system to adjust dynamically, involving multiple phases, including the three phases of ex-ante resilience to shocks, ex-ante adaptation to stabilization, and ex-post recovery and restructuring [39]. Based on the findings of previous studies, the study constructs a multidimensional Urban Economic Resilience Assessment Framework [40,41]. The framework is built around three core dimensions: resistance and recovery capacity, adaptation and adjustment capacity, and transformation and development capacity. In terms of methodology, the entropy value method is used to assign weights to the indicators to achieve an objective and quantitative assessment of urban economic resilience.

In order to quantitatively evaluate the economic resilience of cities along the BRI, this paper adopts the entropy method. The entropy method is a comprehensive evaluation method based on the information entropy of each indicator to determine its weight, and its core idea is to measure the degree of variation of each indicator to explore the information contained in the data, so as to provide an objective basis for comprehensive evaluation. Compared with the subjective assignment method, the entropy method can effectively overcome the evaluation bias caused by the small differences between the indicators, avoid the interference of human factors in the setting of weights, and thus enhance the scientific validity and fairness of the results of economic resilience measurement.

In this study, the specific implementation steps of the entropy value method are as follows:

1. Conduct indicator standardization.

In the evaluation of urban economic resilience, the entropy method is used as a commonly used method of assigning objective indicators [42–44]. Given that the evaluation system of urban economic resilience along the BRI constructed in this study encompasses multiple dimensions and a large number of indicators, it is necessary to standardize all variables prior to formal analysis to ensure the scientific validity and comparability of the results. During the standardization process, the directionality of each indicator's influence on economic resilience is measured. Specifically, this study distinguishes between positive indicators—those where higher values reflect stronger economic resilience (e.g., GDP per capita and fiscal revenue)—and negative indicators, where higher values indicate weaker resilience (e.g., pollution emissions and unemployment rate). In this study, all selected indicators are classified as positive. The normalization formula for such indicators is presented in Equation (1). In this context, X_{ij} refers to the observed value of the jth variable for city x in year i. $maxX_{ij}$ and $minX_{ij}$ represent the maximum and minimum values of the indicator X_{ij}, respectively.

$$X'_{ij} = \frac{maxX_{ij} - X_{ij}}{maxX_{ij} - minX_{ij}} \quad (1)$$

Next, the variation coefficient for each indicator in the urban economic resilience evaluation system along the BRI is calculated. The specific steps will be explained in the next step.

2. Calculate the normalized contribution of indicator j in year i.

This step assesses the relative performance of each indicator across cities and years, providing the foundation for subsequent entropy calculations.

$$p_{ij} = \frac{x'_{ij}}{\sum_{i=1}^{n} x'_{ij}} \tag{2}$$

3. Compute the entropy value of indicator j.

Based on the standardized contributions, the entropy formula is applied to measure the information content of each indicator, reflecting its variation within the dataset.

$$e_j = -\frac{1}{lnk}\sum_{i=1}^{m} p_{ij} ln p_{ij} \tag{3}$$

4. Determine the variation coefficient.

The variation coefficient is obtained by subtracting the entropy value of each indicator from the theoretical maximum entropy, indicating its discriminative power in the overall evaluation.

$$d_j = 1 - e_j \tag{4}$$

5. Calculate the weight w_j of each indicator in the economic resilience evaluation system.

$$w_j = \frac{1-e_j}{\sum_{j=1}^{n} d_j} \tag{5}$$

$$j = 1, 2, 3 \cdots m$$

6. Calculate the composite economic resilience score S_i.

$$S_i = \sum_{j=1}^{n} X'_{ij} w_j \tag{6}$$

$$i = 1,\ 2,\ 3 \cdots n$$

The indicator system adopted in this study and the corresponding results are presented in Table 1.

Table 1. Entropy-based urban resilience indicator weights.

Primary Indicator	Secondary Indicator	Tertiary Indicator	Weight
Urban economic resilience	Resistance and recovery capacity	Per capita economic output (CNY)	0.055024
		Total savings of residents (CNY)	0.140765
		Average wage of employees (CNY)	0.022826
	Adaptability and regulation capacity	Annual actual utilized FDI (in USD 10,000)	0.15418
		Share of tertiary industry in GDP (%)	0.021671
		Total sales of goods in wholesale and retail Trade (CNY 10,000)	0.215789
	Transformation and development capacity	Government expenditure on scientific research (CNY 10,000)	0.197884
		Government expenditure on education (CNY 10,000)	0.080039
		Number of enrolled Students in higher education institutions (persons)	0.111822

3.3.2. Difference-in-Differences Model

In both natural and social science research, quasi-experimental methods are frequently employed to evaluate the actual effects of policy interventions. In this study, to assess whether the BRI has enhanced the economic resilience of cities along its route, we compare two sets of cities with similar baseline characteristics: those exposed to the BRI (treatment group) and those not affected by the policy (control group). The marginal effect of the BRI is identified by comparing changes in economic resilience before and after the policy implementation. In econometrics, such policy assessments commonly utilize the DID methodology. By leveraging both temporal and cross-sectional variation between the treatment and control groups, the DID approach enables the estimation of the net policy effect, and thus has been extensively applied in empirical studies of public policy impact.

In order to verify the impact of the BRI on the level of economic resilience of cities along the route, this paper draws on the common practice in the literature and sets 143 cities along the BRI as the experimental group and 138 non-route cities as the control group. On this basis, a DID estimation model is constructed, incorporating both temporal and city-level fixed effects, in the following form:

$$Resi_{it} = \beta_0 + \beta_1 policy_{it} + \beta_2 X_{it} + \mu_i + \gamma_t + \varepsilon_{it} \tag{7}$$

In Equation (7), the explanatory variable $Resi_{it}$ measures the level of economic resilience of city i along the Belt and Road in year t. Here, the data of the economic resilience comprehensive evaluation index constructed in this paper are used. The core explanatory variable $policy_{it}$, which indicates the economic resilience of city i in year t, is a dummy variable, specifically represented by the interaction between a city-type dummy and a policy-period dummy, to portray the policy treatment effect. It takes the value of 1 when city i belongs to the cities along the BRI and year t is not earlier than the policy implementation year (i.e., 2013); otherwise, it takes the value of 0. X_{it} denotes the set of control variables, and μ_i and γ_t denote the city fixed effect and time fixed effect, respectively, which control for the time-invariant characteristics of the cities and the common shocks in the specific year. ε is the idiosyncratic error term. β_1 is the core coefficient that is the focus of this paper, and the correlation coefficient β_1 estimates the average treatment effect of the BRI on the economic resilience of cities along the route.

3.4. Variables

Dependent variable of economic resilience (Resi): The dependent variable of this paper is the level of urban economic resilience, which is measured by the comprehensive evaluation index constructed based on the entropy value method. This paper is from the three core dimensions of resistance and recovery capacity, adaptation and adjustment capacity, and transformation and development capacity. The higher the index value, the stronger the overall economic resilience of the city.

Core independent variable of the BRI (policy): The independent variable is the treatment effect variable of the BRI, which is set using the interaction term in the DID model. Specifically, this binary variable takes the value of 1 if a city is part of the BRI-affected region and the year is 2013 or later, which marks the beginning of the policy implementation period. It takes the value of 0 otherwise. This variable is used to identify the differential change in economic resilience between the treatment and control groups before and after the implementation of the BRI.

The variable used in the moderating test: Following Xiang (2023), this paper incorporates the local governance capacity as a moderating variable to examine how differences in institutional and fiscal conditions influence the effectiveness of the BRI in enhancing urban resilience [45]. This variable is proxied by the ratio of city-level fiscal expenditure to GDP, which reflects the local government's administrative presence and financial engagement. To avoid endogeneity concerns, we do not interpret this variable as a direct outcome of BRI policies, but rather as a structural characteristic that conditions policy effectiveness.

