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The Impact of New-Type Urbanization on the Development of Livable, Industry-Thriving, and Beautiful Rural Areas: Evidence from 2,093 Chinese Counties

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Research Article

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The Impact of New-Type Urbanization on the Development of Livable, Industry-Thriving, and Beautiful Rural Areas: Evidence from 2,093 Chinese Counties

Abstract: Amid China's drive for balanced spatial development, constructing livable, industry-thriving, and beautiful rural areas (LITBRA) represents a strategic priority for rural revitalization. Using county panel data (2014–2023), this study examines whether the New Urbanization Pilot Policy (NUPP) advances LITBRA development. A staggered-did model design confirms significant positive policy impacts, driven by expanded domestic demand, technological innovation, and government digital economy support. Treatment effects are more pronounced in Western China, non-former poverty counties, low-digital-policy-supply regions, and low-fiscal-stress jurisdictions. These findings offer actionable insights for leveraging urbanization strategies to promote balanced rural development.

Keywords: livable, industry-thriving, and beautiful rural areas; new urbanization pilot policy; staggered difference-in-differences model; Chinese counties

1. Introduction

Since 2014, China officially launched the **New Urbanization Pilot Policy (NUPP)**, sequentially establishing three batches of national pilot regions. The policy aims to break down the urban-rural dual structure through institutional innovation, with a people-centered approach, counties as the primary implementing units, and urban-rural integration as the pathway (Liu 2024). The National New-type Urbanization Plan of China (2014–2020) identifies new-type urbanization is the key pathway to resolving the "three rural issues" (agriculture, rural areas, and farmers), and promoting rural development and urban-rural integration[1].Since the reform and opening-up, China's

[1] The National New-type Urbanization Plan (2014-2020), Gazette of the State Council of China, No. 9, 2014. Available at: https://www.gov.cn/gongbao/content/2014/content_2644805.htm

rural development goals have gradually evolved from from building"New Socialist Countryside" to "Beautiful Countryside" and then to "Rural Revitalization". In 2022, the report of the 20th National Congress of the Communist Party of China first announced the strategic goal of building Livable, Industry-Thriving, and Beautiful Rural Areas (LITBRA), marking a transition of rural development into a new phase. This strategic shift not only raises standards for rural production, ecology, and livelihoods, but also emphasizes material and spiritual progress and the promotion of urban-rural integration. Concurrently, the strategic approach has shifted away from traditional, segregated urban-rural governance toward a novel relationship characterized by industry supporting agriculture, cities driving rural development, and urban-rural mutual complementarity. In 2026, the outline of the 15th Five-Year Plan formally listed the development of LITBRA as a key task for urban-rural integration and a core driver for comprehensive rural modernization in the new era. In this context, empirically evaluating the impact of the NUPP on the development of LITBRA, along with its underlying mechanisms, holds substantial theoretical and practical significance.

Traditional urbanization triggered a "unidirectional siphon effect," drawing labor, capital, and land into cities and causing rural labor shortages, resource depletion, and industrial hollowing. The implementation of NUPP substantially mitigates these issues through three ways. First, new urbanization—with counties as its primary vehicle—prioritizes promoting facilitates bidirectional factor flows (Jiao *et al*. 2024), thereby expanding rural domestic demand and compelling industrial upgrading. Second, urban technological innovations generate spatial spillover effects that drive rural industrial restructuring and boost total factor productivity(Xu *et al*. 2026). Third, NUPP-induced digital economy growth and increased policy attention weaken geographic frictions. By broadening financing and sales channels, NUPP robustly expands cross-regional rural e-commerce, creates local jobs, and

consequently boosted farmers' incomes. Research on the theme of new-type urbanization primarily focuses on promoting urban-rural integration, farmers' income, agricultural industrial structure upgrading, and equalization of public services. These studies fall into three strands: the first highlights NUPP's role in narrowing the urban-rural gap and balancing regional development while improving farmers' income(Liu *et al*. 2022; Li *et al*. 2026; Lv and Fan 2024; Guo and Zheng 2025); the second focuses on its capacity to drive agricultural industrial structure structure, promote rural tri-industry fusion, and expand non-agricultural employment, thereby strengthening the endogenous momentum of rural economic development (Gao 2025; Li and Guo 2024; Hua *et al.* 2026; Jiao 2025); the third strand explores the synergistic coupling of new urbanization with rural revitalization, the digital economy,and the ecological environment, which collectively drives urban-rural integrated development (Ma *et al.* 2025; Bao *et al.* 2026; Wang *et al.* 2025).

However, major research gaps remain. Most existing studies examine rural development through a single-dimensional perspective such as farmers' income and agricultural productivity. Although some focus on multi-dimensional studies, they center on evaluating for rural revitalization. The newer and comprehensive concept of LITBRA still lacks systematic quantitative measurement, with existing research largely confined to theoretical mechanism analysis (Lv and Zhao 2023; Lv 2023; Zhang and Zhou 2023; Zhang *et al.* 2022) . Moreover, among the few studies that attempts quantitative measurement rely solely on provincial data (Zhao and Wang 2024). As the pivotal spatial unit for urban-rural integration, more refined county-level measurement is crucial; provincial data fail to capture localized spatial dynamics. Finally, the LITBRA has rarely been examined from a policy evaluation perspective to rigorously identify the causal effects of NUPP and its underlying mechanisms.

The marginal contributions of this paper are primarily reflected in the three aspects: First, it improves the scale

and data granularity by integrating county-level socioeconomic statistics with high-resolution remote sensing imagery, this study achieve a precise, granular measurement of livable, industry-thriving, and beautiful rural areas at the county scale. Second, by adopting causal inference methods, this study accurately identifies the impact of new-type urbanization on rural development. Third, it advances the understanding of mechanisms by systematically unpacking the "black box" of NUPP's enabling pathways through three key dimensions: **domestic demand scale, technological innovation, and digital economy policy supply.** In sum, this study offers critical empirical evidence and decision support for understanding the relationship between NUPP and the development of livable, industry-thriving, and beautiful rural areas.

