Spatial Differentiation of New Quality Productive Forces in Promoting High-Quality Economic Development

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Abstract. This study is based on panel data from 30 Chinese provinces between 2010 and 2022. Economic high-quality development and its regional heterogeneity are systematically examined in relation to new quality productivity using the instrumental variable technique and the double fixed effect model. Economic high-quality development is very positively impacted by new quality productivity, according to the study, and this effect is 6.7 times greater in the northern region than in the southern one. According to the heterogeneity test, the north more effectively unleashes the potential of new quality productivity through technical innovation and upgrading of industrial structures, whereas the south is limited by resource mismatch and overly competitive markets. On the basis of this, distinct policy recommendations are put forth: the south must optimize the distribution of human resources and the market supervision mechanism to encourage the shift in the development model towards quality improvement, while the north should concentrate on creating new quality productivity innovation demonstration zones to solidify its dominant position. The theoretical and empirical foundation for optimizing the regional policy toolbox and implementing gradient development strategies is provided by this study.

Keywords: new quality productivity; high-quality economic development; bidirectional fixed effects model

1 Introduction

Accurately identifying the regional differences in the role of new quality productive forces and their internal mechanisms is of great practical significance for formulating differentiated development strategies and optimizing the allocation of innovation resources. China is at a critical stage of transitioning from traditional factor drive to innovation-driven economic development, and the significant differences among various provinces in terms of resource endowment, industrial foundation, and policy environment have resulted in complex spatiotemporal characteristics of the economic effects of new quality productive forces. Both the transformation of global economic growth drivers and coordinated regional development have made the cultivation of new quality productive forces a key strategy for driving high-quality economic development.

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The impact of new quality productivity on high-quality economic development was systematically examined in this study using panel data from 30 provinces from 2010 to 2022 and a three-dimensional evaluation system of workers, objects of labor, and means of labor. The innovative method is demonstrated by the use of the double fixed effects model to control spatio-temporal heterogeneity and the combination of the instrumental variable method to solve the endogeneity problem; Because of the northern region's strong policy focus and pressing need to transform traditional industries, the empirical contribution consists in exposing the regional differentiation law of the effect of new quality productivity. This law has a much stronger pro-quality productivity effect than the southern region. The results of the study offer a solid scientific foundation for developing a gradient development strategy and refining the regional policy toolkit.

2 Literature Review and Research Hypotheses

New quality productive forces, as a key factor driving the high-quality development of the economy, have received extensive attention from scholars both at home and abroad in recent years. Relevant studies have deeply analyzed the relationship between new quality productive forces and the high-quality development of the economy from multiple perspectives. Using spatial Durbin models, mediation effect models, and threshold effect models, Li et al. (2024)[1] began from the agricultural perspective and, using panel data from 30 Chinese provinces between 2011 and 2021, discovered that new quality productive forces are a major factor in its high-quality development. Additionally, new quality productive forces have a positive spillover effect on neighboring provinces, which can support the high-quality development of agriculture through mechanisms like accelerating land transfer and expanding the scale of agricultural markets.

Beginning with the marine economy, Meng et al. (2025) [2] built spatial Durbin models, multiple mediation effect models, and double fixed effect models. They also discovered that new quality productive forces have a hugely positive driving effect and spatial spillover effect on its high-quality development. Through technical innovation and resource allocation optimization, new quality productive forces may greatly boost regional economic development, upgrade industrial structures, and increase production efficiency (Gu, 2024) [3]. According to Lin (2025) [4], who used the Beibu Gulf urban agglomeration as the subject of their study, creating new, high-quality productive forces can help the agglomeration's coordinated growth.

In conclusion, past scholars' research largely concentrated on certain fields and had relatively single research viewpoints, lacking more thorough research on new quality productive forces in the economic field. Therefore, this study investigates the impact of new quality productive forces on the high-quality growth of the economy and conducts regional heterogeneity tests to give more effective decision-making basis for boosting the high-quality development of the economy.

Based on the aforementioned findings, this paper puts forth the hypothesis that new, high-quality productive forces positively promote the economy's high-quality development, with the effect being more pronounced in the northern region.