The resilience of urban economies to risk is also affected by a variety of factors [46,47]. Guided by theoretical insights from the existing literature, we select four key dimensions as control factors—economic density, human capital, industrial structure, and urban income level—to comprehensively capture the core elements that influence the resilience of urban economies. First, economic density reflects the spatial concentration of financial and economic resources. A higher level of economic density often indicates a more mature market system with greater availability of investment opportunities and reduced financing costs [48]. In addition, the agglomeration effects associated with high-density areas facilitate risk diversification, improved risk management, and faster information diffusion, all of which enhance a city's ability to respond and adapt to external shocks [49]. Second, human capital is widely regarded as a key driver of economic development and transformation. High-quality human capital, in particular, strengthens a city's capacity to adapt to complex and rapidly changing environments, thereby improving its overall economic resilience [50]. Third, industrial structure represents the allocation and organization of resources and productive activities within a local economy. A rational and flexible industrial structure plays a critical role in cushioning external shocks and accelerating recovery, contributing to the long-term resilience of urban systems [51]. Finally, the urban income level reflects residents' purchasing power and the broader stability of the urban economy. Increases in wage levels can stimulate consumption, strengthen the social security system, and reduce inequality-related risks, thereby enhancing both economic and social resilience [52]. Based on these theoretical considerations, and to reduce omitted variable bias and improve the accuracy of the estimation, we include a set of city-level control variables in order to control other factors that may affect the economic resilience of cities. The choice of variables is based on the existing literature [40,53–55]. (1) Human capital (humcap): This is measured by the ratio of students enrolled in tertiary institutions to the total population, reflecting the level of talent supply and the status of educational resources in the city; cities with a higher level of education are usually equipped with a stronger ability to adapt and innovate. (2) Urban economic density (gdp): This is measured as the total GDP per unit of administrative land area, reflecting the intensity of the economic activity per unit of land. (3) Industrial structure (struc): This is expressed as the proportion of the added value of the tertiary industry to the GDP, representing the degree of servicing of the city's economic structure. Cities with a higher proportion of the service industry usually have stronger flexibility and resilience, which is conducive to enhancing economic resilience. (4) Urban income level (wage): This is measured by the natural logarithm of the average wage of employees, as a representative variable of the income level and consumption capacity of urban residents; the higher the income, the stronger the city's economic resilience to risks. Descriptive statistics for all model variables are presented in Table 2.

Table 2. Descriptive statistics for main variables.

VarName	Obs	Mean	SD	Min	Median	Max
Y	4852	0.026	0.049	0.001	0.012	0.729
did	4852	0.219	0.414	0.000	0.000	1.000
treat	4852	0.483	0.500	0.000	0.000	1.000
post	4852	0.461	0.498	0.000	0.000	1.000
humcap	4852	0.017	0.023	0.000	0.009	0.215
gdp	4852	6.852	1.391	1.705	6.863	11.942
struc	4852	0.399	0.098	0.198	0.386	0.698
wage	4852	10.465	0.683	2.283	10.564	12.678
gov	4852	0.166	0.161	0.009	0.134	3.875

4. Empirical Results

4.1. Correlation Test

Before conducting regression analyses, a correlation test is required to ensure that the regression model is constructed in a theoretically sound manner. This test of correlation seeks to establish whether a statistically significant relationship exists between the main explanatory factors and the outcome variable, thereby evaluating the explanatory power of the selected predictors. If there is a significant positive or negative correlation between the core explanatory variable and the dependent variable, it indicates that the variable has some explanatory power and provides a theoretical basis for the subsequent empirical regression. In this study, a Pearson correlation coefficient matrix was employed to perform an initial examination of the primary variables. As shown in Table 3, there is a significant positive correlation between the core policy variables and the economic resilience of cities, which is in line with the research hypothesis of this paper and initially suggests that the BRI may play a positive role in enhancing the economic resilience of cities along the routes. It should be noted that the correlation test only reveals the bivariate linear relationship between the variables and fails to control for other potential interfering factors or endogeneity problems. Therefore, the correlation analysis is only exploratory in nature and is not sufficient to form causal inferences, which need to be further verified through multivariate regression analyses to ensure the robustness and scientific validity of the study's conclusions.

Table 3. Matrix of correlation coefficients.

	Y	**did**	**humcap**	**gdp**	**struc**	**wage**
Y	1.000					
did	0.186 ***	1.000				
humcap	0.516 ***	0.175 ***	1.000			
gdp	0.523 ***	0.132 ***	0.483 ***	1.000		
struc	0.500 ***	0.317 ***	0.531 ***	0.333 ***	1.000	
wage	0.404 ***	0.468 ***	0.310 ***	0.552 ***	0.512 ***	1.000

Note: *** $p < 0.01$.

4.2. Collinearity Test

Although the correlation test reveals the initial associations between the core variables, further covariance tests are necessary to ensure that there is no serious multicollinearity problem among the explanatory variables in the regression model. Multicollinearity can lead to unstable parameter estimates and large standard errors, affecting the explanatory power and significance judgment of the model, so it is of great importance to carry out covariance diagnosis before regression analysis.

Commonly employed methods for diagnosing multicollinearity include the correlation coefficient test and the Variance Inflation Factor (VIF) test. In this study, the VIF test is adopted to assess the presence of multicollinearity among independent variables. The VIF serves as a key statistical measure of the extent of linear correlation among explanatory variables. A VIF value exceeding 10 is generally considered indicative of serious multicollinearity, which may compromise the stability of coefficient estimates and reduce the explanatory power of the model. Table 4 presents the VIF test results for all key variables. As shown, the VIF values for each variable are below the critical threshold of 10, suggesting that multicollinearity is not a significant concern in this model. This indicates that the selected independent variables exhibit satisfactory independence and meet the basic assumptions required for regression analysis.

Table 4. Collinearity test—Variance Inflation Factor.

	VIF	1/VIF
wage	2.155	0.464
gdp	1.797	0.556
struc	1.751	0.571
humcap	1.68	0.595
did	1.343	0.745
Mean VIF	1.745	

4.3. Baseline Estimation Results

Using a DID framework, this study investigates how the BRI affects the economic resilience of cities along its corridors, with the benchmark regression results displayed in Table 5. By incorporating control variables in a stepwise manner, this study aims to monitor shifts in the primary explanatory factor's effect, verify robustness, detect variable interdependencies, and improve the efficiency of variable inclusion. By adopting this method, we obtain a sharper assessment of the core variables' genuine influence. Regression results are displayed across three columns, corresponding to successively refined models. In Column 1, the regression results without any control variables indicate a significant relationship between the core explanatory variable (did), representing the BRI, and the dependent variable at the 1% significance level, with a coefficient of 0.0051. This suggests that, in the absence of control variables, the BRI has a notable positive effect on the economic resilience of cities along the route, with an average policy impact of 0.0051 units. This preliminary result confirms that the BRI is an effective policy for enhancing urban economic resilience. In Column 2, several control variables—such as human capital (humcap) and urban economic density (gdp), are gradually introduced. The linkage between the DID (did) and the dependent variable remains significant at the 1% level, with a coefficient of 0.0041. Although the policy effect weakens slightly, it remains robust, indicating that the positive influence of the BRI on the economic resilience of cities persists even after controlling other potential factors. In Column 3, all control variables are included in the model. The final regression results show that the linkage between the DID (did) and the dependent variable remains statistically significant at the 1% level, with a coefficient of 0.0045. Even with the full set of control variables, the positive effect of the BRI on urban economic resilience is confirmed, and the policy effect remains significant and robust. These results further validate Hypothesis 1, that the BRI enhances the economic resilience of cities along the route.

