



Research on the heterogeneous impacts and mechanisms of new urbanization on agricultural economic resilience

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SUMMARY: *Based on provincial panel data from 2010 to 2022, this paper examines the mechanisms and heterogeneous effects of new urbanization on China's agricultural economic resilience. The findings are as follows: (1) New urbanization significantly enhances resilience, with a stronger effect in major grain-producing areas. (2) This effect is partially mediated by land transfer, technological progress, and human capital, with human capital being the most influential channel. (3) Agricultural agglomeration has a single-threshold effect; the promoting effect of urbanization is greater where agglomeration is low. (4) The effect demonstrates stage heterogeneity and increasing marginal returns. (5) Considerable potential exists for improving the coupled coordination between the two systems, with notable regional variations. The study concludes that policy interventions must be adapted to local circumstances, fully leverage regional advantages, build a regional coordinated development supply system, and promote the dynamic coupling of common prosperity and high-quality development.*

KEYWORDS: *New urbanization; Resilience of agricultural economy; Heterogeneity; High quality development*

1 Introduction

Against the backdrop of an increasingly complex and volatile international environment, climate change, resource constraints, and demographic pressure have become direct constraints on human settlement systems and food security. New urbanization is therefore no longer limited to population concentration or built-up land expansion; it has increasingly been framed as a coordinated process involving sustainable urban development, urban resilience, technological upgrading, and regional integration [1]. In the Chinese context, the new-type urbanization agenda after 2014 has gradually shifted toward people-oriented development and multidimensional coordination across population, economy, society, and environment [2]. China has made progress in new urbanization and agricultural economic resilience, although uneven urban-rural development, inefficient land resource allocation, and weak agricultural technological innovation remain evident.

In April 2025, the CPC and the State Council released the "Plan for Accelerating the Development of China into an Agricultural Powerhouse (2024-2035)", emphasizing supply security, advanced technology and equipment, efficient operation systems, industrial resilience, and agricultural competitiveness. New urbanization provides an important route for reallocating population, land, capital, and public services between urban and rural areas, and

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its effect on agricultural economic resilience has been confirmed in recent empirical evidence from China [3]. Enhancing agricultural economic resilience is also a prerequisite for stabilizing agricultural modernization under compound shocks [4]. Technological progress and industrial upgrading further explain why urban-rural transformation can strengthen the capacity of agricultural systems to resist, recover, and reorganize after external disturbances [5].

Existing research on agricultural economic resilience has examined rural industrial integration [6], rural population aging [7], digital rural development [8], agricultural industrial agglomeration [9], information technology and digital inclusive finance [10], and agricultural low-carbon transition [11]. Studies on new urbanization have also moved toward the rural digital economy [12], heterogeneous urbanization and agricultural green development [13], urban-agro-ecological coordination [14], and green development efficiency [15]. Building on these studies, the present paper uses provincial panel data from 2010 to 2022 to construct an agricultural economic resilience index covering resistance, recoverability, and reinvention capability, along with a new urbanization index covering population, economy, society, and environment. Panel regression, mediation-effect testing, panel threshold regression, panel quantile regression, and coupling coordination analysis are then used to identify the direct effect, transmission channels, nonlinear threshold features, and regional coordination differences.

2 Journals reviewed

New urbanization is a strategic pathway for coordinating population mobility, industrial upgrading, public-service equalization, and resource-environment constraints. Recent studies have shifted from single-indicator evaluation toward resilience-oriented and sustainability-oriented assessments. Regional evidence shows that agricultural resilience varies markedly across China [16], while risk-management instruments such as agricultural insurance can buffer rural households against natural-disaster shocks [17]. Digitalization also affects agricultural production resilience through nonlinear and spatially differentiated channels [18]. Environmental regulation further conditions the relationship between ecological pressure and agricultural economic resilience [19].

Against the background of food-security pressure and climate uncertainty, agricultural economic resilience has become a central issue in agricultural modernization. Its analytical focus is not only whether agricultural output can remain stable under shocks, but also whether production, circulation, technology adoption, and institutional support can recover and reorganize after shocks. Evidence based on efficiency measurement and quantile regression indicates that the relationship between urbanization and the agricultural economy differs across efficiency levels and regional development stages [20].

A complex interaction exists between new urbanization and agricultural economic resilience. Urbanization changes agricultural production factors through labor mobility, land transfer, market expansion, infrastructure improvement, and technology diffusion. Agricultural economic resilience, in turn, determines whether rural areas can support stable urban-rural circulation under external shocks. Current research indicates that technological progress, rural industrial integration, digital finance, green transformation, and environmental regulation all contribute to agricultural resilience, but the heterogeneous and mechanism-based effects of new urbanization remain insufficiently identified. This paper therefore examines direct effects, mediating channels, threshold heterogeneity, quantile differences, and coupled coordination between new urbanization and agricultural economic resilience.

