

New Quality Productivity Empowering Rural Revitalization: Theoretical Logic and Empirical Verification

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Abstract: New quality productive forces, as a new type of productive forces centered on technological innovation, exert a significant influence on rural revitalization. Based on panel data from 31 provinces in China during 2012–2022, this study thoroughly investigates the impact of new quality productive forces on rural revitalization and its underlying mechanism. The findings reveal that the development of new quality productive forces significantly promotes rural revitalization. Mediation effect analysis demonstrates that new quality productive forces can further advance rural revitalization by fostering education equity. Drawing on these conclusions, it is recommended to strengthen the driving role of new quality productive forces to consolidate the technological foundation for rural revitalization, deepen the “technology education revitalization” mediation pathway, and amplify empowerment effectiveness through education equity.

Keywords: New quality productive forces; Education equity; Rural revitalization; Spatial Durbin model

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1. Introduction

Rural revitalization is a systematic strategy to address the dilemmas of rural development ^[1]. However, structural contradictions such as weak agricultural competitiveness, mounting ecological pressure, and insufficient grassroots governance effectiveness have become increasingly prominent, with the root cause lying in traditional productive forces’ inability to meet the demands of modernization ^[2]. The *2024 Central No. 1 Document* emphasizes building an agricultural powerhouse driven by technological innovation, and new quality productive forces—as a novel form of productive forces centered on the Internet of Things and artificial intelligence—precisely offer a key pathway to overcome these bottlenecks.

Existing research has primarily focused on the respective measurement and unidirectional impacts of rural revitalization and new quality productive forces, yet there remains a lack of systematic empirical examination of their relationship. To address this gap, this paper employs panel data from 31 provinces in China spanning

2012–2022, utilizing fixed effects models, mediation effect models, and Spatial Durbin Models to investigate the impact effects, underlying mechanisms, and spatial spillover characteristics of new quality productive forces on rural revitalization.

2. Theoretical analysis and research hypotheses

2.1. Direct effect

New quality productive forces, with innovation and quality as their core ^[3], drive rural revitalization through technological empowerment. Specifically, this manifests in three aspects: First, they reconstruct production factors by cultivating “new-quality farmers and workers,” popularizing intelligent agricultural machinery, and activating data elements, thereby comprehensively upgrading the three fundamental elements of productivity. Second, they promote industrial integration by leveraging digital technology for precision agricultural management, spawning new service formats such as rural e-commerce, and extending the cultural-tourism-wellness industry chain. Third, they facilitate ecological value transformation by optimizing resource utilization through intelligent monitoring and converting ecological resources into economic capital via digital platforms.

Based on this analysis, Hypothesis H1 is proposed: New quality productive forces significantly promote rural revitalization.

2.2. Indirect effect

New quality productive forces break down spatial barriers to educational resources through digitalization, utilize artificial intelligence to achieve precision teaching, and enhance labor quality, thereby promoting education equity ^[4]. Education equity, in turn, injects endogenous momentum into rural revitalization by narrowing the urban-rural human capital gap, improving rural governance capacity, and stimulating youth entrepreneurship and cultural identity upon returning to their hometowns.

Accordingly, Hypothesis H2 is proposed: New quality productive forces indirectly drive rural revitalization by fostering education equity.

3. Research design

3.1. Data sources

Based on panel data from 31 provinces in China (excluding Hong Kong, Macau, and Taiwan) for the period 2012–2022, this study empirically examines the impact and mechanisms of new quality productive forces on rural revitalization. The data were obtained from the National Bureau of Statistics and the EPS Database, with missing values supplemented through interpolation.

3.2. Variable description

3.2.1. Explained variable

The explained variable in this study is rural revitalization. Following the methodology of Xu and Wang ^[5], a comprehensive evaluation index system was constructed across five dimensions: industrial prosperity, ecological livability, rural civilization, effective governance, and affluent living, with measurements calculated using the entropy method.

3.2.2. Core explanatory variable

The core explanatory variable in this study is new quality productive forces. Drawing on the approach of scholars such as Lu *et al.* [6], an evaluation index system was developed from three dimensions: technological productivity, green productivity, and digital productivity, with measurements derived using the entropy method.

3.2.3. Mediating variable

Current research on education equity predominantly employs the education Gini coefficient—calculated based on average years of schooling—as the primary quantitative measure of educational fairness. Accordingly, this paper utilizes the education Gini coefficient to characterize the degree of education equity across provinces.

3.2.4. Control variables

This study selects the following control variables: marketization process, industrial structure, fiscal support intensity, regional economic scale, industrialization level, transportation infrastructure level, regional population scale, urbanization level, and degree of opening-up.

4. Empirical results and analysis

4.1. Baseline regression

Baseline regression results (Table 1) show that under two-way fixed effects, the regression coefficient of new quality productive forces on rural revitalization is 0.067 (Column 1); after adding control variables, the coefficient is 0.055 (Column 2). Both coefficients are significantly positive at the 1% level, indicating that new quality productive forces significantly promote rural revitalization, thus verifying Hypothesis H1.