Based on the results of the baseline regression, this section further analyses the impact of the control variables on the model results, to examine in greater detail the role that ancillary determinants play in modulating the BRI's policy effects. Specifically, the paper will systematically assess the empirical results of each control variable and analyze its role and impact on the enhancement of urban economic resilience. Firstly, this study measures human capital as the proportion of students enrolled in tertiary institutions relative to the total population. The empirical results indicate that the coefficient for human capital, as a control variable, is 0.4435 and is statistically significant at the 1% level. This finding underscores the pivotal role of human capital in enhancing the economic resilience of cities. A higher proportion of university students reflects the depth of human capital in urban areas, which supports innovation and technological advancement, thereby strengthening economic resilience. The accumulation of human capital not only improves the labor force quality but also fosters industrial optimization and technological progress, enabling cities to better adapt to economic fluctuations and environmental changes. An enhanced human capital base contributes to a more flexible economic structure, allowing cities to respond more effectively to market shifts, foster emerging industries, and mitigate the impacts of recessions. Concentrating talent drives technological innovation and provides long-term momentum for sustainable urban development. A skilled workforce enhances a city's ability to leverage globalization opportunities, boosting its competitiveness and resilience. To further strengthen economic resilience, cities can attract high-quality talent and institutions by offering tax incentives and financial support to universities and research centers, promoting the development of an innovative-driven industrial structure. Additionally, encouraging university–business partnerships can integrate research with industry needs, fostering technological innovation and aligning education with market demands. Creating innovation and entrepreneurship platforms for graduates also supports local economic dynamism and cultivates a generation of resilient, innovative professionals.

Table 5. Benchmark regression.

Variables	(1)	(2)	(3)
	Y	Y	Y
Did	0.0051 ***	0.0041 ***	0.0045 ***
	(4.99)	(2.84)	(3.13)
Humcap		0.4629 **	0.4435 ***
		(2.52)	(2.67)
Gdp		0.0086 ***	0.0111 ***
		(3.53)	(4.91)
Struc			0.0388 **
			(1.97)
Wage			−0.0070 ***
			(−4.75)
Constant	0.0531 ***	−0.0245	0.0174
	(65.94)	(−1.50)	(0.65)
Observations	4852	4852	4852
R-squared	0.260	0.277	0.282
Number of groups	281	281	281
Area	Yes	Yes	Yes
Year	Yes	Yes	Yes

t-statistics in parentheses. *** $p < 0.01$, ** $p < 0.05$.

Second, urban economic density is another key control variable, defined as the ratio of urban GDP to administrative land area. The results of this study indicate that economic density is positively and significantly correlated with the dependent variable, with a coefficient of 0.0111, which is statistically significant at the 1% level. This further highlights the important role of economic density in enhancing economic resilience. Urban economic density generally reflects the efficiency with which land resources are utilized in a city. A higher economic density indicates that a greater amount of economic output is generated per unit of land area, which not only increases urban productivity but also enhances the city's ability to withstand external shocks. Particularly in contexts where land resources are relatively scarce, higher economic density helps maximize the use of existing land, thereby enhancing the efficiency of urban resource allocation. Practically speaking, land resources play a critical role in urban development and have far-reaching implications. Cities with higher economic densities are typically able to achieve more rapid economic growth and greater market dynamism through more intensive land use and efficient infrastructure development. Efficient land use, particularly in cities with high economic density, thus becomes a crucial determinant of urban economic resilience.

As a control variable, industrial structure (struc) is significant at the 5% significance level, indicating that industrial structure also plays an important role in enhancing the economic resilience of cities. Specifically, a reasonable industrial structure helps the city to achieve effective allocation and optimization of resources when facing external economic shocks and improves the adaptability and risk resistance of the economy. Industrial diversification can reduce the dependence on a single industry, thus enhancing the resilience of cities in an uncertain environment. It is important to note that this paper uses the logarithm of average employee wages as a measure of urban income levels. The empirical results reveal a significant negative correlation between urban income levels and the economic resilience of cities, which initially seems to contradict general expectations. However, as an average, the measure of average employee wages is highly sensitive to extreme data, particularly from high-income groups. Specifically, the wages of high-income individuals can disproportionately raise the average income, thus inflating the overall urban income level. As a result, while the average wage may appear higher, it does not accurately reflect the full income distribution within the city. High-income groups, though a small portion of the population, experience income growth at a significantly faster rate than low-income groups. Sarkar (2015) indicates that income growth for high-income individuals generally outpaces that of low-income individuals, contributing to greater income inequality [56]. Increased income inequality can weaken social cohesion and economic resilience, making cities less adaptable and more vulnerable to external economic shocks. Furthermore, as a static annual indicator, the average employee wage fails to capture a city's long-term resilience and adaptive capacity. Therefore, the observed negative relationship between average employee wages and economic resilience should be understood in the context of each city's unique economic structure and income distribution characteristics. This negative correlation underscores the need for a broader approach to enhancing urban resilience. Instead of solely focusing on increasing income levels, it is essential to consider multiple factors, including income distribution and economic diversification, to strengthen cities' ability to withstand and recover from external shocks.

The empirical analysis confirms the validity of Hypothesis 1, which posits that the BRI significantly enhances the economic resilience of cities along its route. By utilizing the DID model and progressively incorporating control variables, the results demonstrate a positive and statistically significant relationship between the core explanatory variable and urban economic resilience at the 1% significance level. This finding substantiates the crucial role of the BRI in strengthening the economic resilience of cities.

4.4. Heterogeneity Analysis

To further assess the spatial heterogeneity of the BRI's impact on urban economic resilience, this study segments the sample into three major regions—eastern, central, and western—based on the regional classification outlined in China's 7th Five-Year Plan, and conducts regression analysis on these subgroups. As presented in Table 6, the BRI demonstrates a statistically significant positive influence on cities in the eastern and central regions, with effects at the 1% significance level. This indicates that the BRI has meaningfully contributed to enhancing economic resilience in these areas. The beneficial effects observed in the eastern and central cities can largely be attributed to their structural advantages. These cities typically feature mature infrastructure networks, more diversified industrial systems, and stronger technological capabilities. Such attributes allow them to better internalize national-level investments and translate transportation-focused initiatives into broader gains, such as industrial integration and trade expansion. Additionally, local governments in these regions tend to exhibit greater institutional effectiveness and policy execution capacity, enabling smoother policy delivery and greater synergy with other national development agendas. Particularly along the eastern seaboard, where international trade linkages and logistics systems are already well established, the BRI has reinforced existing outward-oriented growth trajectories, thereby improving cities' flexibility and adaptive capacity in the face of external disturbances.

Table 6. Heterogeneity analysis (1).

Variables	Eastern Y	Midland Y	Western Y
Did	0.0089 ***	0.0092 ***	−0.0035 ***
	(5.03)	(3.92)	(−6.38)
Humcap	0.2614	0.4488 **	0.2967 *
	(1.31)	(2.20)	(1.82)
Gdp	0.0063 ***	0.0165 ***	0.0103 ***
	(3.52)	(6.84)	(5.50)
Struc	0.0267	0.0203	0.0189
	(0.84)	(0.95)	(0.85)
Wage	−0.0071 ***	−0.0055 ***	−0.0038 ***
	(−4.29)	(−4.48)	(−4.72)
Constant	0.0630	−0.0364	−0.0032
	(1.48)	(−0.91)	(−0.10)
Observations	3586	2920	3364
R-squared	0.257	0.328	0.297
Number of groups	196	163	198
Area	Yes	Yes	Yes
Year	Yes	Yes	Yes