Current research underscores that technological progress, rural industrial integration, green finance, and the digital economy, among other factors, play pivotal roles in enhancing agricultural economic resilience. Meanwhile, the urbanization process interacts with agricultural development through population migration, industrial structure adjustments, and ecological environment impacts. Concurrently, existing literature has also shed light on the challenges China faces in promoting sustainable development, such as urban-rural development imbalances, arable land resource pressures, rural labor force aging, and insufficient agricultural technological innovation.

3 Theoretical Analysis and Hypotheses

3.1 The Direct Impact of New Urbanization

New urbanization focuses on improving residents' livelihoods, promoting urban-rural integration, and achieving common prosperity. It leverages digital means to optimize agricultural production processes and strengthens the industrial system to enhance agriculture's capacity to resist, recover from, and adapt to risks.

First, new urbanization enhances the pre-risk resistance of agricultural economic resilience. It can establish multi-layer logistics networks to improve the circulation of agricultural products, reducing the risk of concentrated losses. Simultaneously, by building IoT and big data platforms to create agricultural digital systems, it enables the simulation of extreme weather impacts on crops, dynamic monitoring of crop growth status, disaster early warning, and market forecasting, significantly improving risk identification and management efficiency. In complex systems, resilience is often supported by redundancy and diversity; new urbanization can achieve "decentralized" risk buffering through physical-digital integration.

Second, new urbanization enhances the post-risk recoverability of agricultural economic resilience. It can accelerate system reconstruction after agricultural shocks. New urbanization promotes the upgrading of the agricultural industrial structure, forming flexible supply chains that can quickly adapt to changes in market demand. Furthermore, innovations in financial insurance tools, utilizing urbanization data, can enable rapid loss assessment and claims settlement, improving payout efficiency. By introducing technological innovations, new urbanization facilitates more flexible resource combinations, enhancing the industry's dynamic adaptive capacity.

Third, new urbanization enhances the post-risk reinvention capability of agricultural economic resilience. It drives systemic transformation and upgrading through technological innovation and institutional reform. Upgraded new infrastructure accelerates the penetration and implementation of cutting-edge technologies in agriculture, such as remote sensing monitoring and smart irrigation, shortening the innovation adoption cycle. Meanwhile, resilience-oriented policies and subsidy mechanisms promote the construction of multi-agent collaborative innovation networks, continuously boosting industrial innovation vitality.

Hypothesis H1: New urbanization has a direct promoting effect on agricultural economic resilience.

3.2 The Indirect Impact of New Urbanization

3.2.1 Land Transfer Effect

The land element optimizes resource allocation through the land transfer effect, enabling new urbanization to enhance agricultural economic resilience. New urbanization promotes the

concentration of land management rights to cooperatives, agricultural enterprises and other new business entities. Concentrated land management can lower production costs per unit area, enhance production efficiency, and achieve scale economy and cost control. Moreover, large-scale operations have better access to credit support, which can be used to improve farmland quality, implement soil amelioration, and enhance the disaster resistance of cultivated land. Through the land transfer effect, new urbanization facilitates the large-scale centralized management of land, making it easier to reduce disaster losses through technological early warning, thereby strengthening the resistance of agricultural economic resilience. In summary, the paper proposes the following hypothesis:

Hypothesis H2a: New urbanization indirectly enhances agricultural economic resilience through the land transfer effect.

3.2.2 Technological Progress Effect

The technology element drives agricultural technological innovation through the technological progress effect, indirectly enhancing agricultural economic resilience. New urbanization improves agricultural production efficiency and boosts resilience through technology diffusion and whole-industry-chain restructuring. The urbanization process facilitates the penetration of advanced technologies into rural areas, accelerating the implementation of intelligent management throughout the agricultural production process. For instance, urbanization promotes the application of agricultural technologies like remote sensing and IoT, enabling precision fertilization and disaster monitoring, thereby reducing resource waste. Furthermore, technology-enabled industrial chain restructuring significantly improves resource allocation efficiency, attracts external capital, and stimulates local reinvestment, forming a virtuous cycle of "technological upgrade - revenue growth - capital aggregation" that sparks innovation momentum. Additionally, capital investment can accelerate post-disaster reconstruction, enhancing the recoverability and reorganizational capacity of agricultural economic resilience. Thus, this paper proposes the following hypothesis:

Hypothesis H2b: New urbanization indirectly promotes agricultural economic resilience through the technological progress effect.

3.2.3 Human Capital Effect

The labor element, through the human capital effect, upgrades skills and productivity, indirectly enhancing agricultural economic resilience. New urbanization drives the skill upgrading and cognitive transformation of the agricultural labor force by optimizing talent cultivation mechanisms and knowledge dissemination networks, building dynamic adaptive capacity for the industrial system to cope with external shocks. This, in turn, enhances the post-disaster resilience of the agricultural economy. Urbanization can force a restructuring of labor market supply and demand through industrial adjustment. The emergence of new service industries and high-tech positions compels workers to participate in vocational skills training. Improved laborer quality enables farmers to quickly transition to non-agricultural employment in the face of agricultural output reduction. Additionally, urbanization promotes the popularization of education, exposes farmers to diverse knowledge systems, enhances the scientific literacy and innovative consciousness of the new generation of farmers, and improves the reorganizational capacity of agricultural economic resilience. In conclusion, the paper proposes the following hypothesis:

Hypothesis H2c: New urbanization indirectly promotes agricultural economic resilience through the human capital effect.

