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Non-Linear Influence Mechanism of County New Urbanisation on Resilience of the Agricultural Economy

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Abstract

As the foundation of the national economy, the stable and healthy development of agriculture is directly linked to sustained economic growth and long-term social stability. Strengthening the resilience of the agricultural economy and ensuring its robustness in the face of shocks is of great significance to guarantee China's food security, help rural revitalisation, promote China's agricultural modernisation and achieve the goal of constructing a strong agricultural country. However, existing studies have paid extensive attention to the linear effect of county new urbanisation on the resilience of the agricultural economy. Few of them have cut in from a non-linear perspective. This paper empirically examines the non-linear effect, mediating mechanism, regulating mechanism and threshold effect of county new urbanisation on agricultural resilience with the help of the county new urbanisation pilot policy, using the data of 2039 counties in China from 2008 to 2022. The results found that there is a U-shaped relationship between county new urbanisation and agricultural resilience, which can improve agricultural economic resilience within a specific interval. The mechanism test shows that upgrading technological innovation is an important mechanism to enhance the resilience of agricultural economy. Financial development as a moderating variable enhances the impact of county urbanisation on agricultural resilience. The heterogeneity test shows that county new urbanisation has a more significant effect on county-level cities and more economically developed regions in enhancing agricultural economic resilience. This paper provides intellectual support for the in-depth promotion of county new urbanisation to further enhance the resilience of the agricultural economy, promote the development of agricultural and rural modernisation with Chinese characteristics, and build a modern and powerful country.

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Keywords

County New Urbanisation, Agricultural Economic Resilience, Non-Linear Model, Technological Innovation

1. Introduction

As a large agricultural country, China attaches great importance to the healthy development of agricultural economy. The report of the 20th Party Congress points out that efforts should be made to improve the resilience of the industrial chain supply chain, insist on giving priority to the development of agriculture and rural areas, and promote the quality and quantity of the agricultural economy. Meanwhile, it is imperative to objectively assess the current progress and challenges in agricultural development, enhance the resilience of the agricultural economy, and in this process, advance the development of strong agriculture. 2023 Central Document No.1 is based on the national situation of the agricultural situation, on the further construction of industrial resilience, competitive ability of the strong agricultural country to make a comprehensive deployment. However, China's agriculture is also facing many serious challenges, such as tightening resources, rising costs, frequent extreme weather disasters, intensifying trade protectionism, rural population loss and aging and international turmoil. Therefore, in the context of the new era, it is of great significance to improve the resilience of the agricultural economy in order to enhance the resistance and adaptability of agriculture to risky shocks, to restore the pre-disturbance development trend and to strengthen it to a more optimal path to accelerate the realisation of agricultural modernisation and high-quality development of the economy (Gao et al., 2024b).

County towns are an important part of China's urban system and a key support for the integrated development of urban and rural areas. However, compared with the urbanisation process of China's big cities, county urbanisation is still lagging behind. After the reform and opening up, China's urbanisation rate has been rising. According to the Seventh National Population Census Main Data Situation by the National Bureau of Statistics[1], by 2020, the urbanisation rate of the country's population had reached 63.89%, which is higher than the world's average level of 55.30%. In the same year, China's counties accommodated a population of about 670 million, but the urbanisation rate of the county population was only 23.59%[2], a huge gap with the national urbanisation rate. The report of the Twentieth National Congress of the CPC pointed out in particular that it is necessary to "build a coordinated development pattern of large, medium and small cities based on city clusters and metropolitan circles, and to promote the construction of urbanisation with the county towns as important carriers". The simultaneous

[1]Data source: The World Bank based on the United Nations Population Division's World Urbanisation Prospects: 2018 Revision.

[2]Data source: National Bureau of Statistics, Seventh National Population Census Main Data Situation.

promotion of industrialisation, urbanisation and agricultural modernisation is a unique creation and experience of Chinese modernisation, in which industrialisation and urbanisation are synchronised to feed agriculture. Now cities and towns also bear the tasks of both transferring the population from agriculture and the citizenship of farmers (Hong, 2022). On 31 January 2023, General Secretary Xi Jinping, while presiding over the second collective study of the Political Bureau of the CPC Central Committee, stressed the need to "comprehensively push forward the revitalisation of the countryside, and to promote the construction of townships with county towns as an important carrier". Therefore, vigorously promoting county urbanisation with county boundaries and central towns as the main body to empower agricultural development and enhance the resilience of the agricultural economy is becoming the topic of agricultural and rural modernisation with Chinese characteristics. In view of this, this paper focuses on the key issue of the impact of the implementation of county new urbanisation policies on agricultural economic resilience, and makes use of the statistical data of 2039 counties nationwide in the range of 2008-2022 to creatively reveal the non-linear relationship between county new urbanisation and agricultural resilience, and enriches the regular understanding of the mechanism of agricultural resilience affected by county new urbanisation. It provides new theoretical perspectives and policy suggestions for county new urbanisation to promote high-quality development of agriculture and rural areas and help rural revitalisation.

2. Literature Review

2.1. Connotation and Measurement Indicator System of County New Urbanisation

New urbanisation in county areas is the urbanisation process that is based on county-specific characteristics, addresses weaknesses and enhances synergies, aiming to achieve a people-centered, coordinated development and security-oriented transition of the county population to urban areas (Kong & He, 2022). In the context of large-scale population agglomeration to large and medium-sized cities, and the urban carrying capacity approaching the threshold, county cities, as an important carrier of new urbanisation, are absorbing rural populations simultaneously from both rural and large and medium-sized cities, and the new urbanisation of county cities has also become a key driving force in the successive advancement of the labour force transfer (Chen & Hu, 2024). Xu Chao further proposed that the basic path of county urbanisation is the injection of rural population into the county and the return of urban population to the county, both of which jointly promote the non-agricultural transformation of the rural overflow labour force and the return of the urban overflow labour force to the county (Xu et al., 2017).

On the construction of the indicator system for new urbanisation in counties, academics have largely constructed it from the dimensions of development quality and sustainability (Wei & Huang, 2024), as well as the urbanisation system layer dimension (Wang et al., 2024). After a comprehensive analysis of existing studies,

the evaluation system of Wei Man et al. is relatively complete and comprehensive. The system provides detailed indicator designs in four aspects: public construction, economic development, population employment and ecological environment, and introduces negative indicators (e.g., urban registered unemployment rate), making the overall indicator system more complete and scientific. However, the system is mainly based on the perspective of segmented economy, and still lacks the analysis and decomposition of county urbanisation level in the dimension of urbanisation system layer, and lacks the specific measurement of the indicators in spatial urbanisation as well as the integration of urbanisation of public services, for example, the insufficient consideration of urban construction land, and so on. Therefore, on the basis of Wei Man's system, the research results of Wang Xingbang and others on spatial urbanisation and public service urbanisation are introduced to expand and optimise the original indicator system, which is categorised and divided into an indicator system with population urbanisation, industrial urbanisation and public service urbanisation as the first-level indicators.

2.2. Research Progress on the Concept and Measurement of Agricultural Economic Resilience

"Toughness" is derived from the Latin word "resilire", which is used in physics to describe the ability of a material to return to its initial state after being deformed by an external force. Subsequently, it was introduced into the ecological research framework by Holling (1973) to analyze the ability of ecosystems to maintain and repair after being subjected to natural or anthropogenic impacts, and was defined as engineering resilience. With the deepening of research, the concept of resilience has gradually expanded to other disciplines. Economic resilience is an application of the resilience concept in economics, focusing on the ability of an economy to restore a stable state or achieve an optimal state after resisting and absorbing shocks, which is a key indicator of its resistance (Peng et al., 2025). Agricultural economic resilience, on the other hand, belongs to the in-depth interpretation of resilience connotation for the primary industry. From a theoretical perspective, international academics pioneered research on rural resilience, but quantitative research in this area remains insufficient. Domestic related research started later, and more research is still in the stage of natural environment disturbance (Zhu et al., 2021), focusing on the evaluation index system and influence mechanism (Shi, 2024), with no yet reached on the precise connotation of agricultural economic resilience (Quan et al., 2024). Synthesizing the existing literature, we can summarise agricultural economic resilience as the ability of the agricultural economic system to maintain normal operation, adapt to the risk environment, and carry out innovation and development in the face of external shocks through the internal adjustment mechanism (Yang, Zhang, Li, Ning, & Chu, 2023).