2. Theoretical Analysis and Research Hypotheses

The impact of the NUPP on the development of LITBRA is reflected in four key dimensions: spatial, factor, industrial, and ecological. Spatially, NUPP optimizes urban-rural spatial layouts by driving county-centered urbanization, bridging infrastructure gaps, and enhancing public services level to narrow the urban-rural gap. In terms of factors, NUPP promotes the two-way flow of capital, technology, and talent from urban to rural areas, reinforcing urban-rural economic ties and functional complementarity, and providing the spatial and material foundations for livable, industry-thriving, and beautiful rural areas. Industrially, urban technology, management expertise and capital inflows optimize county-level industrial structures. On the one hand, traditional agriculture is transitioning toward smart agriculture and extending agrifood processing chains; on the other hand, emerging sectors like rural tourism and e-commerce expand farm income channels and boost endogenous rural growth. Ecologically, NUPP prioritizes green, sustainable agriculture and the living environment improvement, ensuring that rural transformation no longer compromises environments, thereby solidifying the ecological foundation for 'livability'

while injecting green momentum into ‘industry-thriving’. Collectively, these dimensions synergistically foster a new developmental landscape featuring spatial optimization, factor activation, industrial integration, and green development. Based on this, we propose the following hypothesis:

H1: NUPP significantly improves the development level of LITBRA.

With counties serving as the primary spatial units, NUPP expands rural demand via bidirectional factor mobility, including population returns, technology introductions, capital inflows, and policy support. On the one hand, the return of populations and high-skilled labor enriches rural workforce while expanding local consumer markets. Simultaneously, introducing advanced urban technologies facilitates a transition toward highly efficient agricultural operations, which fosters agrifood processing and smart farming, thereby boosting intermediate good demand. Finally, this process is further amplified by capital inflows and policy tilt that upgrade rural infrastructure and public services, effectively releasing latent investment and consumption potentials. On the other hand, according to the local market effect proposed by (Krugman 1991), the expansion of rural demand driven by population return, which in turn promotes the integration of primary, secondary, and tertiary industries in rural areas. This drives non-farm employment and income growth, establishing a virtuous circle of mutually reinforcing demand expansion and industrial development that robustly supports the realization of LITBRA. Based on this, Hypothesis 2 is proposed.

H2: NUPP fosters LITBRA by expanding county-level demand scale.

Based on the Porter hypothesis well-designed policy regulations stimulate technological innovation (Porter and van der Linde 1995). Arrow (1962) demonstrated that innovation outcomes.generates substantial spatial spillovers across regions. In the process of new-type urbanization the spillover of urban technologies to rural areas is primarily demonstrated at three levels: equipment, conceptual, and operational. At the equipment level, adopting advanced

technologies and modern machinery significantly enhances agricultural total factor productivity and crop quality, directly raising farm incomes. At the conceptual level, the penetration of innovation accelerates the transition from traditional to smart agriculture, guiding rural communities toward characterized agriculture and rural tourism, thereby providing industrial support for a favorable business environment... At the operational level, these spillovers promote the research and application of green technologies like ecological planting and circular agriculture. Emphasizing human-nature harmony, this green and low-carbon transition not only ensures agricultural sustainability but also significantly improves rural living environments, achieving livable and beautiful rural conditions. Based on this, we propose the following hypothesis:

H3: NUPP fosters LITBRA by promoting technological innovation.

The implementation of NUPP prompts significant policy tilt and fiscal support toward county-level rural development(Guo and Zheng 2025). As a new form of industrial development, the digital economy is new driver of economic growth serves as a priority for government's economic strategy[2]. This heightened policy support empowers rural areas through three interconnected pathways. First, it mitigates geographic constraints to boost cross-regional e-commerce; as outlined in Krugman's (1991) Core-Periphery model, transportation and information costs restrict market boundaries, but digital adoption weakens these geographic frictions, breaking traditional local production and sales boundaries to expand market access(Ji and Wang 2024). Second, digital inclusion lowers financing thresholds for rural firms and households, effectively easing credit constraints that hinder industrial development(Yu *et al.* 2024). Third, the digital transformation of public services. Digital technologies empower sectors such as education, governance, and public welfare optimizing service delivery, while enhancing governance

[2] The General Office of the State Council of China, *Implementation Opinions on Accelerating the Cultivation and Opening of Scenarios and Propelling the Large-Scale Application of New Scenarios* (No. 37 [2025])

efficiency and life convenience(Mao *et al.* 2024). These pathways collectively enhance public service accessibility for **livability**, expand market boundaries and financing channels for **industry-thriving**, and elevate rural governance for beautiful villages. Based on this, we propose the following hypothesis:

H4: NUPP fosters LITBRA by increasing government support for the digital economy.

3. Research Design

3.1 Model Specification

To accurately evaluate the impact of NUPP on the development of LITBRA, this paper treats the pilot policy as a quasi-natural experiment and constructs a staggered difference-in-differences (DID) model. The model is specified as follows:

$$lwh_index_{it} = \alpha + \beta_0 new_urban_did_{it} + \beta_1 X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

where the subscripts i and t denote county and year, respectively. The core dependent variable, lwh_index_{it}, represents the development level of LITBRA for county i in year t. The core independent variable, $new_urban_did_{it}$, is a policy dummy variable that equals 1 if county i is designated as a pilot region in year t, and 0 otherwise. X_{it} represents a vector of county-level control variables. μ_i captures county fixed effects; λ_t signifies year fixed effects; and ε_{it} the random error term.

3.2 Data Sources and Sample Selection

3.2.1 Data

This paper utilizes a panel dataset covering 2,093 Chinese counties from 2014 to 2023. Missing values for specific variables were imputed using linear interpolation, yielding a final 19,997 valid observations. The data sources are structured as follows:

(1) Core dependent variable data: the development level of LITBRA are primarily derived from the *China County Statistical Yearbook (various years)* and the *Peking University Digital Financial Inclusion Index*. Geographic and remote sensing data are retrieved from the *National Tibetan Plateau Data Center*, the *LandScan Global Population Database*, the N*ational Oceanic and Atmospheric Administration (NOAA)*, the China Land Cover Dataset (CLCD), and *OpenStreetMap*.