3.3 The Threshold Effect of New Urbanization

The impact of new urbanization on agricultural economic resilience, moderated by the level of agricultural agglomeration, operates through a dynamic interplay of factor allocation, technological innovation, and ecological constraints. As a paramount driver of economic transformation, urbanization elongates the agricultural value chain by fostering deep integration between primary agriculture and downstream secondary and tertiary industries. Consequently, it promotes the development of a diversified and resilient rural industrial structure, contributing to sustainable regional development. At lower stages of agricultural agglomeration, industrial chain extension directly increases agricultural added value and market competitiveness. However, when agricultural agglomeration becomes excessively high, homogenized competition may intensify, requiring differentiated positioning and technological innovation to maintain agricultural economic resilience. Furthermore, as the stage of urbanization evolves, the focus of relevant policies needs to shift from "scale expansion" to "quality improvement." For example, when agricultural agglomeration is low, policies primarily focus on labor transfer; when agglomeration is high, policies need to focus on empowering the entire agricultural industrial chain with digital technology to enhance systemic shock resistance. Policies must be designed based on regional heterogeneity and development stage to achieve synergy between "agglomeration efficiency" and "resilience enhancement." In summary, the paper proposes the following hypothesis:

Hypothesis H3: New urbanization has a threshold effect on agricultural economic resilience under different levels of agricultural agglomeration.

Based on the above analysis, the paper constructs a theoretical framework of the mechanism between new urbanization and agricultural economic resilience, as shown in Figure 1.

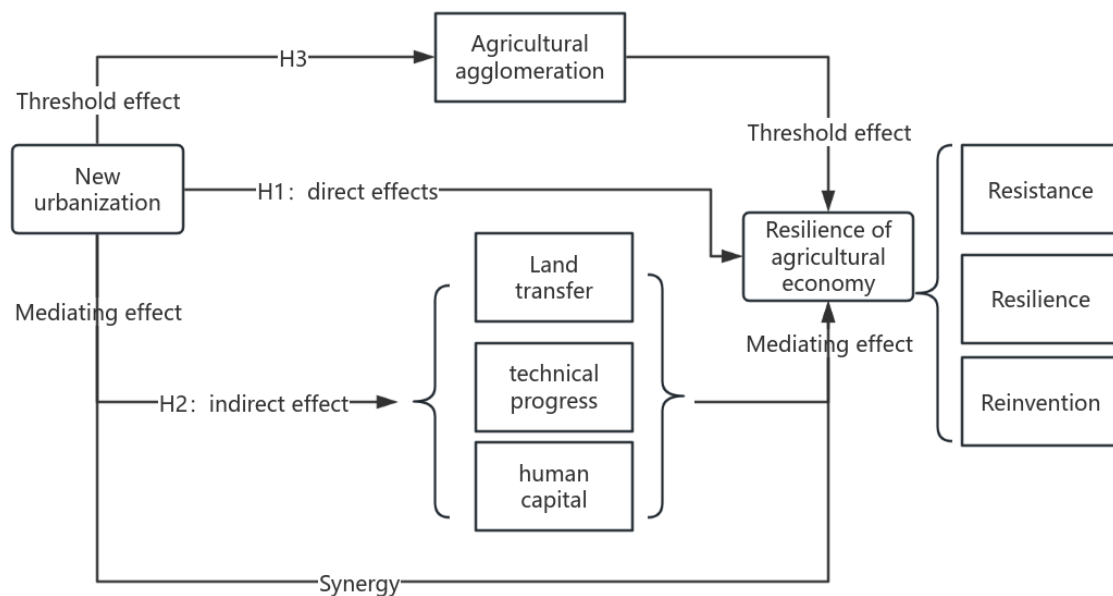


Figure 1: theoretical framework of new urbanization and agricultural economic resilience

4 Model setting

4.1 Model construction

4.1.1 Benchmark Model

To investigate the direct impact of the level of new urbanization on agricultural economic resilience, a panel model is constructed as the benchmark model, with the following settings:

$$RES_{it} = \alpha_0 + \alpha_1 NURB_{it} + \alpha_2 Controls_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

where RES_{it} denotes agricultural economic resilience in province i and year t ; $NURB_{it}$ denotes the level of new urbanization; $Controls_{it}$ is the vector of control variables; α_0 is the constant term; α_1 and α_2 are coefficients to be estimated; μ_i denotes province fixed effects; and ε_{it} denotes the random error term.