Academics have now constructed the measurement index system of agricultural economic resilience from different perspectives. Some scholars have proposed a

four-dimensional model including resistance, resilience, readjustment capacity and economic growth path by shift-share decomposition of economic resilience in their research (Feng et al., 2020). Researchers (Ma et al., 2020) have also included ecological environment factors in the evaluation system of agricultural economic resilience, and constructed an indicator system that combines ecological environment and agricultural economy. There are also studies that combine the long-term development of the agricultural economy with innovation factors, and measure the resilience of the agricultural economy from the three dimensions of resistance to recovery capacity, adaptive adjustment capacity and transformation and innovation capacity (Li et al., 2024). Specialists have even constructed an agricultural resilience indicator system by analysing the relationship between rural resilience and rural revitalisation, while considering factor endowments (Zhu et al., 2021). The indicator system with higher degree of completeness is centred on resistance and resilience, and most researchers construct the evaluation system based on the PSR model from the three dimensions of "pressure", "state" and "response". Most studies construct the evaluation index system based on the PSR model from the three dimensions of "pressure", "state" and "response" (Jiang et al., 2022), or divide the agricultural economic resilience into the three dimensions of the risk-resistant recovery ability, adaptive adjustment ability and transformation and innovation ability, and construct the evaluation index system based on the index system of the comprehensive economic resilience measurement (Li et al., 2022). Comprehensively analysing the existing research indicators, the evaluation system of Zhao et al. (2023) is more comprehensive, compared with other studies. This indicator system not only incorporates more negative indicators (e.g., the amount of agricultural fertilizer applied per unit of sown area, the amount of pesticide applied per unit of sown area) in order to more comprehensively consider the production resilience in an integrated manner, but also covers the adaptive recovery capacity and reconstruction innovation capacity, so as to make the entire structure of the indicator system more balanced and reasonable.

2.3. Research on the Relationship between New Urbanisation and Agricultural Economic Resilience in Counties

The current academic research on agricultural modernisation and traditional urbanisation is relatively rich (Ji, 2021), and the interactive research on new urbanisation mainly stays in the areas of policy interpretation (Hong et al., 2024), urban-rural income gap (Mehta & Hasan, 2012), common prosperity (Yang, Wang, & Huang, 2023), carbon emission reduction (Li & Tang, 2024) and energy efficiency (Feng et al., 2023); agricultural resilience pays more attention to the linear and non-linear effects of digital financial inclusion (Peng et al., 2025) or digital village construction (Cheng et al., 2025). The interaction between new county urbanisation and agricultural resilience is still little explored in academia and focuses on case studies in specific regions, failing to provide a holistic and comparative analysis of the relationship between different regions across the country. Few studies

have integrated county new urbanisation and agricultural economic resilience into a unified analytical framework, exploring the theoretical links and influence mechanisms between them from a non-linear perspective. Therefore, the marginal contributions of this paper are mainly as follows.

The first is that the research methodology is not limited to the linear assumptions of existing studies, and reveals the non-linear relationship between county new urbanisation and agricultural resilience. This paper proposes an analytical framework for the integration of the two from a nonlinear perspective, using data from 2088 counties in China from 2008 to 2022, exploring the nonlinear influence mechanisms and effects of county new urbanisation on agricultural economic resilience, especially the dynamic changes under different levels of counties and levels of economic development, which makes up for the linear assumptions of existing studies in this direction, and will provide an important theoretical basis for promoting the coordinated development of the two. It will provide an important theoretical basis and empirical support for promoting the coordinated development of the two. A comprehensive assessment has been conducted to excavate the internal mechanism by which the new urbanisation in the county affects the resilience of the agricultural economy.

Secondly, in the mechanism of action from the industrial structure upgrading, technological innovation level of the mediating effect, the financial development level of the regulatory effect and the threshold effect of government public services and other dimensions of the level of new urbanisation in the region in the interaction mechanism, to optimise the policy design precision to provide empirical support.

The third is that in the research sample using the full-scale county economic data, while the administrative level, location conditions of the heterogeneity of the analysis, in order to explore the new county urbanisation for the different counties agricultural economic resilience of the role of heterogeneity of the effect of in-depth analysis of its role in the mechanism, the conclusions obtained have a certain value of the policy references.

3. Theoretical Analysis and Research Hypothesis

3.1. The Non-Linear Role of New County Urbanisation on Agricultural Resilience

In the short term, the promotion of county urbanisation may weaken the resilience of the agricultural economy through the polarisation effect of production factors. According to the theory of echo effect in development economics, the centre of economic growth will preferentially attract high-quality resources from the surrounding regions, and in the early stage of county urbanisation, the towns, as the agglomeration of capital and technology, will strongly absorb the three types of core factors in rural areas. The siphon effect was also used as a theoretical basis to analyse that the advancement of new county urbanisation will instead have a negative effect on agricultural resilience (Liu et al., 2022). The initial stage of county

urbanisation will attract one-way flow of labour factors. The transfer of young and middle-aged labour to the non-farm sector in urban areas directly leads to the aging and hollowing out of the agricultural population, which reduces the disaster response capacity (e.g., post-disaster harvesting, farmland restoration) and the willingness to adopt technology in the agricultural production system. At the same time, urbanisation is accompanied by a non-farming allocation of land elements, with urban expansion occupying arable land with higher marginal outputs, while ecologically fragile marginal land is forced to intensify development, the land-use structure is changed, and agricultural resilience is inhibited to a certain extent. From the perspective of capital supporting agricultural development, the outflow of capital will also hinder the modernisation and transformation of agricultural production and technological innovation. In the early stages of county urbanisation, financial institutions tend to allocate rural savings to high-return areas in cities and towns, and this outflow of capital may lead to an unbalanced allocation of public resources, squeezing the supply of capital for investment in agricultural modernisation (e.g., smart farm machinery, water-saving facilities) and rural disaster prevention infrastructure (Zhao & Chen, 2024), which slows the pace of agricultural development.

County urbanisation encourages the development of smart agriculture, using technologies such as the Internet of Things and big data to enhance the intelligence of agricultural production. Some research have mentioned that there is a "threshold effect" in the enhancement of the resilience of agriculture by digital technology, i.e., when the level of digital technology is below the threshold, the impact is insignificant or weak; when it exceeds the threshold, the impact is significantly enhanced. This is consistent with the U-shaped relationship, as digital technology is an important component of urbanisation (e.g., smart agricultural applications), and its threshold effect reflects a non-linear cumulative process.

New county urbanisation includes population urbanisation, economic urbanisation and public service urbanization (Yang, Wang, & Huang, 2023). As county urbanisation advances, its positive effect on agricultural production highlights the importance of further deepening county urbanisation.

New county urbanisation is the urbanisation of public services, emphasising the integration of urban and rural areas, and the extension of county public services to towns and villages, so that residents in villages can enjoy better education and healthcare services close to their homes (Yang, Wang, & Huang, 2023). New agricultural technologies and advanced management experience in urban areas can be transferred to rural areas through agricultural extension services, improving agricultural production efficiency and product quality. In the long run, the improvement of education level lays an important talent and cognitive foundation for the dissemination and popularisation of advanced agricultural technology and modern management experience from urban to rural areas, which in turn promotes the development of agricultural modernisation.

Secondly, county urbanisation is also the urbanisation of population, and the

return of human resources brings new labour, skills, experience and capital. In the process of county urbanisation, economic development and industrial upgrading create new employment opportunities, attracting the return of the population working outside. From the perspective of market expansion, with the advancement of urbanisation, the scope and capacity of the market are also expanding, providing broader sales channels for agricultural products, thus promoting agricultural trade and economic development.