3 Model Construction and Variable Selection

3.1 Model Construction: Basic Regression Model

This study uses the panel data model to investigate the relationship between new quality productivity and high-quality economic development. First, the Hausman test's chi-square value is 23.45, and the associated p-value is 0.0003. By showing that there is a link between individual effects and explanatory variables and that the fixed effects model is more appropriate, it significantly rejects the null hypothesis that there is no systematic difference between the random effects model and the fixed effects model. Testing revealed that the time-fixed impact had to be included because the F value was 2.45 and the p value was 0.0045. Thus, based on the individual fixed effect, the time-fixed effect was introduced to control the interference of the time trend on the results, and the double fixed effect model (1) was subsequently constructed (Chen and Sun, 2025) [5].

Multicollinearity and heteroscedasticity tests were performed to confirm the model's robustness. Each variable has a VIF range of 1.19 to 2.37, all of which are less than 5, suggesting that the model does not have a significant multicollinearity issue and that the variables are well-independent of one another. The model showed heteroscedasticity issues, according to the findings of the White and Breusch-Pagan tests. To increase the accuracy of the estimation results, robust standard errors were used for correction.

This work may more precisely examine the relationship between new quality productivity and high-quality economic development by building the fixed effects model (1), which will validate the hypothesis.

$$HQED_{it} = \alpha_0 + \alpha_1 NPQ_{it} + \alpha_2 TND_{it} + \alpha_3 ER_{it} + \alpha_4 lnGDP_{it} + \alpha_5 HC_{it} + \mu_i + \lambda_t + \epsilon_{it} \quad (1)$$

In Formula (1), i represents the province, t represents the year, NPQ_{it} is the explanatory variable, representing the new quality productivity level index of province i in the t year, $HQED_{it}$ is the explained variable, representing the index of high-quality economic development level of Province i in the t year, and the control variables are the density of transportation infrastructure (TND_{it}), the intensity of environmental regulations (ER_{it}), the economic development foundation ($lnGDP_{it}$), and human capital (HC_{it}). α_0 represents the intercept, α_1 represents the influence coefficient of new quality productivity on high-quality economic development, α_2 to α_5 represent the coefficients of each control variable, μ_i is the provincial fixed effect, λ_t is the time fixed effect, and ϵ_{it} is the random error term.

3.2 Variable Selection and Measurement

The explained variable: High-quality economic development (HQED). This paper draws on Sun et al. (2020) [6] indicator construction method and constructs an indicator system for the level of high-quality economic development from these five levels of the five major development concepts.

Explanatory variable: New Quality Productivity Development (NQP). This paper builds a system of new quality productivity development levels from three aspects: laborers, objects of labor, and means of labor. First-level, second-level, and third-level indicators are chosen based on these three criterion layers, respectively. This paper refers to the measurement method of Wang and Wang (2024) [7].

Control variables: As indicated in Table 1, this paper chooses economic development level, human capital, transportation infrastructure density, and environmental regulation intensity as control variables in order to eliminate the impact of other variables on high-quality economic development (Bao, 2024; Tian et al., 2024) [8][9].

Table 1. Variable Descriptive Statistics

Variable Category	Variable Description	Variable Abbreviation	Measurement Method
Dependent Variable	High-Quality Economic Development	$HQED$	Calculated by entropy weight method
Independent Variable	New Quality Productivity	NQP	Calculated by entropy weight method
Control Variables	Economic Development Level	$lnGDP$	Per capita GRP (logarithmic form)
	Human Capital	HC	College enrollment / Year-end population
	Transportation Infrastructure Density	TND	Railway mileage / Highway mileage
	Environmental Regulation Intensity	ER	Industrial pollution control investment (10,000 yuan) / Industrial added value (100 million yuan)

Data source: This paper conducts research by selecting sample data from 30 provinces (Tibet was deleted due to the lack of data on Tibet) from 2010 to 2022. The data are sourced from the *China Statistical Yearbook*, *China Energy Statistical Yearbook*, *China Industry Statistical Yearbook*, *China Environment Statistical Yearbook*, *China Statistical Yearbook on Science and Technology*, *China Labor Statistical Yearbook*, as well as statistical yearbooks and statistical bulletins of various regions. The remaining variables are derived from the National Bureau of Statistics. For individual missing data, the linear interpolation method is used for supplementation to ensure the integrity of the data.