4.1.2 Mediation effect model

The mediation effect model is constructed through stepwise testing, following the logic of decomposing total, direct, and indirect effects in mediation analysis [21]. The model is set as follows:

$$RES_{it} = \alpha_0 + \alpha_1 NURB_{it} + \alpha_2 Controls_{it} + \mu_i + \varepsilon_{it} \quad (2)$$

$$MED_{it} = \beta_0 + \beta_1 NURB_{it} + \beta_2 Controls_{it} + \mu_i + \varepsilon_{it} \quad (3)$$

$$RES_{it} = \gamma_0 + \gamma_1 NURB_{it} + \gamma_2 MED_{it} + \gamma_3 Controls_{it} + \mu_i + \varepsilon_{it} \quad (4)$$

where MED_{it} denotes the mediating variable, including $LAND_{it}$, $TECH_{it}$, and CAP_{it} ; β_1 measures the effect of new urbanization on the mediator; γ_2 measures the effect of the mediator on agricultural economic resilience after controlling for new urbanization; and the remaining variables are defined as above.

4.1.3 Threshold effect model

Referring to Hansen's panel threshold method [22], this study employs panel threshold regression to investigate the impact of new urbanization on agricultural economic resilience under different degrees of agricultural agglomeration. The constructed panel threshold regression model is as follows:

$$RES_{it} = \theta_0 + \theta_1 NURB_{it} I(AGG_{it} \leq \eta) + \theta_2 NURB_{it} I(AGG_{it} > \eta) + \theta_3 Controls_{it} + \mu_i + \varepsilon_{it} \quad (5)$$

where AGG_{it} is the threshold variable and represents the degree of agricultural agglomeration; $I(\cdot)$ is the indicator function; η is the threshold value; θ_1 and θ_2 are the estimated coefficients of new urbanization below and above the threshold, respectively; and the remaining variables are defined as above.

4.2 Indicator construction

4.2.1 Dependent variable: agricultural economic resilience

An agricultural economic resilience indicator system is developed across three dimensions: resistance, recoverability, and reinvention capability. The entropy method is used to determine

indicator weights [23], and TOPSIS is employed to measure the relative development level of agricultural economic resilience [24]. The full framework is presented in Table 1.

Table 1: Indicator System for Agricultural Economic Resilience

first-level indicator	secondary indicator	third-level indicator	indicator attribute	
resistance	economic resilience	Value-added of agriculture, forestry, animal husbandry, and fishery(AFAHF) / Workforce in the primary industry	+	
		Value-added of AFAHF / Sown area of crops	+	
		Intermediate consumption value of AFAHF / Sown area of crops	+	
		Disposable income of rural households	+	
	Production resilience	Production resilience	Effective irrigation area / Sown area of crops	+
			Total power of agricultural machinery / Sown area of crops	+
			Total grain output / Sown area of crops	+
	ecological resilience	ecological resilience	Disaster-affected area/Disaster-stricken area	-
			Agricultural water consumption / Crop sown area	-
			Pesticide usage / Crop sown area	-
			Application amount of agricultural chemical fertilizer / Crop sown area	-
			Usage of agricultural plastic film / Crop sown area	-
resilience	Restore resilience	Number of employed people in AFAHF / Rural population	+	
		Expenditure on agriculture, forestry, and water affairs / General budget expenditure	+	
		Total output value of AFAHF / GDP	+	
		Agricultural insurance premium income / Total output value of AFAHF	+	
Reinvention capability	innovation resilience	Number of agricultural technical personnel	+	
		The number of applications for new varieties of agricultural plants in that year	+	
		rural power consumption	+	
		Fixed assets investment in AFAHF / Number of employed personnel in AFAHF	+	

4.2.2 Explanatory Variable: Level of New Urbanization.

This study develops the new urbanization indicator system across four dimensions: population, economy, society, and environment. The entropy-weighted TOPSIS method is employed for measurement, and the detailed indicators are provided in Table 2.

Table 2: Indicator System for the Level of New Urbanization

first-level indicator	secondary indicator	specific indicators	indicator attribute
Population urbanization	Population urbanization rate	Ratio of urban population	+
	Number of urban employed people	Number of urban employed people	+
Economic urbanization	Per-capita Disposable Income of Urban Residents	Per-capita Disposable Income of Urban Residents	+
	Per capita consumption expenditure of urban residents	Per capita consumption expenditure of urban residents	+
Social urbanization	Public service facilities	Number of health technicians per 1,000 people in the city	+
	infrastructure	Urban per capita road area	+
Environmental urbanization	Harmless treatment of urban garbage	Harmless treatment rate of urban household waste	+
	Urban sewage treatment	daily urban sewage treatment capacity	+
	Urban per capita green space	Urban per capita park green area	+

4.2.3 Threshold variable, mediating variable, control variable

This study uses agricultural agglomeration as the threshold variable. The agricultural employment agglomeration degree is calculated as follows:

$$Q_{it}^E = (E_{it} / E_t) / (P_{it} / P_t) \quad (6)$$

where Q_{it}^E denotes the agricultural employment agglomeration degree of province i in year t ; E_{it} represents the agricultural employment population in province i ; E_t denotes the national agricultural employment population; P_{it} stands for the total employment population in province i ; and P_t signifies the national total employment population.