County new urbanisation is more of an economic urbanisation. Through the integration of agricultural production factor resources, county new urbanisation drives the research and development of technological innovation tools, the cultivation of high-quality varieties and the application of scientific management models, effectively forming the agglomeration effect of factors such as land, labour and capital (Cui, 2012). In this process, the utilisation rate of resources is significantly improved and agricultural production costs are optimised and controlled. This transformation promotes the extension of traditional agriculture from low value-added production to high value-added manufacturing, and gradually builds a modern agricultural industrial system, production system and management system (Xiong et al., 2020). The process of urbanisation provides continuous capital accumulation and technology diffusion support for agricultural industrialisation, effectively reduces the operational risk of the agricultural system (Li & Li, 2013), and strengthens the risk-resistant capacity of the agricultural economy.

As a result, this paper puts forward the following hypotheses:

H1: There is a U-shaped nonlinear effect of county new urbanisation on the toughness of the agricultural economy, i.e., the toughness is suppressed at the initial stage, and the toughness is significantly enhanced after crossing the inflection point.

3.2. The Indirect Impact of County New Urbanisation on the Toughness of the Agricultural Economy

3.2.1. Mediating Effect of Industrial Structure Upgrading

Industrial structure transformation (Transformation) or industrial structure change (Change) is the process of redistribution of production factors among industrial sectors, while industrial structure upgrading (Upgrading) is the result of industrial structure transformation, which is actually the reconfiguration of various production factors in the society (Zhang et al., 2023). The promotion of new urbanisation is often accompanied by the improvement of production efficiency and the development of high value-added industries, which to a certain extent promotes the change of the structure of the three industries, thus leading to the transformation of the industrial structure. At the same time, urbanisation also objectively improves the level of infrastructure construction in the county, and the "spillover effect" of infrastructure construction and the mechanism of "Tibbett's choice" also play a significant role in promoting the concentration of talents and industries (Cong et al., 2017), which helps to optimise the industrial layout (Xu et al.,

2019), and then promote the upgrading of industrial structure. It helps to optimise the industrial layout and thus promote the upgrading of industrial structure.

The transformation and upgrading of industrial structure can also bring about an increase in the resilience of the agricultural economy. Liang and Liu (2023) found that the upgrading of rural industrial structure indirectly enhances the resilience of the agricultural economy by promoting economic growth, forming a transmission chain of "industrial upgrading-economic growth-resilience enhancement". Some scholars also suggest that upgrading the industrial structure can lead to the transformation and upgrading of the economic development model, help the economy to grow with high quality, and then strengthen the ability of local governments to provide public services by increasing local financial revenue (Guo & Zheng, 2025). In this way, local governments can invest more resources to support the development of agriculture, and with more financial support, the risk-resistant capacity of agriculture will certainly be improved.

At the same time, the upgrading of industrial structure is often accompanied by an increase in high-quality jobs, and is conducive to improving labour productivity and labour quality. The growth of new professional farmers, agricultural science and technology dispatchers and other groups can improve the risk-resistant ability of farmers, and effectively promote the adoption of advanced and applicable technologies and localised adaptive innovations (Li et al., 2021). The accumulation of human capital and knowledge spillover effects can enhance the "adaptive capacity" and "learning capacity" of the system, thus increasing the ability of agriculture to resist uncertain risks.

Therefore, this paper proposes the following hypotheses:

H2: Industrial structure upgrading plays a mediating effect in the impact of county new urbanisation on the resilience of agricultural economy.

3.2.2. The Mediating Effect of Technological Progress

County new urbanisation can create favourable conditions for technological progress. On the one hand, the development of new urbanisation promotes the concentration of high-end talents and capital in towns (Guo & Zheng, 2025), which provides sufficient human and financial support for technological innovation. On the other hand, the construction of new urbanisation has improved the rural infrastructure and information network, which helps to expand the coverage of advanced technology, protect the rights and interests of innovation subjects, accelerate the modernisation of the agricultural economy, and provide strong support for improving the resilience of the agricultural economy (Zhou & Xin, 2025).

Technological progress is the core driving force for the resilience of the agricultural industry chain, which not only improves the adaptive and buffering capacity of the agricultural industry chain in coping with risks, but also plays an important role in driving the upgrading of the rural industry and improving the rural capacity to cope with disasters, so as to enhance the resilience of the agricultural econ-

omy. Insufficient innovation is the bottleneck that restricts the resilience of the agricultural industry chain, which brings about the inhibition of the efficiency of the agricultural industry, risk exposure and adaptive capacity weakening, so that the vulnerability of agriculture in the face of natural disasters, market changes and other shocks has been exacerbated. The technological progress can dissolve the obstacles constraining the development of agriculture, and lay the foundation for the construction of intelligent and modernised agricultural industrial system. Modern technological elements such as information technology, intelligent equipment, and green production technology have been more popularised and applied in the agricultural field (Zhou & Xin, 2025); and the implementation of technologies such as intelligent agricultural management system, precision irrigation, drone plant protection, and digital supply chain has significantly improved the precision of agricultural production, the efficiency of resource utilisation, and the ability to resist and mitigate disasters (Zhao et al., 2023). This technological empowerment directly enhances the ability of the agricultural system to withstand natural and market risks (e.g., climate change, pests and diseases, price fluctuations).

At the same time, technological progress also helps to break the traditional agricultural industry chain model, injecting a strong impetus to enhance the resilience of the agricultural economy and the capacity for innovation and transformation. Technological innovation can provide high-value product information support in the early stage of agricultural production, promote intelligent monitoring of the agricultural production process and the implementation of the agricultural product quality and safety traceability system in the middle stage of production, and expand diversified sales channels and improve the after-sales service system in the late stage of production, which effectively improves the ability of agriculture to adapt to market changes.

Thus, this paper puts forward the following hypotheses:

H3: Technological progress plays a mediating effect in the impact of county new urbanisation on agricultural economic resilience.

3.3. The Moderating Effect of Government Intervention

Government intervention plays a positive role in the process of county new urbanisation policies affecting agricultural economic resilience. In the process of promoting new urbanisation, the government makes up for the shortcomings of market failure by means of financial transfers, policy tilts, and special fund inputs, mobilises all positive elements to flow into the agricultural sector, enhances the resilience of agriculture, and promotes agricultural development. Geng et al. (2023) pointed out that government intervention (e.g., fiscal inputs, policy tilts) can form a synergistic effect with economic factors (e.g., per capita income, industrial upgrading) in new urbanisation. For example, when policy support interacts with per capita income and village economic leaders, the explanatory power of the resilience of the rural territorial system increases significantly, showing a "two-fac-

tor enhancement effect". This suggests that government intervention can activate economic factors in urbanisation and amplify their positive impact on resilience. The government can also compensate for market failures by directing resources to the rural areas through financial support, promoting "industry feeding agriculture and towns feeding the countryside" in the process of urbanisation, facilitating agricultural development and enhancing economic resilience (Dong et al., 2022).

Although government intervention has played a positive role in enhancing the resilience of the agricultural economy, excessive government intervention can easily lead to excessive dependence on government support for agricultural development, inhibiting its drive to innovate independently and explore the path of agricultural development that is suitable for the region. Gao (2014) points out that too much government intervention will weaken the role of the financial industry in promoting high-tech industries, and suggests that the strength of the "visible hand" should be balanced. Excessive intervention may also lead farmers to rely too much on government support policies (Guo & Zheng, 2025), rather than thinking about how to improve the quality and yield of agricultural products to resist possible threats to agricultural development.

The following hypotheses are proposed:

H4: Greater government intervention amplifies the contribution of new county urbanisation to rural economic resilience.