(2) Core independent variable data: the NUPP, policy timelines are sourced from the official websites of *China's National Development and Reform Commission (NDRC)* and the *Ministry of Housing and Urban-Rural Development (MOHURD)*. The pilot policy was rolled out in three waves: late 2014, late 2015, and late 2016. Given that all pilot batches were initiated at year-end, the policy shock years are designated as 2015, 2016, and 2017 to ensure accurate identification of the policy effect. This classification yields a treatment group of 598 pilot counties, with the remaining counties serving as the control group.

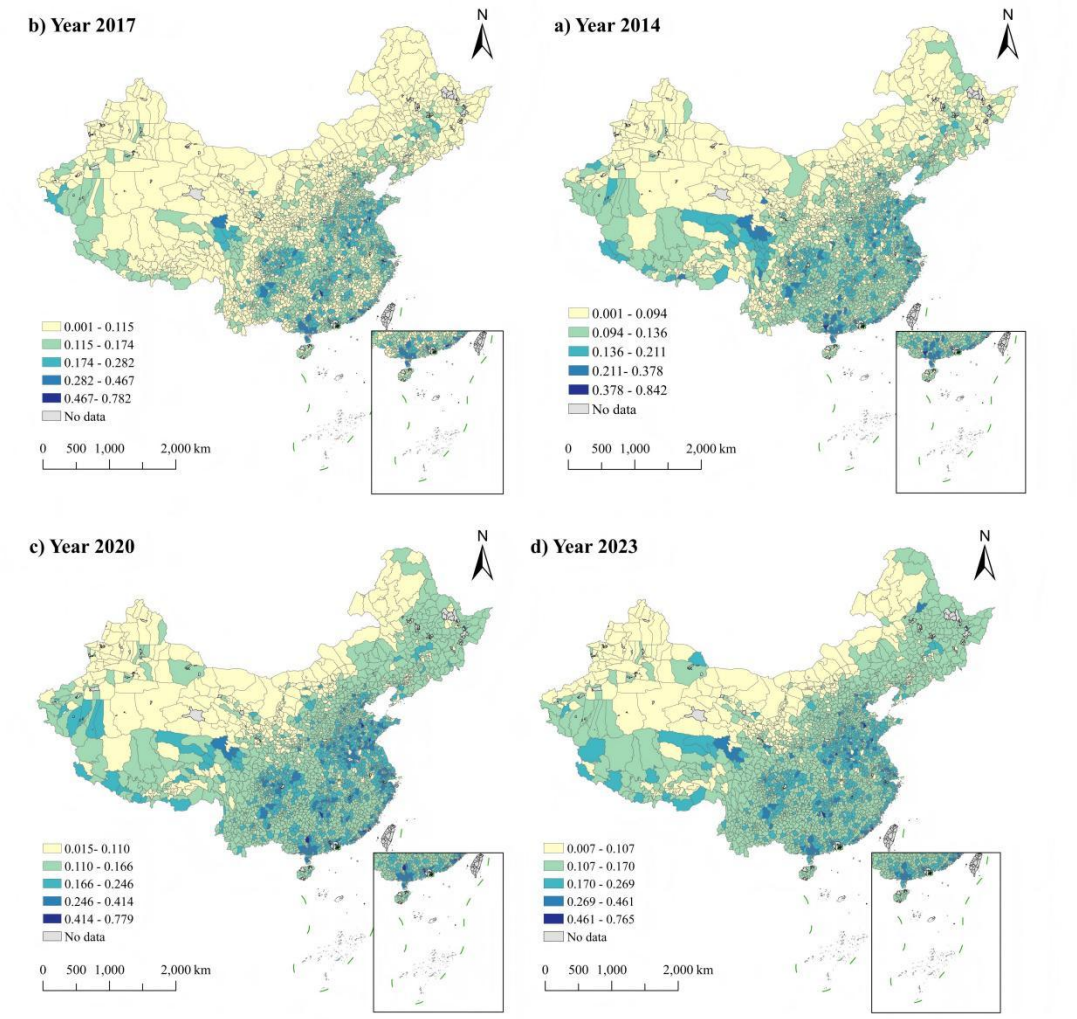
3.2.2 Core Dependent Variable Definitions

Following the established framework by Zhao and Wang (2024), this study employ the Entropy-Weighted TOPSIS method to construct the comprehensive evaluation index for LITBRA shown at table 1, which integrates three core dimensions and 17 sub-indicators to reflect policy connotations while ensuring county-level data availability. Under this evaluation framework, firstly the livability dimension measures fundamental rural functions targeting high-quality human settlements, emphasizing residential comfort and ecological sustainability by integrating ecological indicators like pollutant emissions, climate conditions, and precipitation with public service indicators such as healthcare facilities and road density. Furthermore, the industry-thriving dimension evaluates county-level industrial upgrading, industrial prosperity, and digital finance, focusing on leveraging local agricultural

resources to drive tri-industry fusion, build modern value chains, and expand local employment, which encompasses specific indicators including industrial upgrading indices, agricultural development levels, financial support for industrial growth, industrial infrastructure, and digital financial inclusion indices. Finally, the beautiful villages dimension reflects rural cultural civilization and governance efficiency by balancing social welfare, cultural soft power, and spiritual civilization, which specifically captures government governance capacity, fiscal autonomy, elderly and childcare services, educational resources, and demographic vitality.

Figure 1 illustrates the spatial distribution of LITBRA across Chinese counties in 2014, 2017, 2020, and 2023, revealing substantial spatial heterogeneity and phased evolutionary characteristics. Geographically, high-value clusters are predominantly concentrated in the eastern coastal regions and the middle-to-lower reaches of the Yangtze River; moderate-level counties are widely distributed across North China, Central China, and parts of Southwest China; and low-value areas are mainly concentrated in Northwest China and remote western regions, exhibiting a distinct east-to-west declining gradient. Temporally, the overall rural development level exhibited a progressive upward trend over the four periods, characterized by an expanding footprint of mid-to-high value zones. However, regional disparities remain pronounced, underscores persistent spatial imbalances.