The agricultural industry agglomeration degree is calculated as follows:

$$Q_{it}^A = (A_{it} / A_t) / (I_{it} / I_t) \quad (7)$$

where Q_{it}^A denotes the agricultural industry agglomeration degree of province i in year t ; A_{it} represents the agricultural output value of province i ; A_t is the national agricultural output value; I_{it} denotes the regional GDP of province i ; and I_t is the national GDP. In addition, this paper incorporates the ratio of agricultural to non-agricultural employment population and the ratio of agricultural output value to non-agricultural output value, and applies the entropy-weighted TOPSIS method for measurement.

The mediating variables include three production factors: land, human capital, and technology. The land transfer index uses the total area of farmland transferred through household contracting. The technological progress index uses the number of green patents per 10,000 people. Human capital is represented by the actual per capita labor human capital data for each province, as calculated by the China Center for Human Capital and Labor Economics Research at the Central University of Finance and Economics.

The control variables encompass the level of foreign investment, social security coverage, healthcare standards, and environmental governance. The specific indicators are constructed as shown in Table 3.

Table 3: Construction of Indicators for Threshold Variables, Mediating Variables, and Control Variables

variable	first-level indicator	secondary indicator
threshold variable	Agricultural agglomeration degree (AGG)	Agricultural employment agglomeration degree
		Agricultural industry agglomeration degree
		Ratio of agricultural to non-agricultural employed population
		Ratio of agricultural output value to non-agricultural output value
mediating variable	Land circulation (LAND)	Total transferred area of household-contracted farmland
	Technological progress (TECH)	The number of green patents per 10,000 people
	Human capital (CAP)	Actual per capita labor force human capital
control variable	Level of outward investment (OPEN)	Total foreign investment / Total population
	Social security level (SEC)	Number of insured individuals in basic old-age insurance for urban and rural residents / Total population
	Healthcare Excellence and Access Level (HEAL)	Healthcare expenditure / Total population
	Environmental governance level (ENV)	Investment in the control of environmental pollution / GDP

4.3 Data sources and analysis

This research employs panel data from 30 Chinese provinces (2010–2022), excluding Tibet, HK, Macao, and Taiwan due to data constraints. Sourced primarily from official statistical yearbooks (including national, rural, environmental, etc.), the China National Intellectual Property Administration, and the EPS database, the dataset was pre-processed by interpolating missing values and applying logarithmic transformations to scale-heavy variables. Descriptive statistics are provided in Table 4.

Table 4: Descriptive statistical analysis

	variable	variable meaning	observed value	mean	standard deviation	minimum	maximum
explained variable	RES	Resilience of agricultural economy	390	0.155	0.097	0.039	0.575
explanatory variable	NURB	The level of new urbanization	390	0.233	0.141	0.045	0.848
threshold variable	AGG	Agricultural agglomeration	390	0.282	0.161	0.001	0.772
mediating variable	TECH	technological progress	390	0.111	0.229	0	1.872
	CAP	human capital	390	5.083	0.392	4.242	6.281
	LAND	Land transfer	390	15.957	1.185	11.865	18.049
control variable	OPEN	Level of foreign investment	390	0.841	3.878	0.012	55.213
	SEC	Social Security Level	390	0.346	0.136	0.03	0.575
	HEAL	Medical and health care level	390	0.103	0.055	0.026	0.529
	ENV	Environmental governance level	390	0.014	0.008	0.003	0.042

5 Empirical results and analysis

5.1 Regression results and analysis of direct effects

5.1.1 Full-sample test

The benchmark regression results are reported in Table 5. The analysis reveals a statistically significant positive relationship (at the 1% level) between new urbanization and agricultural economic resilience. According to the panel fixed-effects estimates, each unit increase in the new urbanization level boosts agricultural economic resilience by 42.7 percentage points, confirming Hypothesis H1. This underscores the critical contribution of new urbanization in strengthening the agricultural sector's capacity to withstand shocks. Additionally, all included control variables exert a positive influence on resilience. The elevation of foreign investment levels may foster agricultural modernization by introducing advanced technologies and management expertise. The strengthening of social security systems aids in stabilizing rural residents' incomes and enhancing the risk-resilience of agricultural producers. Improvements in medical and healthcare services ensure the health of the rural workforce, thereby solidifying the human resource foundation for agricultural development. Additionally, the enhancement of environmental governance directly contributes to the sustainability of the agricultural ecological environment, providing crucial support for the long-term, stable development of agriculture.

Table 5: Benchmark regression results of new urbanization on agricultural economic resilience

variable	OLS	FE
	(1)	(2)
The level of new urbanization	0.439***	0.427***
(NURB)	(18.84)	(7.82)
Level of foreign investment	0.001	0.002**
(OPEN)	(1.54)	(2.40)
Social Security Level	-0.140***	0.305***
(SEC)	(-6.11)	(3.74)
Medical and health care level	0.415***	0.300***
(HEAL)	(7.10)	(3.98)
Environmental governance level	0.353	0.301
(ENV)	(0.85)	(0.54)
constant term	0.052***	-0.087***
(CON)	(3.64)	(-2.98)
observed value	403	403
R ²	0.638	0.545

Note: *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively; t-test values are provided in parentheses; the same applies hereinafter.

