

# The Impact of New-Quality Productive Forces on the Urban–Rural Income Gap— From a Human Capital Perspective

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**Abstract.** Exploring the mechanisms through which new-quality productive forces affect the urban–rural income gap holds significant theoretical and practical value for promoting coordinated urban–rural development. Using panel data from 31 Chinese provinces covering the period 2011–2022, this paper systematically examines the impact of new-quality productive forces on the urban–rural income gap from the perspective of human capital. The findings indicate that: (1) new-quality productive forces exert a significant positive effect on the urban–rural income gap, exhibiting an “inverted U-shaped” pattern; (2) this effect is subject to a human-capital-based threshold mechanism, whereby at different stages of human capital accumulation, the impact varies—alternating between narrowing, widening, and a weakening positive effect; (3) there exists pronounced regional heterogeneity, with stronger effects in the central and western regions, weaker effects in the east, and statistically insignificant effects in the northeast. Finally, drawing on these results, the paper proposes policy recommendations aimed at fostering the balanced development of new-quality productive forces while effectively narrowing the urban–rural income gap.

**Keywords:** New-quality productive forces; Urban–rural income gap; Human capital; Threshold-effect model.

## 1. Introduction

In recent years, new-quality productive forces—an advanced form of productivity driven by innovation, technological breakthroughs, and optimized factor allocation—have emerged as a key engine for promoting high-quality economic growth. While facilitating industrial upgrading and enhancing total factor productivity, they have also profoundly reshaped the pattern of urban–rural income distribution. Since the 18th National Congress of the Communist Party of China (CPC), China has consistently prioritized narrowing the urban–rural gap and achieving common prosperity, emphasizing that the fruits of reform and development should be shared more equitably among all people, thereby providing clear guidance for income redistribution. The 19th National Congress of the CPC proposed the rural revitalization strategy, which promotes urban–rural integration and equalized factor flows, breaking the dualistic structure and creating policy conditions for the balanced role of new-quality productive forces. The Fifth Plenary Session of the 19th Central Committee of the CPC further incorporated the significant reduction of urban–rural and inter-resident disparities into the “14th Five-Year Plan” goals, while the 20th National Congress of the CPC called for improving distribution systems and strengthening urban–rural integration mechanisms, providing a practical context for exploring the relationship between new-quality productive forces and the urban–rural income gap.

As a developing country with a pronounced urban–rural dual structure, China continues to face persistent challenges in narrowing income disparities. With the expansion of new-quality productive forces in fields such as the digital economy and smart agriculture, whether rural areas can share in the technological dividends largely depends on the alignment between rural human capital and the demands of technological progress. Against this backdrop, systematically analyzing the mechanisms through which new-quality productive forces affect the urban–rural income gap—particularly the threshold effects of human capital and regional heterogeneity—holds vital significance for promoting coordinated urban–rural development and achieving common prosperity. Based on this, the present study takes China as the research context, employs benchmark regressions and a threshold-effect model from the perspective of human capital, and incorporates regional heterogeneity analysis, with

the aim of filling gaps in existing research and providing theoretical support for differentiated policy design.

## 2. Literature Review

Theoretical literature defines new-quality productive forces as advanced productivity driven by innovation, supported by technological breakthroughs, factor optimization, and industrial transformation. They are characterized by high technology, high efficiency, and high quality, with the core objective of improving total factor productivity. At the same time, the development of new-quality productive forces can foster synergistic urban–rural industrial development, facilitate the flow of production factors across urban and rural areas, and improve infrastructure and public service quality, thereby promoting coordinated urban–rural development <sup>[1]</sup>.

In empirical studies, however, there is no consensus on whether new-quality productive forces widen the urban–rural income gap. Some research argues that they exert an “expansion effect.” At the macro level, Autor and other foreign scholars found that the adoption of automation technologies significantly increased the wage share of high-skilled workers, leading to a widening urban–rural income gap in the United States <sup>[2]</sup>. Related domestic research based on panel data from 30 provinces revealed that the impact of industrial structural change on the urban–rural income gap follows a threshold effect: as the economy develops and labor division deepens, some rural workers gradually adapt to industrial jobs in cities, eventually narrowing the gap; however, an initial phase of gap expansion may precede this convergence <sup>[3]</sup>. Urban-level studies further indicate that the digital economy has significantly boosted the incomes of high human capital groups in cities, thereby widening the income gap between urban and rural residents, with human capital serving as a key mediating factor <sup>[4]</sup>. Research on agriculture shows that agriculture historically provided capital accumulation for industry, but imbalances in urban–rural factor allocation, combined with urban institutional advantages in employment and welfare, reinforced the dual economic structure. Although the rural–urban divide has been progressively dismantled since the reform and opening-up, large disparities in public services remain, partly reflecting the impact of earlier productivity development strategies on the income gap <sup>[5]</sup>.