t-statistics in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

In contrast, Table 6 also reveals that the BRI has had a statistically significant negative effect on the economic resilience of cities located in the western region. While initially counterintuitive, this outcome suggests that, under specific structural and institutional constraints, the traditional infrastructure-led development model may not be universally effective and could even yield unintended adverse consequences. Three underlying factors may explain this outcome. First, persistent geographic and topographical challenges, combined with high infrastructure construction and maintenance costs, have resulted in diminishing returns. Despite years of investment under the Western Development strategy, natural barriers continue to limit the effectiveness of transport and logistics corridors in the region. Consequently, the marginal benefits of additional BRI-related infrastructure investments have declined, often falling short of expectations. Second, limited industrial support and weak market ecosystems have hindered infrastructure utilization. While significant progress has been made in enhancing physical connectivity, complementary efforts in "soft connectivity"—including institutional coordination, talent cultivation, and business environment reforms—have lagged behind. Although high-tech industries such as new energy vehicles and electrical equipment manufacturing have begun to shift westward, the supporting ecosystem—such as technical services, workforce training systems, and urban amenities—remains underdeveloped. As a result, many industrial projects struggle with "isolated operation," lacking upstream and downstream integration, and fail to benefit from agglomeration or scale effects. This fragmentation impedes the conversion of physical infrastructure into sustained economic resilience. Third, compared to eastern and central cities, western regions generally face challenges related to insufficient governance capacity, which has to some extent weakened the effectiveness of implementing the BRI. On the one hand, regional coordination mechanisms are inadequate, and there is a lack of a unified platform for inter-provincial coordination in infrastructure connectivity, logistics integration, and policy alignment, leading to low resource allocation efficiency and an inability to form a collective effort to drive policy implementation. On the other hand, some local governments in western regions have high fiscal dependency, relatively weak administrative enforcement capacity, and lack of interdepartmental coordination, resulting in a 'stepwise reduction' phenomenon in policy implementation, making it difficult for national strategies to be effectively implemented at the grassroots level. These institutional constraints objectively lead to 'inefficient absorption' or 'misallocation' of policy resources, not only weakening the resilience-enhancing effects of the BRI but potentially exacerbating local fiscal burdens and unsustainable development. It is evident that enhancing governance capacity is a prerequisite for the BRI strategy to truly deliver its intended benefits in western regions. Moving forward, it is imperative to address institutional shortcomings by improving regional coordination mechanisms, optimizing port governance systems, and strengthening local government governance capabilities, thereby enhancing the precision and effectiveness of policy implementation.

In summary, the empirical results indicate that the BRI has not only failed to enhance the economic resilience of cities in the western region, but has exerted a significant negative impact. This outcome does not suggest that the policy itself is inherently flawed; rather, it reflects a deeper structural mismatch between the current modes of policy implementation and the specific development conditions of the region. As a strategic gateway and transit corridor within the BRI framework, the western region undoubtedly requires infrastructure investment, which remains both necessary and geopolitically significant. However, policy orientation should move beyond the conventional emphasis on "infrastructure-led" or "hard connectivity-first" approaches. Given the vast land area of the region, low population density, highly heterogeneous resource endowments, and weak industrial foundations, development strategies must adhere to the principle of adapting to local conditions. This calls for a shift from large-scale physical investment toward more differentiated, quality-oriented development pathways. Looking ahead, the implementation of the BRI in western China should place greater emphasis on strengthening local industrial capacity, improving talent attraction and retention mechanisms, and enhancing institutional coordination. While continuing to invest in physical connectivity, greater efforts must be made to accelerate "soft connectivity" through institutional innovation, factor integration, and regional collaboration, ensuring that infrastructure development is effectively aligned with local absorptive and operational capacities. Only by tailoring the pace and focus of policy interventions to the specific structural conditions of the region can the BRI truly contribute to enhancing economic resilience in the western region—thereby avoiding the diminishing returns or unintended adverse effects that may result from the indiscriminate replication of strategies effective in other regions.

To further explore the differential effects of the BRI across cities of varying sizes, this study conducts sub-sample regressions based on urban population scale. The classification follows the Notice on Adjusting the Standards for Classifying City Sizes issued by the State Council, which designates cities with over 5 million permanent residents as megacities, those with 1 to 5 million as large cities, and those with fewer than 1 million as medium and small cities. As shown in Table 7, the BRI significantly enhances the economic resilience of megacities, with coefficients statistically significant at the 1% level. The effect on large cities is also positive, though only marginally significant at the 10% level. In contrast, the initiative appears to have a significant negative impact on medium and small cities, suggesting that it may have inadvertently undermined resilience in these areas rather than strengthening it. These findings underscore the importance of urban scale as a moderating factor in the transmission of national policy effects. Megacities are generally characterized by robust industrial systems, well-developed governance structures, and strong infrastructure and connectivity advantages, which collectively enable them to better utilize policy resources and convert them into economic gains and adaptive capacity. Conversely, medium and small cities often operate under constrained fiscal space, limited industrial diversification, and weak integration with regional markets. As a result, despite receiving substantial policy investment, they may lack the absorptive capacity required to translate it into resilience and may instead face adverse effects such as inefficient resource allocation or rising fiscal risks.

Table 7. Heterogeneity analysis (2).

Variables	Megacities	Large Cities	Medium and Small Cities
	Y	**Y**	**Y**
Did	0.0213 ***	0.0004 *	−0.0016 ***
	(4.87)	(1.83)	(−5.49)
Humcap	0.7234 **	0.2318 ***	0.0743 ***
	(2.49)	(3.92)	(16.67)
Gdp	0.0141 ***	0.0074 ***	0.0022 ***
	(3.26)	(9.41)	(6.05)
Struc	0.0371	0.0241 ***	−0.0041 ***
	(0.70)	(3.50)	(−3.52)
Wage	−0.0316 ***	−0.0029 ***	−0.0042 ***
	(−3.46)	(−2.96)	(−3.39)
Constant	0.2898 ***	−0.0097	0.0575 ***
	(3.08)	(−0.95)	(3.44)
Observations	1765	2950	137
R-squared	0.387	0.492	0.899
Number of groups	118	197	15
Area	Yes	Yes	Yes
Year	Yes	Yes	Yes

t-statistics in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

These results suggest that future BRI implementation should move toward a more differentiated and capacity-sensitive approach. Policymakers must recognize the developmental and institutional asymmetries across cities and avoid one-size-fits-all strategies. In addition to reinforcing the driving role of central cities, more targeted support—in the form of fiscal transfers, industrial planning, and institutional coordination—should be directed toward enhancing the policy uptake and resilience capacity of smaller urban areas. This would help mitigate the risk of policy-induced divergence, where more advanced cities continue to benefit disproportionately, while less-developed ones fall further behind.

To further investigate the potential spatial heterogeneity of policy effects, this study employs the Chow test to compare the policy impacts across different regions, thereby identifying regional variations in policy responsiveness. Specifically, the policy effect is decomposed into two components: the direct effect, which captures the impact within the region itself, and the indirect effect, which reflects the spillover effects on neighboring regions through spatial linkages.

To achieve this, we extend the baseline regression model by introducing interaction terms between the core explanatory variable and regional dummy variables (i.e., East, Mid, and West). We then focus on examining the statistical significance of these interaction terms within both the direct and indirect effect components. The regression results in Table 8 show that the interaction term between the policy variable and the western region (did_west) is significantly positive in the indirect effect component, suggesting that the policy not only exerts a positive influence locally in the western region but also generates notable spillover effects to surrounding cities through spatial transmission mechanisms. This strong positive spillover may be attributed to the western region's higher sensitivity to policy support, its relatively underdeveloped infrastructure, and less efficient resource allocation—all of which may enhance the marginal benefits of policy interventions. Moreover, preferential national strategies directed toward the western region may further reinforce positive interregional linkages. In contrast, the interaction term for the eastern region (did_east) is not statistically significant in any of the three effect components—direct, indirect, or total—indicating that the marginal policy effect in the eastern region remains relatively stable and does not significantly differ from the overall sample average. This result may be explained by the region's already mature development foundation and diminishing marginal returns to policy implementation, which reduce the likelihood of regional policy differentials. More notably, the interaction term for the central region (did_mid) is significantly negative in both the indirect and total effects, indicating that the policy has relatively weak—or even suppressive—impacts on economic indicators in the central region. This may reflect certain institutional constraints in the central region, such as inefficiencies in resource allocation, limited policy implementation capacity, or structural challenges in industrial upgrading, which hinder the full realization and spatial diffusion of policy benefits.