Figure 1 Spatial pattern evolution of livable, industry-thriving, and beautiful rural areas across Chinese counties (2014–2023)



Note: The map is constructed based on the standard map available from the Standard Map Service website of the Ministry of Natural Resources of China (Review Number: GS (2024) 0650). The boundaries of the base map were not modified.Source(s):Authors' own work

Table 1 Indicator system for the development level of livable, industry-thriving, and beautiful rural areas

Level 1 Indicator	Level 2 Indicator	Definition / Measurement	Attribute
Livability	Pollutant emissions	CO^2emissions (tons)	-
	Climate conditions	Hu Huanyong Line: 1 for the southeast side; 0 for the northwest side	+
	Precipitation status	Annual precipitation (mm)	+
	Healthcare infrastructure	Number of beds in hospitals and health centers(beds)	+
	Physical infrastructure	Road density (km/km^2)	+
Industry-Thriving	Rural industrial upgrading	Share of primary industry value-added in GDP*1 + share of secondary industry value-added in GDP*2 + share of tertiary industry value-added in GDP*3	+

Level 1 Indicator	Level 2 Indicator	Definition / Measurement	Attribute
	Agricultural development	Primary industry value-added / GDP (%)	+
	Financial support for industrial growth	Outstanding loans of financial institutions at year-end / GDP (%)	+
	Industrial foundation	Total number of industrial enterprises above designated size	+
	Digital finance development	Digital financial inclusion index	+
	Urban construction shrinkage condition	Construction land area / Agricultural land area (%)	+
	Nighttime light index	Nighttime light index value	+
Beautiful	Government intervention capacity	General public budget expenditure / GDP (%)	+
	Fiscal autonomy	General public budget revenue / general public budget expenditure (%)	+
	Elderly and childcare services	Number of social welfare and adoptive institutions (units)	+
	Educational resource level	Number of students enrolled in regular secondary schools (persons)	+
	Population vitality index	County-level population kernel density value	+

Notes: "+"denotes a positive indicator, "–" denotes a negative indicator. The Hu Huanyong Line is a geographic demarcation line proposed by geographer Hu Huanyong in 1935, reflecting the spatial distribution of China's population and climatic conditions.

3.2.3 Core Independent Variable Definitions

The assignment procedure for the core independent variable, NUPP, is executed as follows: initially, we establish a group dummy variable (treat) by assigning a value of 1 to pilot counties and 0 to non-pilot counties; subsequently, we construct a time dummy variable (post) equal to 1 for the year of policy implementation and all subsequent years, and 0 otherwise; consequently, the interaction term (did = treat × post) is designated as the core independent variable to capture the net policy effect of NUPP on the development of LITBRA.

3.2.4 Descriptive Statistics

Table 2 provides the comprehensive definitions and key descriptive statistics for all primary variables incorporated into analysis.

Table 2 Descriptive statistics of primary variables

Variables	Definition / Measurement	Mean	SD	Min	Max

livable, industry-thriving, and beautiful rural areas *(lwh_index)*	Measured at the county level using the entropy-weighted TOPSIS method	0.133	0.052	0.01	0.583
New urbanization pilot policy *(new_urban_did)*	Whether the county is recognized as a NUPP pilot zone in the current and subsequent years: yes = 1, no = 0	0.24	0.427	0	1
Economic development *(ln_gdp)*	Ln (county gross domestic product) (10,000 RMB)	14.072	1.11	9.85	17.755
Resident savings level *(savings_gdp_ratio)*	Local government year-end resident savings deposits / GDP (%)	0.905	0.477	0	5.649
Fixed telephone users *(ln_fixed_phone)*	Ln (number of fixed telephone subscribers)	10.055	1.199	2.639	15.471
Registered population *(registered_pop)*	Total registered population at the county level (10,000 persons)	49.233	37.076	0.8	252
Average temperature *(avg_temp)*	Average temperature by year (°C)	12.979	6.316	-6.834	25.75
Average wind speed *(avg_wind)*	Average wind speed by year (m/s)	2.119	0.54	0.833	9.507
Terrain ruggedness IV *(tri_index)*	Instrumental variable: The product of the reciprocal of the annual RMB-to-USD exchange rate and the terrain ruggedness index (%)	0.002	0.002	0	0.01
Total retail sales *(ln_retail_sales)*	Ln (total retail sales of consumer goods) (10,000 RMB)	13.022	1.183	8.297	16.659
Total granted patents *(ln_total_patents)*	Ln (total number of granted patents)	4.805	1.736	0	10.674
Digital economy policy support *(ln_digital_level)*	Ln (frequency of keywords related to the digital economy in government work reports)	1.9	1.339	0	5.03
County fiscal pressure *(fiscal_pressure)*	(General public budget expenditures-general public budget revenue)/ general public budget revenue (%)	5.737	8.964	-21.114	174.546

4. Empirical Results

4.1 Benchmark Regression

Table 3 reports the benchmark regression results. Column (1) presents the baseline OLS estimates without any fixed effects or controls, while column (2) incorporates both county and year fixed effects. The estimated coefficient

on new_urban_did is remain significantly positive at the 1% level, suggesting that NUPP effectively promotes the development of livable, industry-thriving, and beautiful rural areas. Columns (3) to (8) sequentially add county-level control variables. Across all models, the coefficients of new_urban_did remain significantly positive at the 1% level, and stable in magnitude, confirming the robustness of our baseline findings. The full specification in column (8) shows that NUPP is estimated to increase the development index of livable, industry-thriving, and beautiful rural areas by approximately 0.3%. The results of the benchmark regression effectively validated Hypothesis 1.