Table 1. Benchmark regression results

Variable	(1)	(2)
	Rural revitalization	Rural revitalization
New quality productivity	0.459 (7.76)	0.055 (3.42)
Control variable	No	Yes
Cons	0.316 (90.48)	0.581 (1.54)
Regional fixed effect	Yes	Yes
Time fixed effect	Yes	Yes
<i>n</i>	341	341
R ²	0.991	0.994

Note: * indicates significance at the 1%, 5%, and 10% levels, respectively. The *t*-statistic is provided in parentheses. The same applies below.

4.2. Robustness checks

4.2.1. Alternative estimation model

Given that the numerical characteristics of sample variables may affect the robustness of model estimation, this study adopts the Tobit model for re-estimation. The regression results, as shown in Column (1) of Table

2, indicate that the regression coefficient of new quality productive forces on rural revitalization is 0.055 and significant at the 1% level, suggesting that the baseline regression results remain robust after changing the regression model.

4.2.2. Sample adjustment

- (1) In light of significant fluctuations in China’s economic, social, and industrial development in 2020, the research sample period was adjusted to 2012–2019 for re-testing. As presented in Column (2) of **Table 2**, the regression coefficient of new quality productive forces is 0.043 and significant at the 1% level, indicating that the research conclusions are credible.
- (2) Considering that the four municipalities of Beijing, Shanghai, Tianjin, and Chongqing possess distinctive administrative resource allocation characteristics, they were excluded from the regression analysis to prevent interference from special samples on baseline model estimation. The regression results, displayed in Column (3) of **Table 2**, reveal that the regression coefficient of new quality productive forces on rural revitalization is 0.062 and significant at the 1% level, demonstrating that the research conclusions are reliable.

4.2.3. Winsorization

To mitigate the influence of outliers on the results, a 1% winsorization treatment was applied to all variable data. The regression results, as shown in Column (4) of **Table 2**, demonstrate that the coefficient of new quality productive forces is 0.065 and significant at the 1% level, confirming that the research conclusions remain robust.

Based on the above robustness analyses, this study concludes that the development of new quality productive forces exerts a significant positive impact on rural revitalization, thereby validating Hypothesis H1.

Table 2. Results of robustness testing

Variable	(1)	(2)	(3)	(4)
	Replacing estimation model	Adjust the sample	Adjust the sample	Tail shortening
New quality productivity	0.055 (2.78)	0.043 (2.81)	0.062 (3.56)	0.065 (4.11)
Control variable	Yes	Yes	Yes	Yes
Cons	0.523 (2.31)	0.820 (1.87)	0.675 (1.68)	0.591 (1.52)
Regional fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
<i>n</i>	341	279	297	341
R ²	-	0.995	0.993	0.994

4.3. Analysis of the mediating effect

The mediation effect test (**Table 3**) reveals that the regression coefficient of new-type productive forces on educational equity is 0.037, statistically significant at the 1% level. This indicates that new-type productive forces promote rural revitalization by enhancing educational equity, thereby confirming Hypothesis H2.

Table 3. Results of the mediating effect test

Variable	(1)
	Equal access to education
New quality productivity	0.037 (2.75)
Control variable	Yes
Regional fixed effect	Yes
Time fixed effect	Yes
Cons	0.521 (3.37)
<i>n</i>	341
R ²	0.362

5. Research conclusion and policy recommendations

5.1. Research conclusion

Based on panel data from 31 provinces in China during 2012–2022, this study employs multiple econometric models to thoroughly investigate the impact, mechanism of action, heterogeneity analysis, and spatial spillover effects of new quality productive forces on rural revitalization. The main conclusions are as follows: First, new quality productive forces can promote rural revitalization. Second, education equity serves as a mediating variable in how new quality productive forces empower rural revitalization; that is, new quality productive forces can promote rural revitalization by fostering education equity.

5.2. Research limitations

Although this study has achieved certain results in exploring the impact of novel productive forces on rural revitalization and its underlying mechanisms, there remain three key limitations:

First, the empirical analysis is based on provincial-level panel data, which fails to examine heterogeneous impacts at the county or village levels. This limitation constrains the precision of the findings and their practical guidance value for localized policy implementation. Future research could collect more granular micro-level data to enable precise analysis of specific impact pathways through which novel productive forces affect rural development.

Second, the study primarily focuses on the mediating effects of novel productive forces via educational equity, while insufficiently addressing other potential mediating mechanisms, such as rural financial development and rural infrastructure construction. Future studies could expand the scope of mediating variables to comprehensively investigate the multi-dimensional pathways through which novel productive forces influence rural revitalization.

Third, the study employs panel data from 2012 to 2022 but does not adequately account for the potential impacts of unexpected events on the research conclusions. Although this study conducted robustness tests through sample adjustments, future research could systematically incorporate shock effect analysis of exogenous events to enhance the applicability and resilience of the findings.

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Disclosure statement

The authors declare no conflict of interest.

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