5.1.2 Benchmark regression heterogeneity test

To examine regional heterogeneity, samples were divided into major grain-producing (MGP) and non-MGP areas for regression analysis (Table 6). The findings indicate that new urbanization significantly promotes agricultural economic resilience at the 1% significance level in both categories, supporting H1 across subsamples. Crucially, the promoting intensity

is significantly greater in MGP areas. This heterogeneity stems from systemic differences in resource endowments and industrial structure. In MGP zones, scaled farming systems allow urbanization to strengthen resilience by enhancing infrastructure and facilitating industrial convergence, which upgrades value chains. In non-MGP zones, weaker agricultural foundations limit the radiating impact of urbanization, resulting in a smaller resilience enhancement. Therefore, when formulating regional policies aimed at promoting agricultural resilience through urbanization, it is crucial to tailor differentiated strategies to local agricultural conditions, particularly in non-grain-producing regions, where there is a need to strengthen the cultivation of agricultural specialties and guide urban functions.

Table 6: Heterogeneity test of benchmark regression of new urbanization on agricultural economic resilience

variable	OLS		FE	
	(1)	(2)	(3)	(4)
	major grain-producing area	Non-major grain-producing areas	major grain-producing area	Non-major grain-producing areas
The level of new urbanization	0.502***	0.306***	0.426***	0.357***
(NURB)	-8.78	-9.91	-4.18	-4.53
Level of foreign investment	0.02	0.001	0.051***	0.001**
(OPEN)	-1.08	-0.86	-3.49	-2.15
Social Security Level	-0.02	-0.262***	0.714***	0.179*
(SEC)	(-0.47)	(-8.86)	-4.99	-1.75
Medical and health care level	0.199	0.517***	-0.046	0.370***
(HEAL)	-1.58	-7.9	(-0.23)	-4.21
Environmental governance level	1.01	-0.329	1.680*	-0.093
(ENV)	-1.51	(-0.66)	-1.8	(-0.13)
constant term	0.003	0.109***	-0.260***	-0.027
(CON)	-0.15	-5.99	(-4.61)	(-0.79)
observed value	169	221	169	221
R2	0.646	0.704	0.641	0.518

5.2 Regression results and analysis of mediation effect

The mediation effect test results are presented in Table 7. The total effect of new urbanization on agricultural economic resilience is significantly positive (coefficient = 0.439, $p < 0.01$). Column (1) shows the results for land transfer as a mediator. The direct effect of new urbanization remains significant (coefficient = 0.406, $p < 0.01$) but is smaller than the total effect. Furthermore, the paths from new urbanization to land transfer and from land transfer to resilience are both significant at the 5% level, confirming that land transfer plays a partial mediating role. Thus, Hypothesis H2a is supported. New urbanization promotes rural

population transfer to urban areas, facilitates land circulation and centralized land management, and enhances agricultural economic resilience. However, the coefficient of land transfer is relatively small (0.008), indicating a weak marginal effect. This may be related to an immature land transfer market in some regions or to a saturated transfer rate that limits further gains.

Columns (2) and (3) of Table 7 present the mediation effect tests for technological progress and human capital, respectively. In both models, the direct effect of new urbanization remains positive and significant at the 1% level, though its coefficient is reduced compared to the total effect, indicating partial mediation. The significant paths from new urbanization to the mediators and from the mediators to agricultural economic resilience confirm their pivotal roles. Specifically, new urbanization fosters resilience by driving technological R&D and enhancing green innovation efficiency through agglomeration effects, aligned with the policy of "revitalizing agriculture through science and technology" (H2b verified). Simultaneously, it boosts resilience by elevating educational attainment, refining labor skills, and facilitating non-agricultural employment, thereby accumulating human capital (H2c verified).

New urbanization significantly promotes agricultural economic resilience through the effects of land circulation, technological progress, and human capital. Among these, the mediating effect of human capital is the strongest (with a mediating effect accounting for 21.9%), followed by the technological progress effect (13.3%), and the land circulation effect is the weakest (7.5%). Although the direct effect dominates, the significance of the mediating effect indicates that new urbanization needs to consider synergistic efforts with human capital investment, green technological progress, and land circulation policies to better enhance agricultural economic resilience.

Table 7: Mediation effect test

variable	Land circulation effect	Effect of technological progress	Human capital effect
	(1)	(2)	(3)
Level of new urbanization	0.406***	0.380***	0.343***
(NURB)	-14.93	-17.18	-13.58
Land transfer	0.008**		
(LAND)	-2.31		
technological progress		0.150***	
(TECH)		-9.04	
human capital			0.087***
(CAP)			-7.51
mediating effect	0.033**	0.058***	0.096***
	-2.273	-4.993	-6.288
direct effect	0.406***	0.380***	0.343***
	-14.932	-17.18	-13.577
total effect	0.439***	0.439***	0.439***
	-18.843	-18.843	-18.843
control variable	Yes	Yes	Yes
constant term	-0.054	0.055***	-0.388***
	(-1.12)	-4.25	(-6.46)
Adj-R ²	0.637	0.697	0.68
F value	114.96***	150.11***	138.44***
Proportion of mediating effect	0.075	0.133	0.219
Sobel test	0.033**	0.058***	0.096***
	-2.273	-4.993	-6.288
observed value	390	390	390