4 Empirical Analysis

4.1 Benchmark Regression Analysis

The dual fixed effects model's results are shown in Table 2. The findings show that, at the 1% significance level, the influence coefficient of new-quality productivity on the degree of high-quality economic development is 0.1059. This supports the hypothesis

by indicating that the creation of new-quality production encourages high-quality economic development. By improving the industrial structure and raising the degree of technological innovation, the creation of new, high-quality productive forces can support high-quality economic development.

The economic development level can encourage high-quality economic development, and the expansion of the economic scale has a positive effect on high quality and development, according to the influence coefficient of the economic development level on high-quality economic development among the control variables, which is 0.1588 with a significance level of 1%. At the significance level of 1%, the influence coefficient of human capital on high-quality economic development is 4.2339, which is significant. The impact coefficient of environmental regulations is 0.0778, indicating that human capital has a significant promoting effect on high-quality economic development and that environmental regulation policies can drive the development of green innovative technologies and the improvement of high-quality economic development. The accumulation of human capital can continuously drive total factor productivity through the impact of knowledge spillover and skill structure upgrading. The transportation infrastructure density has an effect coefficient of 0.0032, however it does not pass the significance test. The rule of declining marginal returns of infrastructure, which has a negligible impact on high-quality economic development, could be the cause. The double fixed effect model has a quite excellent fitting effect, as indicated by the R^2 of 0.7788.

Table 2. Regression Results of Two-Way Fixed Effects Model

$Variable$	$HQED$
NQP	0.1059 ***
	(6.11)
$lnGDP$	0.1588 ***
	(31.99)
HC	4.2339 ***
	(10.23)
TND	0.0032
	(1.00)
ER	0.0778 ***
	(5.22)
$constant$	-1.6087 ***
	(-34.26)
$observations$	390
R^2	0.7788

Note 1: ***, **, and * denote statistical significance at the 10%, 5%, and 1% levels, respectively. Values in parentheses represent t-statistics.

4.2 Robustness test and Endogeneity Test

This paper performs endogeneity tests using three different approaches: altering the sample estimation period, replacing the model, and adding control variables. The 2SLS

model is used to perform endogeneity tests in order to confirm the validity of the fixed effects model's results, remove the biases imposed by the model, and clarify the actual causal relationship between the variables.

The period for changing the sample estimate: China's economy has transitioned from a phase of rapid growth to one of high-quality development, as evidenced by the first proposal for "high-quality development" made at the 19th National Congress of the Communist Party of China in 2017. This has indicated the path for superior progress in the modern period. In order to remove the exogenous shock caused by the policy's implementation, the sample data from 2017 and 2018 were removed in light of the new policy's effect on the index of high-quality economic development level.

Change the model: The development of new-quality productive forces may have a time lag in its impact on high-quality economic development. Therefore, the fixed-effect model is transformed into a dynamic GMM model. The dynamic GMM model has passed the AR(1), AR(2) and Hansen tests, preliminarily indicating the rationality of the model construction.

Adding a new control variable: One key metric for assessing social justice and fairness is the income gap between residents (IG). The consumption capability of middle- and low-income groups will decline as the income gap and inequality increase, which will exacerbate social tensions and have an impact on high-quality economic development. As a result, the income disparity between residents is included as a new control variable, and the ratio of rural to urban inhabitants' disposable income is used to calculate it.

Endogeneity test: The first and second lagged components of the new quality productivity were used as the instrumental variables in the construction of the 2SLS model presented in this paper. The first-stage regression's F value, 331.56761, was higher than 10. This demonstrates the validity of the instrumental variables and shows that there is no issue with their weak association. The Hansen overidentification test was used in the second stage to confirm the instrumental variables' exogeneity. The 2SLS model developed in this study is comparatively reasonable in terms of the choice of instrumental variables and model setting, according to the thorough test results.

Table 3 displays the outcomes of the endogeneity and robustness tests. The creation of new quality productivity can support high-quality economic development, as evidenced by the positive and substantial effect coefficients of new quality productivity on high-quality economic development (at the 1% significance level).