In summary, the above empirical findings confirm the existence of significant spatial heterogeneity in policy effects across regions, particularly with respect to spillover impacts. These results underscore the importance of accounting for regional disparities in economic foundations and institutional environments when formulating and implementing national development strategies. Tailoring policy tools to regional conditions can enhance the precision and coordination of policy outcomes.

Table 8. Heterogeneity analysis (3).

Variables	**East**	**East**	**East**	**East**	**East**	**Mid**	**Mid**	**Mid**	**Mid**	**Mid**	**West**	**West**	**West**	**West**	**West**
	Main	**Wx**	**LR_Direct**	**LR_Indirect**	**LR_Total**	**Main**	**Wx**	**LR_Direct**	**LR_Indirect**	**LR_Total**	**Main**	**Wx**	**LR_Direct**	**LR_Indirect**	**LR_Total**
did	0.012 ***	0.083	0.012 ***	0.041	0.054	0.011 ***	0.095 **	0.012 ***	0.044 **	0.055 **	0.013 ***	0.048	0.013 ***	0.016	0.030
	(2.95)	(1.31)	(2.98)	(1.20)	(1.54)	(3.90)	(2.19)	(3.92)	(2.06)	(2.53)	(4.41)	(1.24)	(4.34)	(0.90)	(1.57)
did_east	0.002	−0.068	0.002	−0.037	−0.035										
	(0.47)	(−1.01)	(0.35)	(−0.96)	(−0.91)										
east	−0.009 ***	0.060 *	−0.009 ***	0.039 *	0.030										
	(−4.30)	(1.80)	(−4.26)	(1.89)	(1.46)										
did_mid						0.014 *	−0.318 ***	0.012	−0.169 ***	−0.157 ***					
						(1.81)	(−2.96)	(1.63)	(−3.00)	(−2.74)					
mid						0.005 **	−0.023	0.005 **	−0.015	−0.010					
						(2.27)	(−0.76)	(2.44)	(−0.87)	(−0.58)					
did_west											−0.009	0.195 ***	−0.008	0.105 ***	0.096 ***
											(−1.58)	(2.61)	(−1.51)	(2.91)	(2.61)
west											0.008 **	0.002	0.008 **	−0.003	0.005
											(2.38)	(0.04)	(2.57)	(−0.13)	(0.23)
humcap	0.199 ***	−0.342	0.198 ***	−0.291	−0.093	0.256 ***	0.595	0.257 ***	0.175	0.432	0.260 ***	−1.227	0.252 ***	−0.765 **	−0.513
	(3.76)	(−0.45)	(3.72)	(−0.68)	(−0.22)	(4.95)	(0.76)	(5.15)	(0.42)	(1.02)	(5.06)	(−1.63)	(5.17)	(−2.10)	(−1.41)
gdp	0.015 ***	−0.000	0.015 ***	−0.006	0.009	0.013 ***	−0.000	0.013 ***	−0.006	0.007	0.014 ***	0.034 **	0.014 ***	0.011	0.025 ***
	(15.16)	(−0.00)	(15.54)	(−0.60)	(0.85)	(14.51)	(−0.00)	(14.83)	(−0.69)	(0.86)	(14.00)	(2.11)	(14.54)	(1.29)	(2.92)
struc	0.212 ***	−0.370 **	0.210 ***	−0.315 ***	−0.105	0.203 ***	−0.535 ***	0.201 ***	−0.383 ***	−0.181 *	0.199 ***	−0.378 **	0.198 ***	−0.291 ***	−0.093
	(16.44)	(−1.96)	(16.18)	(−2.77)	(−0.90)	(15.84)	(−2.88)	(15.71)	(−3.75)	(−1.75)	(15.73)	(−2.06)	(15.67)	(−3.14)	(−0.99)
wage	0.039 ***	0.291 ***	0.040 ***	0.154 ***	0.194 ***	0.038 ***	0.295 ***	0.039 ***	0.140 ***	0.179 ***	0.035 ***	0.305 ***	0.036 ***	0.135 ***	0.171 ***
	(10.35)	(5.30)	(10.40)	(4.18)	(5.22)	(10.01)	(5.03)	(10.07)	(3.99)	(5.01)	(9.48)	(5.46)	(9.49)	(4.17)	(5.21)
rho	−0.726 ***					−0.880 ***					−0.996 ***				
	(−3.59)					(−4.38)					(−4.74)				
sigma2_e		0.002 ***					0.002 ***					0.002 ***			
		(36.65)					(36.66)					(36.66)			
Observations	2698	2698	2698	2698	2698	2698	2698	2698	2698	2698	2698	2698	2698	2698	2698
R-squared	0.185	0.185	0.185	0.185	0.185	0.193	0.193	0.193	0.193	0.193	0.186	0.186	0.186	0.186	0.186
Number of id	142	142	142	142	142	142	142	142	142	142	142	142	142	142	142

z-statistics in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.5. Moderating Effect

To further assess the moderating role of local governance capacity in the transmission of the BRI policy effects, this paper introduces an indicator of local government governance capacity (gov) and incorporates an interaction term between this variable and the policy treatment indicator (did) into the regression model. As reported in Table 9, the coefficient of the interaction term $did \times gov$ is significantly positive at the 1% level, with an estimated value of 11.6353. This finding suggests that higher levels of local governance capacity significantly strengthen the positive impact of the BRI on urban economic resilience. In other words, cities with stronger institutional capacity are better positioned to absorb and utilize policy resources, improve implementation efficiency, and enhance cross-sectoral coordination—thereby achieving more robust resilience outcomes. This result empirically confirms Hypothesis 2 proposed in this study, which argues that the effectiveness of the BRI in enhancing urban economic resilience is significantly conditioned by local governance capacity. It also reinforces the earlier findings from the regional heterogeneity analysis, where weaker governance in western cities was found to constrain the effectiveness of BRI implementation. Governance disparities not only determine the extent to which cities can internalize and translate national strategies into tangible outcomes but also influence how effectively such strategies are executed at the local level. In particular, institutional capacity—reflected in administrative efficiency, resource integration, and interdepartmental coordination—emerges as a critical condition for successful policy delivery. In regions where governance foundations remain underdeveloped, such as parts of western China, the absence of institutional support may prevent cities from leveraging policy inputs effectively, and in some cases, may even result in negative or unintended outcomes.

Table 9. Moderating effect.

Variables	**(1)**	**(2)**
	Y	**Y**
Did	0.0046 ***	−0.0099 ***
	(3.15)	(−10.83)
Did × Gov		11.6353 ***
		(7.44)
Gov	−0.0156 *	0.0025
	(−1.85)	(0.51)
Humcap	0.4130 **	0.1296
	(2.57)	(0.99)
Gdp	0.0076 ***	0.0096 ***
	(2.78)	(16.00)
Struc	0.0407 **	0.0168
	(2.12)	(0.89)
Wage	−0.0060 ***	−0.0045 ***
	(−4.35)	(−5.46)
Constant	0.0358 **	0.0164
	(1.97)	(0.86)
Observations	4852	4852
R-squared	0.285	0.624

Table 9. *Cont.*

Variables	(1)	(2)
	Y	Y
Number of groups	281	281
Area	Yes	Yes
Year	Yes	Yes

t-statistics in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Taken together, both theoretical and empirical evidence points to a consistent conclusion: strengthening local governance capacity is essential for enhancing the implementation effectiveness of the BRI and promoting urban economic resilience along the initiative's corridor. This finding highlights the decisive role of institutional foundations in national strategy execution and offers meaningful insights into advancing regionally differentiated approaches to BRI policy implementation.