5.3 Threshold effect regression results and analysis

The Bootstrap test with 500 replications (Table 8) confirms a significant single-threshold effect of agricultural agglomeration (threshold = 0.04) at the 1% level. The threshold regression results in Table 9 show that the coefficient for new urbanization is 1.166 when agricultural agglomeration is below the threshold and 0.465 when it is above the threshold, both significant at the 1% level. This indicates that new urbanization consistently promotes agricultural economic resilience, with a substantially stronger effect in regions with low agricultural agglomeration, thereby verifying Hypothesis H3. In regions with low agricultural agglomeration, agricultural resources are relatively dispersed and infrastructure demand is high. New urbanization can fill this gap by introducing technology and policy support, thereby enhancing agricultural economic resilience. In regions with high agricultural agglomeration, the agricultural system is more complex and more dependent on fixed production models. New urbanization then requires breakthrough technologies to support industrial upgrading and must address ecological and industrial expansion constraints, which increases reform costs and limits the marginal effect.

Table 8: Panel threshold effect test and threshold results

threshold variable	F-value	P-value	BStimes	threshold value			threshold value	95% confidence interval
				0.1	0.05	0.01		
single threshold	159.18	0	500	52.107	66.781	91.751	0.04***	[0.039,0.041]
Double thresholds	-85.55	1	500	68.142	82.591	129.469		

Table 9: Regression results of panel threshold effect

variable	agri_resilience
	(1)
new_urban(agri_agglom≤0.04)	1.166***
	(4.07)
new_urban(agri_agglom>0.04)	0.465***
	(3.08)
Level of foreign investment	0.002***
(OPEN)	(3.11)
Social Security Level	0.365**
(SEC)	(2.16)
Medical and health care level	0.129
(HEAL)	(0.55)
Environmental governance level	0.314
(ENV)	(0.39)
constant term	-0.115**
(CON)	(-2.14)
R ²	0.609
observed value	390

5.4 Further inspection

5.4.1 Panel quantile regression

To further investigate the impact of different stages of new urbanization on agricultural economic resilience and reduce the influence of extreme values, panel quantile regression is conducted after 1% winsorization [25]. Four quantile points of agricultural economic resilience are set at 0.25, 0.50, 0.75, and 0.90 to examine the dynamic and differentiated effects of new urbanization on agricultural economic resilience. The panel quantile regression results are presented in Table 10.

The test results indicate that new urbanization positively promotes agricultural economic resilience at different quantile points, consistent with the aforementioned test results. Specifically, as the quantile point increases, the estimated coefficient of new urbanization gradually increases, indicating that its influence on agricultural economic resilience also gradually strengthens. At the low quantile point (0.25), agricultural economic resilience is weak, the agricultural foundation is weak, and it is vulnerable to external shocks, with a relatively small impact from new urbanization; at the medium quantile point (0.50), there is a certain degree of agricultural economic resilience and risk resistance, but the effect is not yet stable; at the higher quantile points (0.75 and 0.90), agricultural economic resilience is higher, the agricultural system is more mature, and there is a more comprehensive institutional system, making it easier to reflect the synergistic effect of new urbanization and agricultural development. New urbanization has a scale effect on enhancing agricultural economic resilience, exhibiting a marginal increasing characteristic, and the empowering effect of new urbanization level increases with the improvement of agricultural economic resilience level.

Table 10: Panel quantile regression test results

variable	Q=0.25	Q=0.50	Q=0.75	Q=0.90
	(1)	(2)	(3)	(4)
Level of new urbanization (NURB)	0.374*	0.447	0.490*	0.525**
Level of foreign investment (OPEN)	0.01	0.019	0.033	0.032
Social Security Level (SEC)	0.066	0.126	-0.032	0.077
Medical and health care level (HEAL)	0.266	0.201	0.277*	0.144
Environmental governance level (ENV)	0.822	0.673	0.451	0.325
N	390	390	390	390

5.4.2 Coupling coordination degree analysis

Based on the above test results, the impact of new urbanization on agricultural economic resilience exhibits a threshold effect. Therefore, only when new urbanization and agricultural economic resilience develop in a coupled and coordinated manner can they better play their roles. By establishing a coupling coordination degree model, the average development relationship between new urbanization and agricultural economic resilience in each province from 2010 to 2022 was evaluated using data. The ten-level division method was employed, revealing that the coupling coordination degrees of most provinces fall within the range of 0.3 to 0.6, indicating a state between marginal disharmony and initial coordination. Specifically,