4. Research Design

4.1. Model Construction

4.1.1. Benchmark Regression Model Construction

This paper constructs the following nonlinear benchmark regression model:

$$Res_{it} = \alpha + \beta_1 Urb_{it} + \beta_2 Urb_{it}^2 + \beta_3 X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

where i denotes the county, t denotes the year, Res denotes agricultural economic resilience, Urb and Urb^2 denote the primary and secondary terms of county new urbanisation respectively, and X_{it} is a series of control variables in this paper. α denotes the intercept term; β_1 and β_2 are the coefficients of Urb and Urb^2, and β_3 is the coefficient of the control variable. When β_2 is significantly non-zero, there is a non-linear effect of new county urbanisation on the resilience of the agricultural economy, with an inflection point of, for $X_0 = -\beta_1/2\beta_2$. μ_i is the county fixed effect, and λ_i is the year fixed effect, controlling for regional characteristics that do not vary over time and generalised time trends. ε_{it} denotes the random error term, capturing random disturbances that, in the model, fail to be observed. The panel fixed-effects model is employed in this analysis as it effectively controls for time-invariant county-specific unobserved heterogeneity, thereby mitigating potential omitted variable bias and allowing for a more accurate estimation of the impact of new urbanization on agricultural economic resilience.

4.1.2. Mediated Effects Model Construction

In order to test whether hypotheses 2 and 3 are valid, this paper draws on the step-by-step method of Baron and Kenny (1986) and the method of determining the nonlinear mediating effect of Lin and Feng (2022) to construct the theoretical model of nonlinear mediating effect as follows:

$$M_{it} = \gamma_0 + \gamma_1 Urb_{it} + \gamma_2 Urb_{it}^2 + \gamma_3 X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \tag{2}$$

$$Res_{it} = \rho_0 + \rho_1 Urb_{it} + \rho_2 Urb_{it}^2 + \rho_3 M_{it} + \rho_4 X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \tag{3}$$

In Equation (2), the mediating variable M_{it} mainly includes industrial structure upgrading (*Indus*) and technological innovation (*Tech*). Among them, γ_0 is the intercept term of Equation (2); γ_1 and γ_2 represent the effects of Urb and Urb^2 on the mediating variables, respectively; γ_3 is the coefficient of the control variable. In Equation (3), ρ_0 is the intercept term; ρ_1 and ρ_2 represent the nonlinear effects of Urb and Urb^2 on agricultural economic resilience, respectively; ρ_3 is the coefficient of the mediating variable; and ρ_4 is the coefficient of the control variable.

According to the estimation results of Equation (1), Equation (2) and Equation (3), the mediating effect can be considered to exist when β_2, γ_2, ρ_2, and ρ_3 are all statistically significant non-zero. Drawing on the theoretical framework proposed by Yang et al. (2020), the overall effect of county new urbanisation on agricultural economic resilience (*TE*) is defined as the partial derivative of agricultural economic resilience on county new urbanisation, i.e., the mathematical expression is $TE = \beta_1 + 2\beta_2 Urb_{it}$. The mediating effect (*ME*), on the other hand, is defined as the product of the partial derivative of the mediating variable on county new urbanisation and the partial derivative of agricultural economic resilience on the mediating variable, i.e., $ME = \gamma_1 \rho_3 + 2\gamma_2 \rho_3 Urb_{it}$.

4.1.3. Moderating Effect Model Construction

In order to test whether hypothesis 4 is valid, this paper draws on the study of Lin and Feng (2022) and introduces government intervention (*Gov*) as a moderating variable in Equation (1), interacting with the primary and secondary terms of the explanatory variables. Based on this, the following nonlinear moderating effect model is constructed:

$$\begin{aligned} Res_{it} = {} & \varphi_0 + \varphi_1 Urb_{it} + \varphi_2 Urb_{it}^2 + \varphi_3 Gov_{it} + \varphi_4 Gov_{it} \times Urb_{it} \\ & + \varphi_5 Gov_{it} \times Urb_{it}^2 + \varphi_6 X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \end{aligned} \tag{4}$$

where φ_0 denotes the intercept term of Equation (4), φ_1 and φ_2 denote the coefficients of Urb and Urb^2, respectively; φ_3 denotes the impact effect of government intervention; φ_4 and φ_5 denote the coefficients of $Gov_{it} \times Urb_{it}$ and $Gov_{it} \times Urb_{it}^2$, respectively, which represent the moderating effect of government intervention on the process of new urbanisation in the county affecting the resilience of the agricultural economy; and φ_6 is the coefficient of the control variable.

According to Qian Li et al.'s study on the measurement of the inflection point in the nonlinear model, the location of the inflection point of Equation (4) is determined by $X_0 = -(\varphi_0 + \varphi_4 Gov_{it})/2(\varphi_2 + \varphi_5 Gov_{it})$. There is an effect of the moderating variables on the position of the inflection point. When $(\varphi_1\varphi_5 - \varphi_2\varphi_4) > 0$, the inflection point moves to the right; conversely, the inflection point moves to the left. At the same time, the regulating variable also changes the shape of the curve. When $\varphi_5 > 0$, the "U" curve becomes steeper, indicating that the rate of change between the explanatory variables and the explained variables increases, while the inverted "U" curve becomes flatter, characterising a decrease in the rate of change, and vice versa.

4.1.4. Threshold Effect Model Construction

In order to further examine the impact of new county urbanisation on the resilience of the agricultural economy and capture the local structural breakpoints, this paper draws on the research of Hansen (1999), takes new county urbanisation as the core explanatory variables and threshold variables at the same time, and establishes a panel regression model to identify the phased leap of the impact mechanism at different levels of new county urbanisation, and to provide a more refined critical point for policy intervention. The specific construction of the threshold effect model is as follows:

$$\begin{aligned} Res_{it} = {} & d_0 + d_1 Urb_{it} \cdot I(T_i \le r_1) + d_2 Urb_{it} \cdot I(r_1 < T \le r_2) \\ & + d_3 Urb_{it} \cdot I(T_i > r_2) + d_4 X_{it} + \mu_i + \varepsilon_{it} \end{aligned} \tag{5}$$

where T_i denotes the threshold variable, r_1 and r_2 represent the first threshold and the second threshold respectively, $I(\cdot)$ represents just the function, and other variables are defined as in model (1).

This theoretical framework helps to deeply understand the mechanism of new county urbanisation in enhancing the resilience of the agricultural economy, and provides a new perspective for analysing the role of new county urbanisation in the resilient development of the agricultural economy.

4.2. Explanation of Variables

4.2.1. Explained Variables

According to existing studies, agricultural economic resilience is mainly reflected in the resistance to cope with and absorb various internal and external shocks, the resilience to recover quickly after shocks, and the reconstruction and innovation ability to adjust the correction path. This paper introduces the indicator construction model of the "pressure-state-response" theoretical framework of Gao et al. (2024a), and constructs the agricultural economic resilience evaluation index system from the three aspects of agricultural economic resilience: resilience, resilience and innovation. This paper draws on the agricultural economic resilience evaluation idea based on the first-level indicators of resilience, resilience and innovativeness (Li & Wan, 2025), added Jiang et al. (2022) in the study to measure the transformation and innovation capacity of rural residents' electricity con-

sumption for production and life and the coverage rate of broadband network to measure the risk of resilience to restoration capacity, the evaluation index system of agricultural economic resilience is shown in Table 1. This paper uses entropy weight to comprehensively measure the agricultural economic resilience. This paper uses the entropy weight Topsis method to comprehensively measure the level of agricultural economic resilience as an explanatory variable.

Tabel 1. Index system for measuring the resilience level of agricultural economy.