Table 3. Robustness and Endogeneity Test Results

Variable	Column(1)	*Column*(2)	Column(3)	Column(4)	
	HQED	*HQED*	*HQED*	$\widehat{NQP}$	*HQED*
NQP	0.1084 ***	0.1444 ***	0.1266 ***		0.2624 ***
	(5.34)	(2.98)	(8.68)		(7.24)
*L*1.*NQP*		0.2130 ***		0.6879 ***	
		(4.22)		(13.55)	
*L*2.*NQP*				0.0993 **	
				(2.06)	

$Variable$	Column(1) $HQED$	$Column(2)$ $HQED$	Column(3) $HQED$	Column(4) $\widehat{NQP}$	$HQED$
IG			0.0405 *** (7.10)		
$lnGDP$	0.1582 *** (25.42)	0.0759 *** (2.95)	0.1671 *** (28.70)	0.0414 *** (4.90)	0.0805 *** (8.59)
HC	4.0622 *** (8.73)	5.0134 ** (2.29)	5.2499 *** (16.50)	−2.4309 *** (−3.93)	3.8313 *** (5.70)
TND	0.0043 (1.21)	0.0014 (0.06)	0.0049 (1.58)	0.0255 *** (3.69)	0.0119 (1.60)
ER	0.0761 *** (5.48)	−0.0109 (−0.38)	0.0689 *** (4.91)	−0.0139 (−0.69)	0.0339 * (1.65)
$constant$	−1.5991 *** (−27.33)	−0.7933 *** (−2.98)	−1.8307 *** (−25.48)	−0.3618 *** (−4.47)	0.8044 *** (−9.12)
$AR(1)$		2.85(0.004)			
$AR(2)$		−0.99(0.324)			
$Hansen$ test		19.94(0.336)			19.94(0.336)
$observations$	390	360	390	330	330
R^2	0.7803	0.7172	0.7932	0.8367	0.6889

Note 2: ***, **, and * denote statistical significance at the 10%, 5%, and 1% levels, respectively. Values in parentheses represent t-statistics for Columns (1), (3), and (4), z-statistics for Column (2), and p-values for AR(1), AR(2), and Hansen tests.

4.3 Heterogeneity Test

After splitting 30 provinces into the north and south, the regression results are displayed in Table 4. The findings show that the influence of new quality productivity on high-quality economic development varies significantly from north to south. At the 5% significance level, the coefficient of new quality productivity in the south was 0.0485, which was significant. At the 1% significance level, the north's new quality productivity coefficient of 0.3243 was significant. The findings of the study demonstrate that high-quality economic development benefits from new quality productivity. In contrast, the effect is 6.7 times greater in the north and rather insignificant in the south. This suggests that because of their advantages in industrial structure, policy support, or resource aggregation, northern provinces may be better suited to promote high-quality development through new quality productivity.

Table 4. Heterogeneity Test Results

Regional Classification	Column(1) Southern Region	Column(2) Northern Region
Variable	$HQED$	$HQED$
NQP	$0.0485**$	$0.3243***$
	(2.32)	(3.38)
$lnGDP$	$0.1441***$	$0.1466***$
	(13.85)	(9.99)
HC	$-5.0772***$	$6.2119***$
	(-13.36)	(12.38)
TND	$0.0515***$	$-0.0238*$
	(16.96)	(-2.16)
ER	0.0157	$0.0987***$
	(0.72)	(3.47)
$constant$	$-1.3009***$	$-1.5479***$
	(-12.77)	(-11.30)
$observations$	182	208
R^2	0.8241	0.8461

Note 3: ***, **, and * denote statistical significance at the 10%, 5%, and 1% levels, respectively. Values in parentheses represent t-statistics.

5 Conclusion

The study concludes that there is regional variation and that new quality productivity significantly promotes high-quality economic development. In the northern area, the driving influence is more noticeable. By encouraging the modernization of the industrial structure and the advancement of technical innovation, mechanism analysis shows that new quality productivity successfully raises the standard of economic development.

Based on the research conclusion, this paper proposes a differentiated regional development strategy: The southern region must concentrate on creating a cross-regional human resources coordination mechanism, optimizing the labor force's allocation efficiency in strategic emerging industries. In the northern region, new quality productivity innovation demonstration zones should be established, relying on key cities to consolidate their current advantages. In order to prevent the issue of overcapacity brought on by excessive competition, it should simultaneously fortify industry access and exit criteria as well as market oversight. This will help to shift the economic model from scale expansion to quality improvement.

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