At the micro level, international surveys using individual-level microdata from China and India find that productivity growth induces factor flows from agriculture to non-agriculture and from rural to urban sectors. In China, however, institutional factors such as the household registration system raise the cost of rural-to-urban migration. The insufficient increase in urban labor supply fails to offset the rising demand for labor, pushing up urban wages and thereby widening the urban–rural wage gap <sup>[6]</sup>. Domestic evidence likewise shows that rural laborers lag significantly behind their urban counterparts in education years and digital skills, facing pronounced mismatches with jobs created by new-quality productive forces and thus remaining disadvantaged in the distribution of technological dividends <sup>[7]</sup>.

Other studies, however, suggest that new-quality productive forces may produce a “convergence effect.” At the macro level, some foreign scholars argue that automation reshapes labor markets through skill-biased technological change (SBTC): while it raises demand for high-skilled labor, the spread of education—particularly in rural areas—can mitigate skill premiums. In the long run, as technology diffuses to rural areas, skill returns improve, narrowing skill and income gaps between urban and rural regions. Domestic studies also show that with the advancement of technological diffusion and education, new-quality productive forces help enhance rural human capital in the long run, thereby reducing income inequality <sup>[8][9]</sup>. At the micro level, foreign evidence from studies on export manufacturing and randomized experiments on training programs suggests that the synergy between technological penetration and skill training is an effective pathway to narrowing urban–rural disparities <sup>[10][11]</sup>. In China, Liang Xiaocheng and others found that rural migrant workers engaged in activities related to new-quality productive forces experienced faster income growth once they acquired basic digital skills, narrowing their income gap with low-skilled urban workers <sup>[12]</sup>.

Furthermore, based on financial data of A-share listed firms from 2015 to 2022, domestic scholars concluded that ESG development significantly promotes firms' new-quality productive forces<sup>[13]</sup>.

The fundamental reason behind these divergent findings lies in moderating factors. If rural human capital accumulation lags behind technological progress, the gap widens; conversely, if policy interventions effectively enhance the adaptability of rural human capital to new technologies, the gap may converge<sup>[14][15]</sup>. Accordingly, some studies find that indicators of new-quality productive forces, such as R&D investment and the scale of the digital economy, show an "inverted U-shaped" relationship with the urban–rural income gap. In the early stage of technological development, dividends concentrate in urban areas, widening the gap. During the policy-driven stage and gradual diffusion of technology (e.g., "digital villages" and "smart agriculture"), the gap tends to converge, though it remains on an upward trajectory at present<sup>[16]</sup>.

In sum, while existing studies have preliminarily revealed the pathways through which new-quality productive forces influence the urban–rural income gap, systematic analyses from the perspective of human capital remain scarce. Therefore, this paper, grounded in China's institutional and developmental context, employs human capital as a mediating variable to investigate the mechanisms at play. The study seeks to enrich the theoretical literature and provide policy references for promoting balanced human capital development and narrowing the urban–rural income gap, offering both academic value and practical significance.