Table 3 Benchmark regression results

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
new_urban_did	0.029***	0.004***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ln_gdp			-0.002	0.003	0.004*	0.002	0.002	0.001
			(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
savings_gdp_ratio				0.007***	0.007***	0.007***	0.007***	0.006***
				(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ln_fixed_phone					-0.002***	-0.002***	-0.002***	-0.001***
					(0.000)	(0.000)	(0.000)	(0.000)
registered_pop						0.001***	0.001***	0.001***
						(0.000)	(0.000)	(0.000)
avg_temp							-0.001	-0.002*
							(0.001)	(0.001)
avg_wind								-0.003***
								(0.001)
Constant	0.134***	0.119***	0.145***	0.065*	0.069**	0.056	0.074**	0.089***
	(0.001)	(0.000)	(0.026)	(0.034)	(0.035)	(0.034)	(0.034)	(0.034)
Year fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	27,710	27,710	25,277	20,746	20,283	20,260	20,241	19,997
R-squared	0.019	0.295	0.324	0.342	0.344	0.354	0.354	0.363
Number of id	2,771	2,771	2,616	2,169	2,121	2,120	2,118	2,093

Note: ***, ** and *significance levels at 0.01, 0.05 and 0.1, respectively. Standard errors are reported in parentheses.

4.2 The Parallel Trend Test

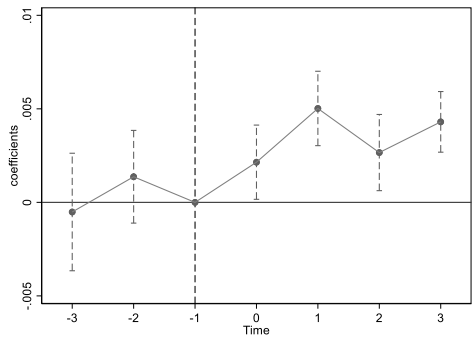
The validity of the staggered DID approach hinges on the parallel trends assumption, requiring that the

treatment and control counties exhibit identical pre-treatment development trends in LITBRA. Following Jacobson et al. (1993), this study employ the event study framework to test this assumption using the following econometric specification:

$$new_urban_did_{it} = \alpha + \sum_{k=-3}^{k=3} \alpha_t D_{i,t_0+k} + \beta X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (2)$$

Where D_{i,t_0+k} represents a set of dummy variables, t_0 denotes the year of policy implementation(with t_0=0), k indicates the k[th] year relative to the year the policy was implemented.. Negative values of k indicate years before policy implementation, while positive values indicate years after. For clarity in presenting the parallel trends results, we set the pre-policy period (k=-1) as the baseline period. Figure 2 presents the event study results. The estimated coefficients are insignificant across all pre-policy periods, indicating that there are no significant differences between pilot and non-pilot counties prior to the policy intervention, which satisfies the parallel trends assumption. In contrast, the coefficient turns positive in the first period after implementation and exhibits a continuous upward trend in subsequent periods. In sum, these results support the parallel trends assumption.

Figure 2 Parallel trends test



Source(s):Authors' own work

4.3 Placebo Tests

To rule out the possibility that the benchmark estimates are driven by omitted variables or unobserved random factors, I follow(Chen et al. 2025) to conduct placebo tests from two dimensions: randomizing the policy timing and

randomizing the treatment counties.

First, this ressearch randomize the policy implementation timing while keeping the actual pilot counties unchanged.For each pilot county, we randomly assign a pseudo-treatment year drawn from the pre-policy window [2014, t-1], and re-estimate the model based on the generated pseudo-interaction term. This procedure is repeated 1,000 times, and the resulting kernel density distribution of the placebo coefficients is presented in figure 3. The estimated coefficients are normally distributed around zero with a mean of -0.006, which is nearly two times smaller than the baseline estimate of 0.003. This counterfactual counter-evidence confirms that the promotional effect of NUPP on the development of LITBRA is genuinely causal rather than accidental.

Second, I randomize treatment counties while keeping policy timing fixed. For each year *t* with *n* pilot counties, we randomly select *n* never-treated counties as the pseudo-treatment group and re-estimate the model. Repeating this 1,000 times yields figure 4. The placebo coefficients cluster around zero (mean = -0.001), substantially smaller than the true coefficient of 0.003, further confirming that our results are not driven by unobserved random shocks, consistent with the theoretical expectations of the placebo test.

Figure 3 Kernel density plot of the placebo test (randomized policy timing)

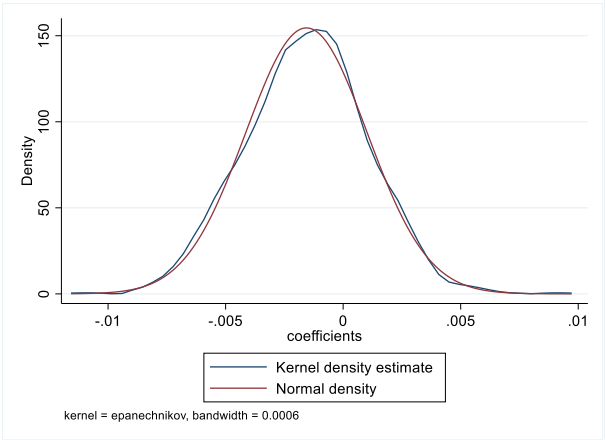
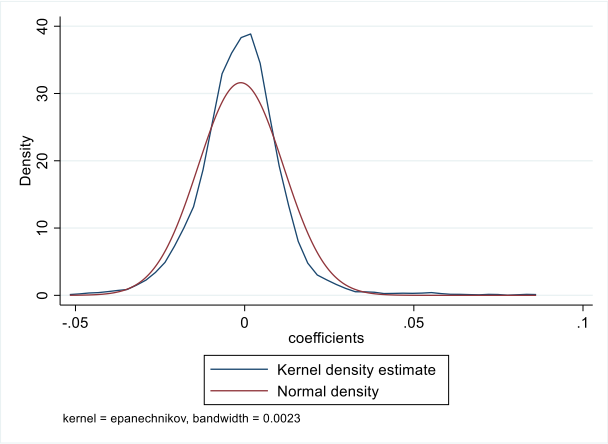


Figure 4 Kernel density plot of the placebo test (randomized treatment counties)