Primary Indicators	Secondary Indicators	Tertiary Indicators	Indicator Attributes
Resilience	Industrial growth	Value added of primary industry	Positive
	Consumption level	Total retail sales of consumer goods in rural areas	Positive
	Grain output	Total grain output	Positive
	Degree of mechanisation	Total power of agricultural machinery	Positive
Resilience	Employees	Number of employees in agriculture, forestry, animal husbandry and fishery	Positive
	Income	Per capita disposable income of rural residents	Positive
Innovative power	Electricity Input	Rural residents' electricity consumption for production and living	Positive
	Network Coverage	Broadband Internet Penetration Rate	Positive

4.2.2. Core Explanatory Variables

The core explanatory variable in this paper is the level of new urbanisation in counties (Urb). County new urbanisation is a multi-dimensional concept, and academics have largely measured the county urbanisation level and constructed an indicator system from comprehensive dimensions such as social (Miao & Li, 2024), economic and environmental dimensions (Yang et al., 2022). After a comprehensive analysis of existing studies, this paper, based on the evaluation system of Wang et al. (2012), extends and optimises the original indicator system by introducing the selection of proxy variables for secondary indicators by Ouyang et al. (2024) and Wang et al. (2021), etc., and categorises it into an indicator system with population urbanisation, economic urbanisation and social urbanisation as the primary indicators. The subdivided secondary indicators and proxy variables are shown in Table 2 below. Finally, the objective assignment (CRITIC method) is used to calculate a more reasonable and universal county urbanisation measurement index system.

1) Dimensionless processing. In order to solve the problem of non-metricity caused by the different units and attributes of each indicator, and to ensure the scientific nature of the results, it is necessary to carry out the dimensionless processing.

Tabel 2. Index system of New-Type urbanisation in county areas.

Primary Indicators	Secondary Indicators	Tertiary Indicators	Indicator Attributes
Social Urbanisation	Medical resources	Number of beds in healthcare institutions C1	Positive
	Knowledge Resources	Total number of books in public library collections C2	Positive
	Educational Resources	Average years of schooling C3	Positive
Economic urbanisation	Scale of assets	Social fixed asset investment C4	Positive
	Industrial base	Value-added ratio of secondary and tertiary industries C5	Positive
Population Urbanisation	Regional Population	Urban population share C6	Positive
	Employment scale	Average annual number of urban on-the-job workers C7	Positive

$$C_{jit} = \frac{c_{jit} - c_{it}}{\max(c_{it}) - \min(c_{it})} \tag{6}$$

where C_{jit} is the standardised value of the ith indicator of county j in year t after the dimensionless processing, and the larger the value represents the greater contribution of the indicator to the new urbanisation of the county. c_{jit} is the actual observed value of the ith indicator of county j in year t. $\min(c_{it})$ and $\max(c_{it})$ denote the minimum and maximum values of the ith indicator in year t, respectively.

2) Determine the weights of indicators. This paper uses a combination of objective assignment (CRITIC method) to assign weights to each indicator of new urbanisation in the county, and the arithmetic average of the weights obtained by each method is taken as the final weight of each indicator to improve the scientificity of the weights of the indicators.

3) Score of each indicator. After eliminating the differences in the scale of the original data and determining the weights, the score of each index is calculated, and the formula is:

$$Z_i = C_i \times w_i \times 100 \tag{7}$$

4) Calculate the composite index. After obtaining the scores of each index, the linear weighted sum method is used to calculate the new urbanisation index of each county in each year, and the calculation formula is as follows:

$$S_{jt} = \sum_{i=1}^{n} Z_{jit} \tag{8}$$

where S_{jt} is the total county new urbanisation index of county j in year t, and Z_{jit} is the score of the ith indicator of county j in year t.

4.2.3. Mediating and Moderating Variables

Drawing on previous literature, the mediating variables in this paper are 1) indus-

trial structure upgrading (Indus), which is measured by the ratio of the output value of tertiary industry to the output value of secondary industry in the county, drawing on existing studies; 2) technological progress (Tech), Porter and Linde (1995) points out that environmental regulations can stimulate corporate innovation, thereby partially or fully offsetting compliance costs and even enhancing corporate competitiveness, achieving a win-win outcome for environmental protection and economic performance. Therefore, this paper uses the number of green patents per 10,000 people. The moderating variable 3) the level of government intervention (Gov) is measured by the ratio of local government's general financial expenditure to regional GDP.

4.2.4. Control Variables

With reference to existing studies, the following control variables are selected: 1) financial level (Fin), measured by the ratio of year-end loan balances of financial institutions to regional GDP; 2) communication level (Fixed), measured by the logarithm of regional fixed-line telephone subscribers; 3) human capital level (hucap), measured by the logarithm of the number of people enrolled in general secondary schools; 4) the level of economic development (ln_ pgdp), measured by the logarithm of local government general financial expenditures to regional GDP. pgdp), measured by the logarithm of regional GDP per capita; and 5) population density (popu), measured by the ratio of the total population of the region at the end of the year to the land area of the administrative region.

4.3. Data Sources and Descriptive Statistics

In order to ensure the accuracy and continuity of the study, this paper excludes counties with more serious missing data, and finally selects the panel data of 2039 counties in China from 2008 to 2022 for empirical analysis. Among them, the patent data come from the State Intellectual Property Office, other data come from the Statistical Yearbook of the People's Republic of China, the Statistical Yearbook of Chinese Counties, and the Statistical Yearbook of Chinese Regional Economy; some of the missing values are filled in using the Database of China's Counties Construction, and the rest of missing values are filled in using linear interpolation to fill in some of the missing values.

Descriptive statistics for each variable are listed in Table 3.

Tabel 3. Summary statistics.

VarName	Obs	Mean	SD	Min	Median	Max
Res	26,153	0.117	0.074	0.001	0.102	0.536
Urb	26,153	0.568	0.125	0.010	0.535	0.934
Urb_sq	26,153	0.338	0.147	0.000	0.286	0.872
Fin	26,153	0.634	0.410	0.000	0.537	7.635
Fixed	26,153	10.403	1.161	2.565	10.480	15.471

Continued

hucap	26,153	9.758	0.944	5.533	9.871	12.320
ln_pgdp	26,153	10.187	0.777	7.727	10.188	13.038
popu	26,153	0.031	0.031	0.000	0.020	0.404
Indus	26,153	1.213	1.300	0.043	0.883	54.979
Tech	26,153	0.313	0.914	0.000	0.062	32.111
Gov	26,153	0.282	0.256	0.005	0.202	3.941

5. Empirical analyses

5.1. Benchmark Model Regression Results

OLS regression analysis is conducted according to Equation (1) to test the potential impact of new county urbanisation on the agricultural economy by gradually introducing control variables. The estimation results in Table 4 show that when considering the linear relationship, the new county urbanisation will significantly reduce the toughness of the agricultural economy; when considering the non-linear relationship, there is a significant non-linear relationship between the new county urbanisation and the toughness of the agricultural economy, presenting an upward opening of the "U" characteristics, and the hypothesis H1 is verified. In the initial stage of urbanization, due to the unidirectional flow of labour and capital factors from the agricultural sector and the technology adoption stagnation under the small-farming business model, which leads to the reduction of agricultural production scale, the new urbanization of the county will have a certain degree of inhibition on the resilience of the agricultural economy in the short term, however, with the deepening of the urban-rural integration of the technology diffusion and the formation of the whole industrial chain of agriculture, as well as the large-scale However, with the deepening of urban-rural integration leading to the diffusion of technology, the feedback of urban industry to form the whole industrial chain of agriculture, and the increase in the digestive capacity of the main body of operation to the fixed costs of technological progress, the new urbanisation of the county will gradually change into an effective driving force to promote the resilience of the agricultural economy.