Hainan (0.309), Chongqing (0.316), Jiangxi (0.326), Shanxi (0.340), Shaanxi (0.349), Yunnan (0.356), Jilin (0.360), Xinjiang (0.368), Guangxi (0.392), and Inner Mongolia (0.395) exhibit values between 0.3 and 0.4, suggesting that the development of new urbanization and agricultural economic resilience has begun to intertwine, albeit with overall instability. In Hubei, Hunan, Anhui, Heilongjiang, Sichuan, Fujian, and Liaoning, the coupling coordination degrees are 0.422, 0.441, 0.449, 0.450, 0.451, 0.470, and 0.487, respectively, falling within the 0.4 to 0.5 range. This indicates that these regions are on the brink of achieving coordination, yet their stability remains inadequate and susceptible to external influences. Tianjin, Hebei, Henan, and Shanghai have coupling coordination degrees of 0.504, 0.510, 0.538, and 0.595, respectively, placing them in the 0.5 to 0.6 range. These regions have achieved initial coordination and demonstrate a favorable development trend, though there is still room for improvement. Certain provinces, including Jiangsu, Guangdong, Beijing, Zhejiang, and Shandong, boast coupling coordination degrees exceeding 0.6, signifying moderate to good coordination. Among them, Shandong, Zhejiang, and Beijing exhibit moderate coordination with values of 0.606, 0.628, and 0.636, respectively, showcasing a pronounced synergistic effect and robust development. Jiangsu and Guangdong surpass 0.7, with values of 0.771 and 0.769, respectively, indicating a high degree of interdependence and coordination new urbanization and agricultural economic resilience, coupled with efficient regional development. Conversely, Guizhou, Gansu, Qinghai, and Ningxia have coupling coordination degrees below 0.3, specifically 0.258, 0.284, 0.296, and 0.29, respectively. These regions are in a state of moderate disharmony, with poor coordination between new urbanization and agricultural economic resilience, characterized by numerous contradictions and lags.

From this, it is evident that there are significant regional disparities among the provinces in China. The eastern coastal areas have a higher coupling coordination degree, with new urbanization and agricultural modernization advancing simultaneously, rapid industrial upgrading, richer capital and technology, and strong complementarity between agricultural development and urbanization development. Through the "city leading the countryside and urban-rural integration," a virtuous cycle is formed. However, the agricultural sector in the central and western regions relies more on traditional models, which may lead to issues such as weak agricultural infrastructure, resource and environmental constraints, and insufficient agricultural policy support. This results in lower agricultural economic risk resistance and weaker agricultural economic resilience. In the process of urbanization, the phenomenon of "emphasizing cities and neglecting agriculture" may occur, leading to a disconnect between the two and making coordinated development more difficult.

6 Conclusion and Suggestions

This study constructs index systems for new urbanization (covering population, economy, society, and environment) and agricultural economic resilience (encompassing resistance, recovery, and regeneration), measuring their respective development levels using the entropy weight TOPSIS method. Employing panel regression, a mediation effect model, a threshold model, and a coupling coordination degree model, the research empirically examines the impact and mechanisms of new urbanization on agricultural economic resilience. The findings reveal that: (1) New urbanization significantly promotes agricultural economic resilience, with a more pronounced effect in major grain-producing areas. (2) The promotion occurs indirectly through land circulation, technological progress, and human capital, where the mediating effect of human capital is the strongest. (3) Agricultural agglomeration exerts a single threshold effect; the impact of new urbanization is greater in regions with lower

agglomeration levels. (4) The empowering effect of new urbanization varies across its different stages and strengthens with the level of agricultural economic resilience, showing a characteristic of marginal increase. (5) Significant potential remains for improving the coupled and coordinated development between the two systems, with notable regional variations.

Based on these conclusions, the following policy recommendations are proposed:

Firstly, we should enhance the development of new urbanization, continue to explore the sustainable development potential of new urbanization, and enhance its driving effect on agricultural development. We should promote the synergy between smart agriculture and urbanization development, strengthen the development of digital infrastructure, establish regional agricultural innovation platforms, enhance the construction of knowledge sharing platforms, and continue to explore the integrated development model of low-carbon urbanization and resilient agriculture.

Secondly, we should improve the system of production factors' role, and establish a positive cycle of "factor upgrading - production efficiency improvement - resilience enhancement". Optimize resource allocation and property rights protection, and establish a regional land circulation trading platform; build a demand-driven innovation ecosystem, and set up agricultural technology subsidy policies; strengthen the empowering role of education, enhance skills investment, and stimulate endogenous motivation.

Thirdly, the coordinated development of new urbanization and agricultural economic resilience should be tailored to local conditions and align with the local economic development level and policy orientation. For major grain-producing areas, increase fiscal investment in high-standard farmland and smart agricultural infrastructure, and establish a special compensation mechanism for these areas. In regions with low agricultural economic resilience, priority should be given to strengthening the agricultural foundation and actively promoting the construction of new urbanization infrastructure. In medium resilience regions, be wary of the "transformation trap" and optimize institutional policies. In high resilience regions, focus on the value-added functions of urbanization and facilitate the structural upgrading of the agricultural value chain. The eastern coastal areas should further explore green and low-carbon models, while the central and western regions need to strengthen investment in agricultural infrastructure construction, promoting differentiated synergy between agricultural modernization and urbanization development. All regions should fully leverage their regional advantages to continuously provide energy for coordinated development and promote common prosperity.

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