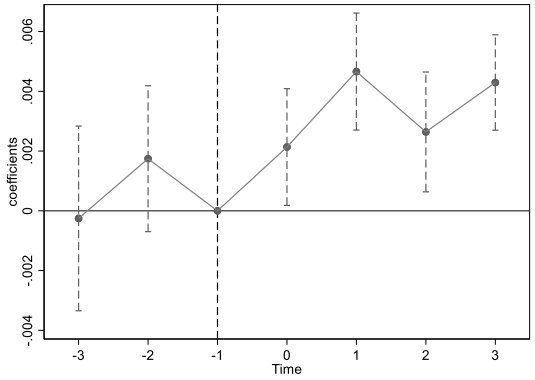
Source(s):Authors' own work

4.4 Robustness Checks

4.4.1 PSM-DID Analysis

To mitigate potential estimation bias arising from the non-random selection of the urbanization pilot sample, we further employ the PSM-DID method to correct for sample selection bias. Specifically, I adopt k-nearest neighbor matching (k = 4, caliper = 0.02) to sequentially match the treatment and control groups on a year-by-year basis. Table 4 shows that post-matching standardized biases are substantially reduced and mean differences between treatment and control groups become insignificant, confirming the balancing assumption, thereby establishing a reliable sample base for subsequent DID estimations. Furthermore, the parallel trends test conducted on the matched sample, illustrated in figure 5, fully satisfies the parallel trends assumption. Based on this matched sample, the re-estimated result presented in column (1) of table 6 demonstrates that NUPP still significantly positive impact on the development level of LITBRA, indicating that the baseline findings remain highly robust after controlling for sample selection bias.

Figure 5 Parallel trends test for the PSM-DID estimation



Source(s):Authors' own work

Table 4 Covariate balancing test results

Variables	Unmatched/ Matched	Mean_Treated	Mean_Control	%bias	P-Value
ln_gdp	U	14.645	13.839	78.5	0.000***

savings_gdp_ratio	M	14.644	14.642	0.2	0.908
	U	0.876	0.917	-9	0.000***
ln_fixed_phone	M	0.876	0.875	0.2	0.910
	U	10.592	9.836	67.1	0.000***
registered_pop	M	10.591	10.576	1.4	0.444
	U	63.887	43.257	56.2	0.000***
avg_temp	M	63.846	63.56	0.8	0.702
	U	14.512	12.353	36.1	0.000***
avg_wind	M	14.507	14.693	-3.1	0.063
	U	2.179	2.095	15.7	0.000***
	M	2.178	2.206	-5.3	0.006**

Note: ***, ** and *significance levels at 0.01, 0.05 and 0.1, respectively.

4.4.2 Excluding Municipalities

This study employs county-level samples for the empirical analysis. However, counties under the jurisdiction of the four municipalities—Beijing, Tianjin, Shanghai, and Chongqing—possess distinct advantages in economic development, policy support, cultural resources, and industrial foundations. Including these regions in the regression sample might confound the estimation results and upwardly bias the estimated coefficients. Consequently, we re-estimate the model after excluding the samples from these four municipalities, with the results reported in column (2) of table 5. The results remain consistent with the baseline.

4.4.3 Shortening the Sample Period

The sample period of this study is from 2014 to 2023, the latter half of which might be confounded by non-policy shocks factors such as the COVID-19 pandemic. To eliminate this potential influence, this research excluded the samples after 2021 and re-estimate the regression. The results are shown in column (3) of Table 5. The estimated coefficient of the new urbanization policy on the LITBRA still remains significantly positive, and the conclusion of the baseline regression remains robust.

4.4.4 Controlling for Concurrent Policy Interferences

Within our sample window, several other pilot policies were concurrently implemented across counties, including National Modern Agricultural Demonstration Zones, the Entrepreneurship Returnee Pilot Program, the Rural E-commerce Comprehensive Demonstration Pilot, the National Rural Revitalization Demonstration Counties, the National Agricultural Industrialization Demonstration Bases, and the Agricultural Modernization Demonstration Zones. To control the interference of these concurrent policies on the estimation baseline results, I controlled the dummy variables for each pilot policy in the model and re-performed the regression. The results are shown in the (4) column of table 5. The results indicate that the estimated coefficient of NUPP remains significantly positive, and the size of the coefficient is basically consistent with the baseline regression. This further verifies that NUPP effectively enhances development level of LITBRA.

4.4.5 Mitigating Extreme Outliers (1% Winsorization)

To mitigate the potential influence of extreme outliers, we winsorize all continuous variables at the 1st and 99th percentiles and re-estimate the model on the transformed sample. The results, shown in column (5) of table 5, indicate that the coefficient of the core independent variable remains consistent with the baseline findings. This confirms the robustness of our baseline conclusions.

4.4.6 Addressing Endogeneity

To address potential endogeneity concerns arising from reverse causality and omitted variable bias, we employ an instrumental variable (IV) approach. Specifically, while the construction of new urbanization enhances the development level of livable, industry-thriving, and beautiful rural areas, the improvement of rural areas may conversely accelerate localized urbanization processes, and this simultaneous bidirectional causality can trigger endogenous issues. Additionally, the omission of key unobserved control variables may also bias our estimates. To

mitigate the endogeneity issues, we employ the instrumental variable (IV) strategy to obtain consistent estimates and improve the robustness of the conclusion.

Topographical conditions are a fundamental natural endowment for new urbanization (Dai et al. 2018). Following Liu (2019), we select county-level terrain ruggedness as the foundational instrumental variable for our core independent variable. Regarding the problem that this variable is cross-sectional data and lacks a time dimension, I refers to the approach of Lv and Fan (2024) and construct a new instrumental variable by interacting terrain ruggedness index[3] by the reciprocal of the annual RMB-to-USD exchange rate[4], since exchange rate fluctuations effectively capture regional macroeconomic openness and exert a substantial influence on urbanization processes.

This part i use two-stage least squares (2SLS) estimation, with results reported in columns (6) and (7) of table 5. The first stage shows that the IV is significantly positive at the 1% level, with an F-statistic of 324.06, far exceeding the threshold of 10, thus rejecting weak instrument concerns. The second stage yields an estimated coefficient of 0.079 for the IV variable after controlling for endogeneity, which is larger than the baseline and consistent with our main findings. This confirms that NUPP significantly promotes development level of LITBRA, reinforcing the robustness of our benchmark results.