4.6. Parallel Trend Test

Following the confirmation of a significant moderating effect of local governance capacity on policy outcomes, this paper proceeds to examine a key identifying assumption of the DID, modeling the parallel trends assumption. Establishing causality using the DID framework requires that, prior to policy implementation, the treatment and control groups exhibit similar temporal trends in the dependent variable.

To test this assumption, an event study approach is employed by constructing a series of time-specific interaction terms around the policy implementation year. Specifically, the year immediately preceding the policy (pre_1) is set as the reference period, while the variables pre_2 to pre_6 represent the second through sixth years before the policy, and post_1 to post_6 correspond to the first through sixth years after the policy took effect. As illustrated in Figure 2, the coefficients of the pre-policy interaction terms are statistically insignificant, indicating that the treatment and control groups followed parallel trends prior to the intervention. This provides strong support for the validity of the parallel trend's assumption. Moreover, as shown in Table 10, the post-policy interaction terms (post_3) become significantly positive from the third year onward, at least at the 5% significance level. This suggests that the impact of the BRI did not manifest immediately after implementation but rather emerged gradually with a time lag. These findings indicate that the BRI exerts a positive effect on urban economic resilience, with a delayed response that aligns with the expected trajectory of large-scale policy execution and the cumulative realization of policy benefits.

Table 10. Parallel trend test.

Variables	(1)
	Y
Pre_6	−0.0048
	(−1.63)
Pre_5	−0.0019
	(−1.20)
Pre_4	−0.0020
	(−1.18)
Pre_3	−0.0009
	(−0.68)

Table 10. *Cont.*

Variables	(1) Y
Pre_2	−0.0004
	(−0.57)
Current	0.0012
	(1.54)
Post_1	0.0008
	(1.25)
Post_2	0.0007
	(0.92)
Post_3	0.0030 **
	(2.47)
Post_4	0.0029 ***
	(3.02)
Post_5	0.0029 ***
	(6.58)
Post_6	0.0075 ***
	(10.65)
Humcap	0.3569 ***
	(7.99)
Gdp	0.0104 ***
	(4.57)
Struc	0.1419 ***
	(5.72)
Wage	0.0286
	(1.45)
Constant	−0.4296 *
	(−1.71)
Observations	4852
Number of groups	281
R-squared	0.443
Area	Yes
Year	Yes

t-statistics in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

In conclusion, the results of the parallel trend test provide strong empirical support for the validity of the DID identification strategy. The control and treatment groups exhibited similar pre-treatment trends, satisfying the core assumption for causal inference. Furthermore, the observed delayed policy effects reinforce the notion that the BRI's impact on urban economic resilience unfolds progressively over time, consistent with the long-term nature of strategic infrastructure and institutional reforms.

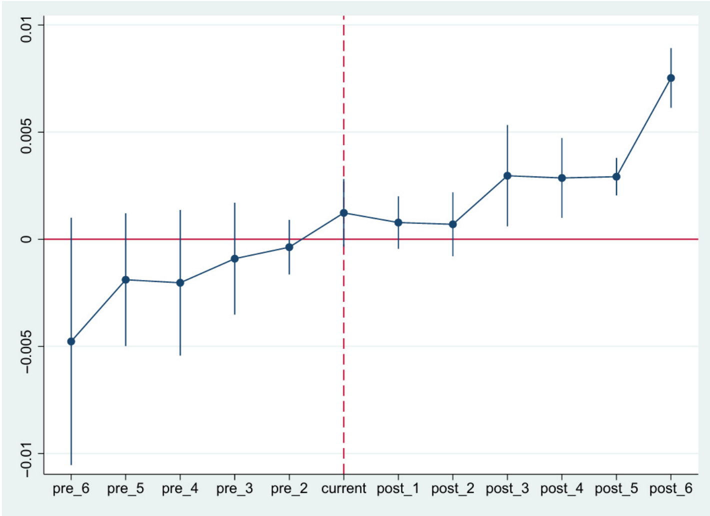

Figure 2. Parallel trend test. The X-axis (red solid horizontal line) represents the policy implementation time point, usually a specific year or time. Labels such as pre2, pre3, post1, post2, and post3 indicate different time points before and after policy implementation. The red long dashed line represents the baseline period, dividing the graph into the pre-policy period on the left and the post-policy period on the right. The short vertical lines represent the 95% confidence intervals, which are used to assess the significance of the coefficient estimates.

4.7. Robustness Tests

4.7.1. Handling and Removal of Exceptional Values

Following the validation of the parallel trend's assumption, this paper further conducts a series of robustness checks to ensure the reliability and consistency of the baseline findings. Specifically, four robust strategies are employed: (1) excluding special years to control external shocks; (2) introducing a one-period lag of the core explanatory variable to address potential endogeneity; (3) applying the PSM-DID method to correct for sample selection bias; and (4) conducting a placebo test.

First, to account for the impact of extreme external disturbances, the year 2020 is excluded from the sample due to the profound and widespread disruptions resulting from the COVID-19 pandemic. As the pandemic may have introduced exogenous shocks unrelated to the BRI, its inclusion could bias the estimation of policy effects. Excluding this year helps isolate the causal impact of the BRI more accurately. As shown in the first column of Table 11, the core policy variable (did) remains statistically significant at the 1% level after excluding 2020, with consistent sign and magnitude, thereby confirming the robustness of the main findings.

Table 11. Exclusion of special values and lagged processing.

Variables	Excluding the Impact of COVID-19	One-Period Lag
	Y	f_Y
Did	0.0016 ***	0.0046 ***
	(5.61)	(3.10)
Humcap	0.6916 ***	0.3985 *
	(14.62)	(1.77)
Gdp	0.0073 ***	0.0086 ***
	(4.89)	(4.53)

Table 11. *Cont.*

Variables	**Excluding the Impact of COVID-19**	**One-Period Lag**
	Y	**f_Y**
Struc	0.0361 **	0.0392 *
	(2.23)	(1.69)
Wage	−0.0060 ***	−0.0075 ***
	(−3.85)	(−3.92)
Constant	0.0209	0.0459
	(1.17)	(1.16)
Observations	4414	4413
R-squared	0.304	0.278
Number of groups	281	277
Area	Yes	Yes
Year	Yes	Yes

t-statistics in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.7.2. Lagged Processing

Second, to address potential reverse causality and to explore the dynamic effects of the policy, this paper re-estimates the model by introducing a one-period lag of the core explanatory variable. This specification serves two purposes: first, it mitigates simultaneity bias by ensuring that the policy variable precedes the outcome variable in time; second, it accounts for the delayed realization of policy impacts, a factor of particular importance within the BRI framework, where infrastructure construction, interregional coordination, and institutional adaptation may require a certain time frame before translating into measurable changes in urban economic resilience. Column (2) of Table 11 indicates that the lagged policy variable continues to be positively linked to the dependent variable at the 1% significance level, thereby reinforcing the robustness of the findings.

Overall, the use of a lagged specification reinforces the credibility of the causal relationship and highlights the persistence of the BRI's positive effect on urban economic resilience over time.

4.7.3. Model-Based Robustness Check: PSM-DID Approach

Following the robustness checks that incorporated lagged terms and excluded atypical policy years, this paper further applies PSM to mitigate potential selection bias stemming from observable heterogeneity. Although the DID framework controls time-invariant unobserved confounders, it relies heavily on the parallel trend's assumption. When pre-treatment differences between the treated and control groups are substantial, this assumption may not hold, undermining the validity of causal inference. To address this concern, PSM is employed to construct a more comparable counterfactual group by matching treated and untreated observations with similar pre-policy characteristics. In practice, the matching procedure is implemented using a 1:1 nearest neighbor approach with a caliper of 0.01 to ensure precise alignment of propensity scores. As illustrated in Figure 3, the kernel density plots reveal clear discrepancies between the two groups before matching, while post-matching distributions converge substantially, with the mean lines overlapping closely indicating improved balance. Figure 4 further supports this outcome, showing that matched observations exhibit standardized differences closer to zero compared to unmatched data points.