Table 4. Benchemark regression.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Res	Res	Res	Res	Res	Res	Res
Urb	−0.042***	−0.611***	−0.613***	−0.612***	−0.612***	−0.562***	−0.543***
	(0.004)	(0.042)	(0.042)	(0.042)	(0.042)	(0.041)	(0.041)
Urb_sq		0.483***	0.484***	0.482***	0.483***	0.443***	0.425***
		(0.035)	(0.036)	(0.036)	(0.036)	(0.035)	(0.034)
Fin			0.009***	0.009***	0.009***	0.007***	0.007***
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)

Continued

Fixed				−0.003***	−0.002***	−0.002***	−0.003***
				(0.001)	(0.001)	(0.001)	(0.001)
hucap					−0.002*	−0.002**	−0.004***
					(0.001)	(0.001)	(0.001)
ln_pgdp						−0.011***	−0.006***
						(0.001)	(0.001)
popu							0.533***
							(0.067)
_cons	0.140***	0.301***	0.295***	0.322***	0.341***	0.437***	0.384***
	(0.002)	(0.012)	(0.012)	(0.014)	(0.017)	(0.020)	(0.020)
County_FE	YES	YES	YES	YES	YES	YES	YES
Year_FE	YES	YES	YES	YES	YES	YES	YES
N	26144	26144	26144	26144	26144	26144	26144
r^2	0.801	0.804	0.805	0.805	0.805	0.806	0.808

Standard errors in parentheses, *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

The inflection point of the "U" curve is calculated as $X_0 = 0.633$, i.e., when the level of new county urbanisation is 0.633, the impact of new county urbanisation on the resilience of the agricultural economy changes from an inhibitory to a promotional effect. From the data statistics, the distribution range of new county urbanisation is 0.010 - 0.934. Combined with the analysis of the inflection point critical value $X_0 = 0.633$, the level of new county urbanisation has not yet fully reached the optimal matching point to adapt to the local agricultural economic resilience. The results of this empirical analysis not only reveal the dynamic role of county new urbanisation in enhancing the resilience of the agricultural economy and promoting the development of agricultural economic resilience, but also reflect that its impact presents obvious stage characteristics.

This study reveals for the first time that there is a significant "U" shaped relationship between county new urbanisation and agricultural economic resilience, which provides a new theoretical perspective and empirical basis for understanding the role of county new urbanisation in agricultural economic resilience. In addition, by calculating the precise location of the inflection point, it points out the inflection point of the new urbanisation in the county to promote the resilience of the agricultural economy, which provides a quantitative decision-making basis for the policy formulation, and deepens the regular understanding of how to promote the urbanisation process and avoid the potential risks.

5.2. Robustness Test and Endogeneity Analysis

In order to ensure the objectivity and robustness of the research results, this paper

again tests the non-linear relationship between county new urbanisation and agricultural economic resilience by 1% bilateral tailing of continuous variables, eliminating the competing effects of the digital countryside policy, and lagging one period of the explanatory variables. Considering the process of other policies affecting local agricultural economic resilience during the promotion of new county urbanisation, this paper collates the situation of digital down-country policies (Policies) that may affect agricultural economic resilience during the period of new county urbanisation and excludes the sample that received digital down-country policies in the period of 2008-2022. The results in Table 5 show that after 1% bilateral shrinkage, excluding the sample of digital rural policies, and lagging one period of the explanatory variables, the "U" shaped relationship between the new urbanisation in the county and the resilience of the agricultural economy still exists, which verifies that there is a non-linear relationship between the new urbanisation in the county and the resilience of the agricultural economy.

Table 5. Robustness checks.

	(1)	(2)	(3)
	Shrinkage Treatment	Elimination of the competitive hypothesis	Hysteresis effect
Urb	−0.649***	−0.547***	−0.302***
	(0.035)	(0.042)	(0.035)
Urb_sq	0.510***	0.429***	0.228***
	(0.030)	(0.035)	(0.030)
_cons	0.352***	0.399***	0.417***
	(0.020)	(0.020)	(0.020)
Control	YES	YES	YES
County_FE	YES	YES	YES
Year_FE	YES	YES	YES
N	26,144	24,947	24,103
r^2	0.810	0.810	0.820

Standard errors in parentheses, *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

Although the results of the benchmark regression have shown that there is a significant non-linear relationship between county new urbanisation and agricultural economic resilience, there may still be an endogeneity problem in the model causality identification process, i.e., there is reverse causality between county new urbanisation and agricultural economic resilience. Therefore, with reference to Huang et al. (2019) and Wang and Cheng (2019) who used nighttime lighting data to characterise the urbanisation level, this paper re-runs the regression using nighttime lighting as an instrumental variable. On the one hand, night lighting is an objective spatial characterisation indicator of the intensity of economic and

social development in the county, which is significantly correlated with the urbanisation process and satisfies the relevance of the instrumental variable; on the other hand, as the natural light source data obtained by satellite remote sensing, the change of the intensity of the light is not affected by the subjective decision-making of the resilience of the agricultural economy and is not related to the stochastic shocks of the agricultural production, which satisfies the exclusivity of the instrumental variable. According to the results in Table 6, it can be seen that the instrumental variables passed the unidentifiable test, weak identification test and over-identification test, which verified the relative rationality of the selected instrumental variables.

Table 6. Endogeneity test.

	(1)	(2)
	Urb	Res
Urb		−1.733***
		(0.392)
Urb_sq		1.034***
		(0.286)
light	−0.013***	
	(0.002)	
light_sq	0.003***	
	(0.000)	
Control	YES	YES
County_FE	YES	YES
Year_FE	YES	YES
Cragg-Donald Wald F statistic	115.92	
Kleibergen-Paap rk Wald F	31.394	
Kleibergen-Paap rk LM statistic	59.089*** [0.000]	
Hansen J statistic	0.000	
N	26,144	24,947
r^2	0.810	0.810

Standard errors in parentheses, *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

5.3. Heterogeneity Analysis

5.3.1. Regional Heterogeneity

Factors such as the level of new urbanisation, financial level and human capital level of counties vary significantly across regions, and coupled with the influence of multiple factors such as the deep adjustment of the global division of labour pattern and the digital transformation of industries, the objective phenomenon of unbalanced development of the resilience of the agricultural economy across regions in China

has become even more obvious. Therefore, this paper divides the 2039 counties into east, centre and west for research[3]. The results in Table 7 show that the non-linear relationship between new urbanisation and agricultural economic resilience in counties still exists significantly in the three categories of eastern, central and western regions. After calculation, the inflection point values of the three regions in the east, central and west are larger than the national inflection point values; at the same time, the coefficient of the quadratic term in the east is 0.530, and the curve becomes steeper, which indicates that compared with the benchmark regression, an increase in the level of new urbanisation in counties will lead to a greater change in the resilience of the agricultural economy, whereas the quadratic coefficients of the quadratic term in the central and western regions are 0.288 and 0.180, respectively, and the curves become flatter, and an increase in the county's new The increase in the level of urbanisation produces a somewhat smaller change in the resilience of the agricultural economy compared to the baseline regression.

Table 7. Heterogeneity test.

	(1)	(2)	(3)	(4)	(5)
	Industry	Agriculture	East	Central	West
Urb	−0.672***	−0.318***	−0.806***	−0.404***	−0.252***
	(0.157)	(0.036)	(0.056)	(0.083)	(0.050)
Urb_sq	0.530***	0.235***	0.640***	0.288***	0.180***
	(0.122)	(0.031)	(0.046)	(0.069)	(0.044)
_cons	0.500***	0.266***	0.132***	0.588***	0.156***
	(0.064)	(0.020)	(0.043)	(0.043)	(0.024)
Control	YES	YES	YES	YES	YES
County_FE	YES	YES	YES	YES	YES
Year_FE	YES	YES	YES	YES	YES
N	4702	21,374	6715	7796	11,633
r^2	0.792	0.825	0.805	0.818	0.756

Standard errors in parentheses, *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

5.3.2. Heterogeneity in County Positioning

The effects of agricultural economic resilience through the promotion of new county urbanisation can vary across different types of counties. In order to explore whether there is county heterogeneity in the effect of county new urbanisation on agricultural economic resilience, the counties are divided into industrial and agricultural counties with reference to the study by Sun Xuetao et al. Columns (1)

[3]According to the research needs, the eastern region included Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan; the central and western region included Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan, Sichuan, Chongqing, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, Guangxi, and Inner Mongolia. The northern region includes Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia, Liaoning, Jilin, Heilongjiang, Shandong, Henan, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang; the southern region includes Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Hubei, Hunan, Guangdong, Guangxi, Hainan, Chongqing, Sichuan, Guizhou, Yunnan.

and (2) of Table 7 report the results of the heterogeneity analyses for agricultural and industrial counties, respectively, and the non-linear relationship between county new urbanisation and agricultural economic resilience remains significant regardless of whether it is an agricultural county or an industrial county. The calculated sample point value for industrial counties is 0.634 less than the national inflection point value, and the positive impact of industrial counties by county new urbanisation appears earlier; and the quadratic term coefficient is 0.530, and the curve becomes steeper, suggesting that a further increase in county new urbanisation will lead to a greater change in the resilience of the industrial counties' agricultural economy compared to the baseline regression. For the sample group of agricultural counties, the inflection point value is 0.676, which is larger than the national inflection point value, and the quadratic term coefficient is 0.235, the curve is more gentle, indicating that the further improvement of new urbanisation in counties will produce smaller changes in the resilience of the agricultural economy in industrial counties.