Table 5 Robustness checks results

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	PSM-DID	Excluding Municipalities	Shortening the Sample Period	Controlling for Concurrent Policy Interferences	Mitigating Extreme Outliers	First-stage (2sls)	Second-stage (2sls)

[3] Source: Relief Degree of Land Surface Dataset of China (1km), https://www.geodoi.ac.cn/WebCn/doi.aspx?Id=887

[4] Exchange Rate: Annual RMB-USD exchange rate (2014–2023). Source: People's Bank of China, https://www.pbc.gov.cn/zhengcehuobisi/125207/125217/125925/index.html

did_psm1	0.003***						
	(0.001)						
new_urban_did		0.003***	0.004***	0.003***	0.003***		
		(0.001)	(0.001)	(0.001)	(0.001)		
tri_index(IV)						244.336***	0.079***
						(16.2633)	(0.009)
Constant	0.056***	0.089***	0.092***	0.107***	0.019	0.058	0.048*
	(0.020)	(0.034)	(0.035)	(0.009)	(0.034)	(0.193)	(0.025)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,882	19,631	16,084	19,997	19,997	19,997	19,997
R-squared	0.367	0.363	0.385	0.362	0.368	0.225	0.048
Number of id	2,092	2,056	2,090	2,093	2,093	2,093	2,093

Note: ***, ** and *significance levels at 0.01, 0.05 and 0.1, respectively. Standard errors are reported in parentheses.

5. Mechanism Analysis

5.1 Demand Side: Scale of Domestic Demand

From the demand side, I utilizes the total retail sales of consumer goods as the core indicator to measure the scale of domestic demand. Urbanization drives rural population agglomeration and income growth, which stimulates rural industrial development. It promotes the "industry-thriving, livable, and beautiful" goals across multiple dimensions, including job creation, infrastructure-backed consumption support, and the revitalization of life services. The regression results in column (1) of table 6 suggest that a larger scale of total retail sales of consumer goods significantly amplifies the promotional effect of the urbanization policy on the development of LITBRA. This indicates that expanding domestic demand effectively strengthens rural infrastructure construction and development

momentum, providing robust support for achieving these comprehensive rural development goals. These findings empirically validate Hypothesis 2.

5.2 Supply Side: Technological Innovation

From the supply side, the total number of granted patents at the county level is employed to represent the level of technological innovation. New urbanization has enabled more advanced technologies to be introduced to rural areas, enhancing agricultural production efficiency and the competitiveness of non-agricultural industries, which in turn drives the upgrading and optimization of rural industrial structures.The estimation results in column (2) of Table 6 show that a higher number of granted patents significantly enhances the promotional impact of the urbanization policy on upgrading livable, industry-thriving, and beautiful rural areas. By optimizing the allocation of production factors and increasing output efficiency, technological innovation provides industrial support for "industry-thriving," creates material foundations for "livability," and injects growth momentum into "beautiful villages." These results empirically validate Hypothesis 3.

5.3 Governance Side: Digital Economy Policy Supply Level

From the perspective of government governance, following Tao (2023) and employing the digital economy policy supply level to measure local government support for digital development.This indicator is constructed based on the word frequency of digital economy-related keywords in government work reports, reflecting local governments' policy attention and resource allocation toward the digital economy. Urbanization fosters county-level economic agglomeration, industrial upgrading, and talent inflows, which heightens local governments' recognition of the digital economy’s role in development. Guided by these policies, digital infrastructure is continuously improved. The digital economy expansion broadens financing and sales channels for rural industries, lowers

transaction costs, and enhances factor allocation efficiency.Consequently, it creates more employment opportunities for "industry-thriving" dimensions, enhances daily convenience for "livability", and strengthens rural governance efficiency for "beautiful villages" goals. As reported in column (3) of Table 6, a higher level of digital economy policy supply significantly amplifies the promotional effect of NUPP on LITBRA, thereby validating Hypothesis 4.

Table 6 Mechanism analysis results

Variables	(1) Scale of Domestic Demand	(2) Technological Innovation	(3) Digital Economy Policy Supply Level
ln_retail_sales*new_urban_did	0.007***		
	(0.001)		
ln_total_patent*new_urban_did		0.004***	
		(0.001)	
ln_digital_level*new_urban_did			0.001***
			(0.000)
Constant	-0.000	0.050	0.091***
	(0.034)	(0.033)	(0.034)
Observations	15,432	19,401	19,997
R-squared	0.403	0.378	0.364
Number of id	1,895	2,081	2,093

Note: ***, ** and *significance levels at 0.01, 0.05 and 0.1, respectively. Standard errors are reported in parentheses.

6. Heterogeneity Analysis

6.1 Regional Heterogeneity

To capture regional variations, I divide the sample into eastern, central, and western regions following of the National Bureau of Statistics of China, and group-based regression analysis is conducted to examine the impact of NUPP. Columns (1) to (3) of table 7 show that NUPP significantly enhances the development of LITBRA only in the western region, while its impact is insignificant in the central and eastern regions. This likely reflects that western

China with its lagging urbanization, yields higher marginal returns from policy-driven resource influxes, while the more developed eastern and central regions experience limited incremental gains. Overall, the policy effect exhibits notable regional heterogeneity, with western counties are effectively activated by the policies.

6.2 Economic Level Heterogeneity

Following Guo *et al.* (2025), I split the sample into non-former poverty (Np) and former poverty (P) counties based on the national poverty list of 832 counties released by the State Council in 2014. The results in columns (4) and (5) indicate a significant positive treatment effect exclusively in non-former poverty counties, which possess stronger fiscal capacities and better infrastructure to support policy execution. Conversely, former poverty counties were still engaged in the critical phase of the "Poverty Alleviation Campaign" during our sample period, prioritizing basic "addressing weaknesses" tasks, which delayed the realization of policy dividends.