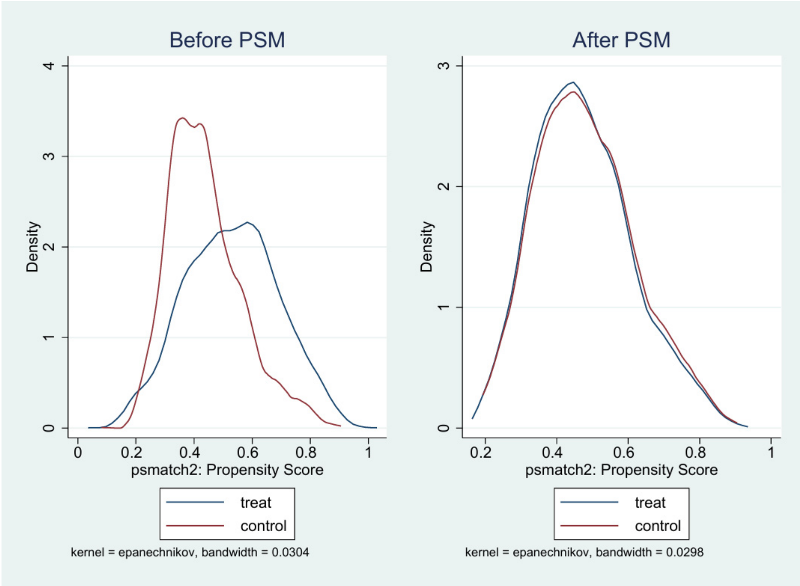

Figure 3. Comparative kernel density plot of matched propensity scores.

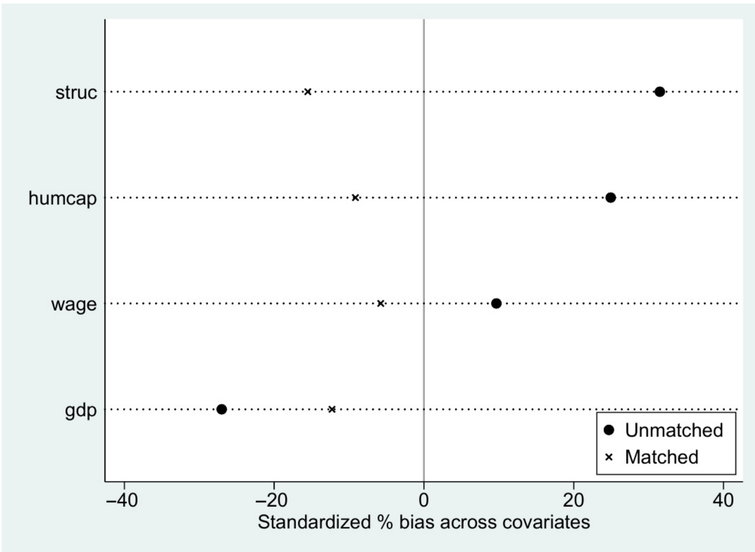

Figure 4. Parallel trends plot.

Table 12 presents the covariate balance diagnostics before and after matching. The results indicate that most covariates experienced a considerable reduction in standardized bias after matching, with values falling below the conventional thresholds of 10% or 15%, and variance ratios remained within acceptable bounds. Although several variables continued to exhibit statistically significant differences in *t*-tests, the magnitude of their standardized biases was notably reduced, suggesting that the residual imbalance is limited and unlikely to materially affect the treatment effect estimates.

Overall, the implementation of PSM significantly improves the covariate comparability between treated and control groups, thereby enhancing the credibility of the estimated policy effects.

Following the matching procedure, regression analyses were performed on the matched dataset. As reported in Table 13, the results show that the coefficient of the DID (did) remains significantly positive at the 1% level. Consistent with the initial estimates, this result provides additional support that the BRI significantly and robustly enhances the economic resilience of cities situated along its route.

Table 12. Balance sheet of differences.

Variable	Matched	Treated	Control	%Bias	∣Bias∣	*t*	*p* > ∣*t*∣	V(C)
Humcap	U	0.0203	0.0147	24.90		8.740	0	2.25 *
	M	0.0201	0.0222	−9.200	63.30	−2.550	0.0110	0.81 *
Gdp	U	6.658	7.033	−27		−9.460	0	2.08 *
	M	6.623	6.794	−12.30	54.50	−4.060	0	1.55 *
Struc	U	0.414	0.384	31.50		10.97	0	1.12 *
	M	0.413	0.428	−15.50	50.70	−4.890	0	0.81 *
Wage	U	10.50	10.43	9.700		3.370	0.00100	0.950
	M	10.49	10.54	−5.800	40.30	−2.010	0.0440	0.930

In propensity score matching (PSM) regression analysis, U and M represent unmatched data and matched data, and * indicates $p < 0.1$.

Table 13. PSM regression.

Variables	**(1)**
	Y
Did	0.0046 ***
	(3.67)
Humcap	0.4065 **
	(1.99)
Gdp	0.0176 ***
	(9.85)
Struc	0.0598 ***
	(2.85)
Wage	−0.0149 ***
	(−3.28)
Constant	0.0460
	(1.02)
Observations	2318
Number of groups	276
Area	Yes
Year	Yes
R-squared	0.283

t-statistics in parentheses. *** $p < 0.01$, ** $p < 0.05$.

4.7.4. Placebo Tests

Although the baseline regression controls observable characteristics that may influence the treatment assignment, concerns remain regarding potential endogeneity arising from unobserved confounders. To address this issue and further validate the robustness of the results, a placebo test based on counterfactual assumptions is conducted. Specifically, the original treatment and control groups are randomly reassigned, and a new pseudo-treatment group of equal size is generated. The policy implementation time is also randomly reassigned. Using this reshuffled data, a pseudo-did variable is constructed by interacting with the falsified treatment assignment with the new policy time dummy. This simulation is repeated 500 times. The distribution of the resulting placebo coefficients is illustrated in Figure 5. As shown, the estimated coefficients from the placebo tests approximately follow a normal distribution, suggesting that the reassignments are statistically random and free from systematic manipulation. Importantly, the actual DID coefficient lies at the far tail of the placebo distribution, indicating that the observed treatment effect is unlikely to be driven by chance. These findings provide strong support for the credibility of the estimated policy effect and confirm that the placebo test is successfully passed.

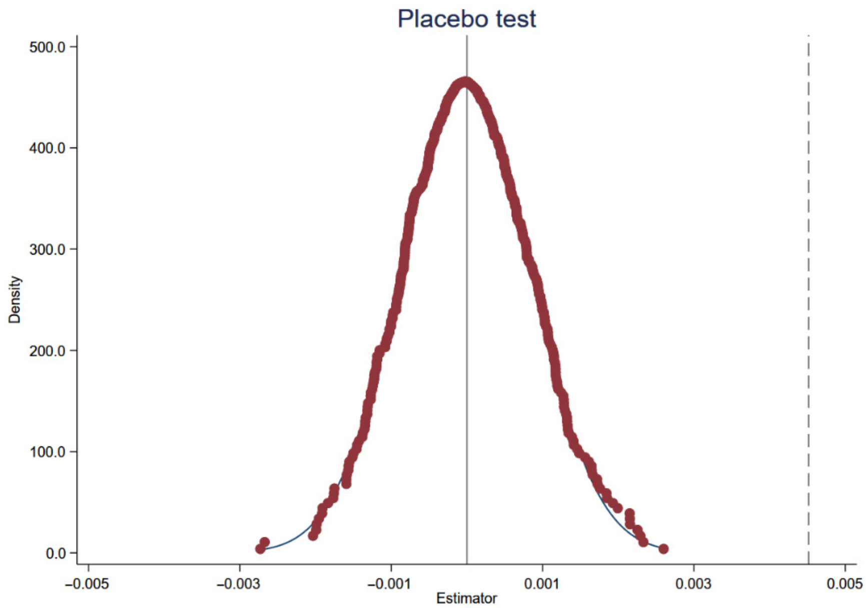

Figure 5. Placebo tests. The grey solid vertical line marks 0 on the coefficient axis; it is included as a visual reference to help readers locate zero-valued estimates. The grey dotted vertical line indicates the true coefficient value for comparison. The red dotted line (red dots) represents the *p*-values. The blue curve depicts the kernel density of the estimated coefficients.