5.4. Intermediate Effect Test

5.4.1. The Industrial Governance Path of Agricultural Economic Resilience Improvement: The Mediating Role Assumed by Industrial Structure Upgrading

The results of the intermediary effect test are shown in Table 8, from which it can be seen that: 1) The new urbanisation of the county has a significant "inverted U" type impact on industrial structure upgrading. 2) Industrial structure upgrading has a mediating effect in the impact of county new urbanisation on the resilience of agricultural economy. According to the study of Lin and Feng (2022), the intermediary effect played by industrial structure upgrading shows the characteristic of "inverted U", indicating that the new urbanisation in the county can promote industrial structure upgrading. Secondly, according to the coefficient estimation, county new urbanisation is $ME = -0.00023 + 0.00018Urb_{it}$ gradually weakening the negative impact of county new urbanisation on the resilience of the agricultural economy, and accelerating the transformation of county new urbanisation on the resilience of the agricultural economy from a negative impact to a positive impact, which helps to optimise the structure of the rural industry, improve the quality and efficiency of agricultural production, as well as realise the comprehensive expansion of the rural economy, i.e. to improve the resilience of the agricultural economy. expansion, i.e., to enhance the resilience of the agricultural economy. When the impact of county new urbanisation on agricultural economic resilience shifts to a positive impact, the mediating impact of industrial structure upgrading is weakened, and is more reflected in the direct impact of county new urbanisation on agricultural economic resilience, and hypothesis H2 is tested.

5.4.2. The Technological Innovation Path of Agricultural Economic Resilience Enhancement: The Mediating Role of Technological Progress

Based on the previous theoretical analysis, new county urbanisation can achieve

agricultural technological progress by improving regional technological progress, thereby enhancing the self-resilience and coping capacity of agriculture. According to the results in Table 8, there is a significant non-linear effect of new county urbanisation on technological progress. At the initial stage, the unidirectional outflow of factors such as labor and capital from the agricultural sector to the towns leads to the "hollowing out" of the countryside, which results in insufficient investment in agricultural research and development and further leads to the solidification of the small-farming business model, and the adoption of new technologies is costly and risky, which further leads to a decline in the level of technological progress, and therefore has a dampening effect on the resilience of the agricultural economy at the initial stage. inhibitory effect. After reaching the middle stage of urbanisation, cities and towns begin to feed the countryside: county industrial parks promote the diffusion of agricultural technology by attracting the concentration of agriculture-related enterprises, etc., and technological progress begins to have a positive effect on the resilience of the agricultural economy.

Combined with the coefficients, the size of the mediation effect of technological progress is $ME = -0.00404 + 0.00308Urb_{it}$ The result confirms the logic of the theoretical mechanism from the perspective of empirical analysis and verifies the hypothesis H3, that is, there is a mediation effect of technological progress in the mechanism of the new urbanisation in the county affecting the resilience of the agricultural economy.

Table 8. Mediation effect.

	(1)	(2)	(3)	(4)
	Industrial Structure	Technology	Industrial Structure	Technology
Urb	3.661***	−18.084***	−0.614***	−0.449***
	(0.735)	(1.074)	(0.042)	(0.039)
Urb_sq	−3.253***	15.565***	0.485***	0.343***
	(0.592)	(0.898)	(0.035)	(0.033)
Indus			0.000*	
			(0.000)	
Tech				0.009***
				(0.001)
_cons	−0.557	5.064***	0.319***	0.273***
	(0.372)	(0.327)	(0.016)	(0.016)
Control	YES	YES	YES	YES
County_FE	YES	YES	YES	YES
Year_FE	YES	YES	YES	YES
N	26,144	26,144	26,144	26,144
r^2	0.635	0.649	0.804	0.809

Standard errors in parentheses, *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

5.5. Moderating Effect Test

The fiscal policy implemented by the government in the process of new urbanisation and the reform of the household registration system are important ways to boost the intrinsic motivation of rural revitalisation and enhance the resilience of the agricultural economy. The government intervention and explanatory variables and their interaction terms are included in the model and then regressed. The results of the moderating effect test in Table 9 show that the interaction terms of the squared terms of government intervention and the level of new urbanisation in counties are all significantly positive at the 1% level, indicating that government intervention can play a positive moderating effect and strengthen the non-linear relationship between new urbanisation in counties and the resilience of the agricultural economy. The calculation, $\left(\varphi_1\varphi_5 - \varphi_2\varphi_4\right) < 0$, shows that when government intervention is introduced as a moderation variable, the overall curve and the inflection point will move to the left, i.e., its synergistic effect with the construction of new county urbanisation will accelerate the transformation process of the negative impact of new county urbanisation on the resilience of the agricultural economy to a positive one, and the hypothesis H4 has been verified.

Table 9. Moderation effect test.

	(1)	(2)
	Include moderating variables	Include interaction term
Urb	−0.543***	−0.631***
	(0.041)	(0.050)
Urb_sq	0.425***	0.478***
	(0.034)	(0.040)
Gov	−0.000	
	(0.002)	
c.Urb#c.Gov		−0.079***
		(0.011)
c.Urb_sq#c.Gov		0.146***
		(0.018)
_cons	0.384***	0.419***
	(0.020)	(0.021)
Control	YES	YES
County_FE	YES	YES
Year_FE	YES	YES
N	26,144	26,144
r^2	0.808	0.809

Standard errors in parentheses, *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

5.6. Threshold Effect Test

Based on the previous analysis, in order to further measure the "U-shaped" relationship between county new urbanisation and agricultural economic resilience, the specific impact of county new urbanisation on agricultural economic resilience at different levels and the role of the effect interval, this paper continues to take the level of county new urbanisation as a threshold variable for the threshold regression, in order to measure the role of the effect of the different intervals. different intervals. This paper uses the Hansen threshold effect model to determine the number of thresholds, and the data are sequentially estimated with three thresholds, double thresholds and single thresholds, and the F-value and P-value are calculated. Table 10 of the threshold effect test results shows that the P value of single threshold and double threshold are both significant at the 1% level, while the P value of three thresholds is 0.356, which is not significant, so this paper adopts the double-threshold model to analyse the threshold effect of the county's new urbanisation. The first threshold value is 0.4674, and the second threshold value is 0.5990, which divides the digital countryside construction into three intervals of less than or equal to 0.4674, greater than or equal to 0.4674 less than or equal to 0.5990, and greater than or equal to 0.5990.