6.3 Digital Economy Policy Supply Heterogeneity

An optimal levels of local government digital economy policy supply can effectively promote rural capital circulation, industrial development, and employment improvement.However, excessive policy supply may lead to crowding-out effects in policy implementation. To examine the heterogeneous moderating role of digital economy policy supply, I divide the sample into three groups based on quartiles of the digital economy policy supply indicator: low digital supply (Lds, below 25%), medium digital supply (Mds, 25%–75%), and high digital supply (Hds, above 75%). The regression results in columns (6) to (8) of Table 7 demonstrate that the estimated coefficients for both the low and medium supply groups are significantly positive. This indicates that under moderate supply constraints, NUPP significantly enhances development of livable, industry-thriving, and beautiful rural areas. Conversely, the

coefficient for the high-supply group is insignificance. This suggests an optimal threshold: moderate digital support unlocks policy dividends, but excessive intensity yields diminishing returns.

6.4 Fiscal Pressure Heterogeneity

In general, counties under severe fiscal pressure face constraints in financing rural infrastructure, industrial upgrading, healthcare, education, and ecological governance and cultural development, which limits the spillover effects of urbanization on rural upgrading. Following Zhang *et al.* (2025), we evaluate how local fiscal constraints condition policy efficacy. Fiscal pressure partitioned into low fiscal pressure (Lfp, below 25%), moderate fiscal pressure (Mfp, 25%–75%), and high fiscal pressure (Hfp, above 75%).Higher values indicate tighter fiscal capacity, which is theoretically unfavorable for policy efficacy. The estimation results,shown in columns (9) to (11) of table 7 suggest that a significant positive effect exists exclusively within the low fiscal pressure group, while the coefficients for the moderate and high groups are insignificant. This validates the inhibitory role of fiscal constraints, demonstrating that counties with lighter fiscal burdens possess the flexible resource buffers necessary to fully capitalize on NUPP dynamic.

Table 7 Heterogeneity analysis results

Variables	(1) East	(2) Central	(3) West	(4) Np	(5) P	(6) Lds	(7) Mds	(8) Hds	(9) Lfp	(10) Mfp	(11) Hfp
new_urban_did	0.002	0.001	0.004**	0.003**	0.001	0.004**	0.002*	0.006	0.005*	0.001	-0.004
	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.006)	(0.003)	(0.001)	(0.003)
Constant	0.090	0.042	0.123***	-0.018	0.273***	0.246***	0.072*	0.085	0.128	-0.026	0.325***
	(0.082)	(0.036)	(0.047)	(0.039)	(0.072)	(0.094)	(0.038)	(0.087)	(0.132)	(0.039)	(0.079)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

effects											
Observations	5,335	5,971	8,691	12,136	7,861	5,472	10,298	4,227	2,367	11,137	6,493
R-squared	0.411	0.537	0.292	0.373	0.402	0.373	0.379	0.358	0.474	0.436	0.342
Number of id	587	608	898	1,289	804	1,441	1,886	1,416	542	1,620	975

Note: ***, ** and *significance levels at 0.01, 0.05 and 0.1, respectively. Standard errors are reported in parentheses.

7. Conclusions and Policy Implications

Based on a panel dataset of 2,093 Chinese counties from 2014 to 2023, this paper constructs a comprehensive evaluation index system for the development of LITBRA using the entropy-weighted TOPSIS method to map its spatiotemporal evolution. Furthermore, a staggered DID model is employed to empirically examine the impact and underlying transmission mechanisms of the NUPP on county-level livable, industry-thriving, and beautiful rural development.The empirical findings have three parts. Firstly, the baseline regression demonstrates that NUPP significantly accelerates the development level of livable, industry-thriving, and beautiful rural areas, remains exceptionally robust across a battery of robustness checks, including parallel trends, placebo, PSM-DID, and concurrent policy controlling tests, as well as instrumental variable (IV) estimations to mitigate potential endogeneity bias. Second, the mechanism analysis reveals that NUPP facilitates rural progress primarily through three structural pathways: expanding domestic demand scale, driving technological innovation, and strengthening local government support for the digital economy. Third, heterogeneity analysis indicates that this promotional effect is more pronounced in China's western region, former non-property counties, areas with low and medium digital economy policy supplies, and counties unburdened by low fiscal distress.

Based on the above findings, the policy implications of this study are clear and multifaceted:

Policymakers should continuously advance people-centered new-type urbanization, emphasizing the bidirectional flow of demographic, land, and capital factors between urban and rural areas, thereby optimizing resource allocation efficiency. At the same time, the functional role of the counties must be strengthened as a vital

hub for integrated urban-rural development, driving the structural integration of regional infrastructure and the equalization of basic public services to improve the overall level of LITBRA.

The potential of county-level domestic demand must be fully unleash to solidify the market foundations of rural industries. On one hand, policy efforts should focus on stabilizing agricultural income growth and improving rural pension and healthcare systems to strengthen residents' consumption capacity and expectations. On the other hand, it involves expanding commercial service networks—such as commerce and logistics to cover county-level and rural areas, reducing circulation costs and enhancing commodity accessibility. Expanding localized demand can effectively trigger domestic industrial expansion and employment growth, thereby optimizing the supply-demand cycle.

Governments should strengthen technological innovation and digital economy empowerment to modernize rural governance and industrial development. This requires policy support for technological innovation at the county level, encouraging tech-driven enterprises to establish operations in these counties, and promoting industrial upgrading and the cultivation of emerging industries. At the same time, accelerating the deployment of digital village information infrastructure to establish a digital backbone, fully unleashing the potential of digital technologies to weaken geographic constraints and broaden market channels.

Governments should implement differentiated and tailored policy frameworks to promote coordinated regional development based on local conditions. Given that Chinese counties exhibit variations in natural conditions and socioeconomic baselines, the potential for building livable, industry-thriving, and beautiful rural areas also exhibits uneven characteristics. Therefore, NUPP frameworks must adapt to local conditions. For western counties where policy returns are highest, they should continue to be prioritized as key areas for advancement, strengthening spatial

spillovers and demonstration effects. For counties with lower digital development but lighter fiscal burdens, upgrading digital infrastructure should be prioritized to maximize policy implementation efficiency. Finally, for financially constrained counties, governance should prioritize optimizing the allocation of capital, talent, and technology rather than simply intensifying policy input intensity to boost policy implementation efficiency. Through the implementation of tailored policies, China can achieve the coordinated advancement of policy effects across counties.

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