5. Conclusions and Implications

Utilizing panel data from 281 prefecture-level cities spanning 2003–2021, this paper utilizes a DID model to rigorously assess the BRI's effect on urban economic resilience and to identify the moderating mechanisms. For this evaluation, an integrated index of urban economic resilience is developed using the entropy method. Taking the BRI as a quasi-natural experiment, the study identifies causal effects by comparing cities participating in the initiative (treatment group) with those not involved (control group). The empirical findings show that the BRI has significantly enhanced the economic resilience of participating cities. Further analysis of moderating effects reveals that improvements in local governance capacity substantially amplify the impact of policy. This finding emphasizes the institutional role of local governments in facilitating the implementation of national strategies and indirectly affirms the effectiveness of China's multilevel governance system in supporting major policy delivery. In addition, the heterogeneity analysis reveals notable disparities in policy effectiveness across different types of cities. On the one hand, the BRI significantly promotes resilience in megacities and large cities, but appears to exert a suppressive effect on medium and small cities. On the other hand, while cities in the eastern and central regions benefit considerably from the initiative, cities in the western region experience a significantly negative effect. These results raise critical questions about the undiscriminating impact of national strategies: as a nationwide policy framework, should the BRI adopt more adaptive and context-specific approaches in the western region? For this research question, the answer is yes. How to enhance the development capacity and resilience of western cities while respecting regional differences and existing conditions still remains a key issue for future policy refinement and institutional innovation.

Nonetheless, this study reveals that although the BRI has significantly improved the economic resilience of Chinese cities overall, its effects in western regions remain weak or even negative. This spatial heterogeneity highlights the need to formulate differentiated and field-oriented operational policy strategies tailored to the specific developmental stage, institutional capacity, and resource endowment of western China. To more effectively integrate the western region into the national modernization strategy and ensure the long-term sustainability of the BRI, several key directions merit policy attention. First, clarifying and reinforcing the strategic positioning of western regions within China's national modernization process constitutes a fundamental prerequisite for advancing their high-quality development. For a long time, many western cities have adopted a "multi-pronged and functionally generalized" development approach, leading to fragmented industrial layouts, inefficient resource allocation, and a lack of distinctive, high-impact industrial clusters. To address these challenges, a shift is needed from the traditional logic of "comprehensive regional development" toward a more selectively concentrated strategy of "targeted and strategic breakthroughs," enabling regional economies to evolve toward a model that is more streamlined, specialized, and resilient.

Building on this industrial specialization framework, the western region should further develop a multi-tiered regional coordinated structure, anchored by the Chengdu–Chongqing Economic Circle, and complemented by Xi'an in Shaanxi and Guiyang in Guizhou. This would mirror the integration experience of the Yangtze River Delta by establishing a coordinated western urban agglomeration. Through a "core-leading, sub-core-supporting, and peripheral-synergizing" spatial model, the region could foster a nested pattern of "small-circle driving big-circle" dynamics. The Chengdu–Chongqing core would serve as the innovation and industrial engine, while Xi'an and Guiyang would function as secondary coordination nodes, facilitating industrial division of labor and functional complementarity with surrounding cities. This spatial configuration is expected to generate strong endogenous momentum, high levels of synergy, and significant spillover effects, thereby transforming the current fragmented landscape into a more cohesive and integrated western growth pole. It is noteworthy that the realization of such strategic positioning ultimately hinges on the strength of local governance systems and capacities. Empirical findings from this study demonstrate that local governance significantly amplifies the positive impact of the BRI on urban economic resilience. This highlights the pivotal role of institutional capacity in translating national strategies into concrete local development outcomes. Strengthening governance not only improves policy implementation but also fosters a new dimension of "institutional competition" among cities, which in turn creates differentiated advantages and facilitates strategic breakthroughs in the evolving regional development landscape of western China. For this local governance, the central government should better promote the performance-based incentive system for public–private, central–local partnerships.

Second, human capital remains a binding constraint on the high-quality development of western cities. Despite increasing policy attention, the outflow of educated and skilled labor persists, partly due to limited career opportunities, lower wages, and weak public service provision. To address this challenge, it is essential to build an inclusive and competitive talent development ecosystem. This includes promoting industrial agglomeration to create high-quality employment opportunities, improving the accessibility and quality of public services such as education, healthcare, and housing to increase the attractiveness of settlement, and reshaping the national perception of western cities through targeted branding and incentive mechanisms to enhance their visibility and desirability among the mobile workforce.

Finally, advancing land system reforms that are tailored to the specific conditions of western China is a critical pathway for unlocking the development potential of the region. Compared to the densely populated and highly land-intensive eastern region, western China possesses abundant land resources; however, land use efficiency remains generally low. A large share of peri-urban and rural land has long remained idle or underutilized, resulting in a structural paradox of "land surplus" coexisting with "development constraints." This phenomenon reveals a range of institutional barriers and implementation challenges that hinder land reform efforts in the western region. The underlying causes primarily lie in the rigidity of the land-use classification system, the complexity of administrative approval procedures, and the ever-increasing institutional divide between urban and rural land governance. Specifically, first, the processes of land reclassification and redevelopment are often constrained by cumbersome institutional procedures. This issue is particularly pronounced in less-developed western areas, where local governments tend to have limited land management capacity and lack efficient and transparent mechanisms for land circulation and consolidation. These institutional deficiencies significantly restrict the potential for reactivating low-efficiency land. Second, the dual-track structure of urban and rural land regimes remains deeply entrenched. The marketization of the rural collective land development framework is still in its exploratory phase, and in the absence of a sound legal framework and mature benefit-sharing mechanisms, attempts to incorporate such land into the formal market may provoke property rights disputes and resistance from local stakeholders. Furthermore, the heavy fiscal reliance on land-based revenues by some local governments drives a preference for short-term land sales over long-term, sustainable spatial planning and land consolidation strategies. This orientation undermines the systemic and sustained implementation of land reforms.

In strengthening land use, it is essential to consider not only bottom-up driving mechanisms, but also top-down policy initiatives and proactive governance [57]. To address these challenges, reform efforts should focus on three interrelated priorities. First, a differentiated land-use policy for the western region should be introduced, allowing for the reclassification and functional reuse of inefficient land parcels, especially in urban fringes and small- and medium-sized cities with population inflows. Second, a pilot program should be launched in some western provinces to incorporate rural collective land into a unified construction land market to activate inefficient and idle land in the west. Third, a regional land reserve and redevelopment mechanism should be established to enable local governments to strategically acquire, consolidate, and redistribute dispersed land resources, especially in declining industrial zones or abandoned village areas, for coordinated reuse.

By addressing these structural constraints and reorienting development strategies based on the unique conditions of the western region, the BRI can more effectively support balanced regional development and contribute to the long-term resilience and modernization of China's urban system.

It is important to acknowledge that, despite its contributions, this study has certain limitations. While the heterogeneity analysis captures regional and urban-scale disparities, and the Chow test was conducted to explore potential spillover effects across regions, the empirical model does not fully incorporate spatial dependence among cities. Given the interconnected nature of infrastructure and economic networks under the BRI, a more explicit consideration of spatial interactions remains essential. Future research could adopt spatial econometric approaches to better capture spatial interlinkages and provide deeper insights into the diffusion mechanisms and network dynamics underlying national strategies such as the BRI.

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