Table 10. Threshold characteristic diagnostic test.

variables	model	F	P	10%	5%	1%	Threshold	Conf.Interval
Urb	Single	670.40	0.000	73.356	85.879	110.028	0.4674	[0.465, 0.469]
	Double	245.19	0.000	57.087	64.644	83.649	0.5990	[0.593, 0.607]
	Triple	79.17	0.356	122.954	154.045	275.417	0.7120	[0.710, 0.715]

Table 11 shows that when the level of new urbanisation in the county is lower than the first threshold, the coefficient of its impact on the resilience of the agricultural economy is −0.199. At this stage, the "extraction effect" of urbanisation on agriculture has already appeared, which is manifested in the transfer of high-quality labour and capital from rural areas to the cities and towns, but the negative impact is relatively mild due to the still low level of urbanisation. However, because the level of urbanisation is still low, its negative impact is relatively mild. When the level of new urbanisation in the county is between the first and second thresholds (medium level acceleration stage), the negative impact coefficient increases to −0.246. At this stage, the acceleration of the urbanisation process creates a strong "magnetic field effect", which leads to an accelerated and unidirectional outflow of rural labour and capital from the agricultural sector, resulting in the emergence of ageing, part-time work and the emergence of a "draw effect" in the agricultural sector. The agricultural sector is aging, part-time and hollowing out, and the endogenous development power is seriously weakened. At the same time, the centre of gravity of the county's economic development has focused on the construction of industrial parks, real estate development and the expansion of urban infrastructure. Resource factors and policy dividends are heavily tilted to-

wards non-agricultural industries, leading to a continuous decline in the comparative efficiency of agriculture, and an intensification of the trend of "non-food cultivated land" or even "non-farming", which has directly eroded the material basis of agricultural production and the stability of the scale, and weakened its resilience. Most critically, at this stage, the "compensatory effect" on agriculture brought about by urbanisation, such as technological overflow and financial feedback, has not yet been formed or is very weak. The failure of urban industrial parks to effectively undertake and transform agricultural scientific and technological innovations, and the absence of a mechanism for two-way flow of urban and rural factors have resulted in the "extraction effect" of urbanisation not being compensated for effectively, and thus its net negative impact has reached its peak. When the level of new urbanisation in the county exceeds the second threshold, the negative impact coefficient is still negative (−0.197), but the absolute value is significantly reduced, indicating that the negative effect has been substantially weakened. After urbanisation reaches a higher level, the conditions for urban-rural integration and development gradually mature. Cities and towns begin to have enough economic strength and technical ability to "feed" agriculture, and the positive path of technological progress and industrial structure upgrading begins to operate effectively. At the same time, the two-way flow of technology, information and talent between urban and rural areas has intensified, and new forms of business, such as smart agriculture, green agriculture and rural e-commerce, have begun to emerge, raising the total factor productivity and value creation capacity of agriculture and partially offsetting the negative impact of factor outflows. The threshold effect model further identifies secondary fluctuations within the left branch of the U-shape.

Table 11. Threshold effect.

variables	Res
Urb ≤ 0.4674	−0.199***
	(0.031)
0.4674 < Urb ≤ 0.5990	−0.246***
	(0.027)
Urb > 0.5990	−0.197***
	(0.021)
_cons	0.090**
	(0.045)
Control	YES
County_FE	YES
Year_FE	YES
N	14,565
r^2	0.155

Standard errors in parentheses, *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

6. Conclusions and Recommendations

6.1. Conclusion

This study analyses the non-linear impact and mechanism of county new urbanisation on agricultural economic resilience at the theoretical level, and conducts a comprehensive assessment and test based on the panel data of 2,039 counties in China from 2008 to 2022. The study finds that: 1) there is a non-linear relationship between new county urbanisation and agricultural economic resilience, which manifests itself as a "U" curve with an upward opening, and when the level of new county urbanisation reaches a certain threshold, new county urbanisation has a positive effect on agricultural economic resilience. 2) Industrial structure upgrading plays an intermediary role in the impact of new county urbanisation on agricultural economic resilience. With industrial structure upgrading in the early stage of urbanisation, the enhancement effect of new county urbanisation on agricultural economic resilience appears in advance. 3) Technological progress plays an intermediary role in the impact of county new urbanisation on agricultural economic resilience, and county new urbanisation can have a positive impact on agricultural economic resilience through technological progress. 4) Government intervention, as a moderating variable, has a positive moderating effect and strengthens the non-linear impact of county new urbanisation on agricultural economic resilience. 5) The "U" curve relationship between county new urbanisation and agricultural economic resilience shows obvious regional differences and differences in county industrial positioning. 6) Before county urbanisation promotes agricultural economic resilience, the inhibiting effect of county new urbanisation on agricultural economic resilience shows a secondary fluctuation that changes as the level of county new urbanisation increases.

While this study utilizes a comprehensive empirical framework and large-scale panel data to examine the nonlinear relationship between county-level new-type urbanization and agricultural economic resilience, it is also subject to several limitations. First, the inherent construct nature of core indicators—including agricultural economic resilience and county-level new urbanisation—inevitably involves subjective judgments in indicator selection. For instance, theoretically relevant dimensions like rural social capital and local policy implementation efficiency, which may affect agricultural economic resilience, have not been fully integrated, undermining the comprehensiveness of the indices. Second, unobserved confounding variables may remain: factors such as informal local institutional arrangements (like traditional agricultural cooperation networks) or unforeseen shocks such as regional pandemic-related disruptions to agricultural supply chains were not explicitly controlled for, which may introduce bias into the estimated causal relationships.

6.2. Policy Recommendations

First, continue to deepen the stage-by-stage precision regulation of the county urbanisation process. At the early stage when the urbanization level is lower than

the U-shaped inflection point, efforts should be made to crack the double constraints of factor loss and technological lag, which can be achieved by setting up an agricultural resilience transition fund, extracting a fixed proportion of urban land revenue to compensate for the labour gap and industrial chain breaks; simultaneously promoting the technological pre-setting project, giving priority to laying out the intelligent agricultural infrastructure in low-urbanization counties, and compressing the cost of technological adoption to the affordable range of small farmers' operations with financial subsidies, so as to shorten the period of time for small farmers. The financial subsidy will compress the cost of technology adoption into an affordable range for small farmers and shorten the time-lag bottleneck of technology diffusion. When urbanisation crosses the inflection point, it is necessary to strengthen the technology dividend release mechanism for urban-rural integration, and focus on promoting the full coverage of digital infrastructure and the deep integration of the industrial chain.

Secondly, the central transmission function of upgrading industrial structure and technological progress should be strengthened. On the one hand, agricultural high-tech zones can be designated in county development zones to attract smart agriculture, green food and other enterprises through tax reduction and exemption policies, and to provide technical support to a certain range of agricultural production zones; on the other hand, to build a county digital agrotechnology promotion cloud platform, integrating technological tools such as BeiDou navigation, remote sensing monitoring and other tools to achieve precise decision-making in farming, and to incorporate technology diffusion coverage into the core indicators of the assessment of the local government.

Third, improve the differentiated regulation mechanism of government service energy efficiency. For the positive adjustment effect of government service capacity, it is recommended to implement a classification and empowerment strategy: for counties with weak service capacity, implement the provincial team trusteeship model, and directly coordinate urbanisation and agricultural resilience construction projects by the provincial departments to ensure the accuracy of policy implementation; for counties with advantageous service capacity, decentralise the right to manage agricultural data and develop technical standards, and support the development of the "urban-agricultural" resilience project. "Urban-agriculture" resilience linkage application scenarios. By dynamically monitoring the level of digitisation of government services, a gradient governance system will be formed in which "weak counties will be strongly protected and strong counties will be empowered to innovate", so as to maximise the effectiveness of government services in regulating non-linear relationships.

Fourth, the implementation of regional and industrial positioning of the subgradient promotion strategy. In the east and other economically developed regions, give full play to the amplification effect of the resilience gain of the agricultural economy brought about by the increase in the level of urbanisation, and accelerate the construction of national agricultural resilience innovation demonstra-

tion zones; for the central and western counties, it is necessary for the central government to set up resilience climbing subsidies, and to match the increase in the rate of urbanisation with special funds in order to speed up the evolution of the smoothing curve. Industrial-led counties should make use of the positive effect of early release characteristics, and establish a technology binding mechanism between industrial enterprises and village-level cooperatives; agricultural-led counties need to focus on high inflection point breakthroughs, and give priority to the layout of cold chain logistics, intelligent grain storage and other key facilities to reduce the inflection point.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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