### **3. Theoretical Mechanism and Research Hypotheses**

New-quality productive forces represent the integration of technological breakthroughs and optimized factor allocation, serving as the core driving force for high-quality economic development and urban–rural coordination. Against the backdrop of innovation-driven development and urban–rural integration, the evolution of new-quality productive forces is a complex process of multi-factor linkage—"technology, capital, human resources, and institutions"—and urban–rural interaction. From a dynamic perspective, the impact of new-quality productive forces on the urban–rural income gap exhibits stage-specific characteristics. In the early stage of development, as carriers of technological progress, new-quality productive forces widen the urban–rural gap through skill-biased technological progress. Urban areas, with better technological infrastructure and richer reserves of highly skilled labor, are able to capture new technological dividends more quickly. For instance, high-paying jobs in fields such as the digital economy and artificial intelligence are concentrated in cities, while rural laborers, constrained by skill mismatches, find it difficult to participate, leading to faster income growth in cities and a widening urban–rural income gap. As technology matures and diffuses, however, the spillover and trickle-down effects of new-quality productive forces gradually emerge. On one hand, technological diffusion promotes rural industrial upgrading and creates new income growth opportunities; on the other hand, rural human capital, gradually enhanced under policy guidance, improves its adaptability to new technologies and can increasingly share in the dividends. At this stage, the urban–rural income gap shows a narrowing trend. The overall relationship thus presents an "inverted U-shaped" pattern<sup>[17]</sup>. Meanwhile, in combination with Lewis' dual-economy theory<sup>[18]</sup>, labor transfer shows a lagging feature. In the early stage of new quality productive force development, the expansion of the modern urban sector accelerates and attracts an inflow of rural labor. Yet, due to disparities in education and skills, rural laborers are concentrated in low-skill jobs, and the income gap between them and urban high-skilled laborers widens. Once the Lewis turning point is crossed, surplus rural labor diminishes, agricultural productivity rises, pushing up agricultural wages, while the diffusion of urban technology drives rural non-agricultural development, leading to a gradual convergence of the urban–rural income gap. Furthermore, endogenous growth theory<sup>[19]</sup> indicates that technological progress is the fundamental driver of economic growth. As the concentrated embodiment of technological advancement, new-quality productive forces directly influence the pace of urban–rural economic growth. In the initial stage, urban areas grow faster due to stronger absorptive capacity for technology,

while in the later stage, rural areas achieve faster growth through technological catch-up, ultimately shaping the dynamic evolution of the urban–rural income gap. Based on the above analysis, the following hypotheses are proposed:

**H1a:** *New-quality productive forces have a positive effect on the urban–rural income gap.*

**H1b:** *As the level of new-quality productive forces improves, the urban–rural income gap first widens and then narrows.*

Schultz’s human capital theory emphasizes that education and skill accumulation are prerequisites for workers to share in technological dividends. The development of new-quality productive forces imposes higher requirements on labor skills<sup>[20]</sup>. High human-capital groups adapt more quickly to technological change, with income growth significantly exceeding that of low human-capital groups. When regional human capital is at a low level, urban and rural labor skills are generally insufficient, making it difficult to effectively absorb technological dividends; at this stage, the impact of new-quality productive forces on the urban–rural income gap is weaker. As human capital levels rise, urban laborers, through education and training, acquire adaptive skills earlier, leading to rapid income growth, while rural laborers, constrained by lagging skills, become marginalized, thus widening the urban–rural gap. When regional human capital reaches a relatively high level, rural labor skills improve significantly, enabling participation in occupations related to new-quality productive forces. The disparity in dividend distribution between urban and rural areas then narrows, and the positive impact of new-quality productive forces on the income gap weakens. Accordingly, the following hypothesis is proposed:

**H2:** *The impact of regional new-quality productive forces on the urban–rural income gap exhibits a nonlinear pattern as human capital levels increase.*

Resource-based theory<sup>[21]</sup> posits that regional development differences stem from uneven resource endowments. Significant disparities exist among eastern, central, western, and northeastern China in terms of economic foundations, educational resources, and industrial structures, leading to regional heterogeneity in the impact of new-quality productive forces on the urban–rural income gap. From the perspective of human capital reserves and educational resources, the eastern region, with its well-developed educational system and high proportion of skilled labor, can quickly absorb and apply new technologies. By contrast, rural areas in the central, western, and northeastern regions face insufficient educational resources and weak skill training systems, which limit the adaptability of rural labor to new-quality productive forces. As a result, technological dividends are mainly concentrated in urban sectors, and the widening of the income gap is likely more pronounced. Based on this, the following hypothesis is proposed:

**H3:** *The impact of new-quality productive forces on the urban–rural income gap exhibits regional heterogeneity.*

## 4. Model Construction and Variable Specification

### 4.1. Model Construction

To examine the impact of new quality productivity on the urban-rural income gap, this study constructs the baseline regression model as shown in Equation (1):

$$Gap_{it} = \beta_0 + \beta_1 NQP_{it} + \sum \beta_k Control_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

In Equation (1),  $i$  denotes region, and  $t$  denotes year;  $Gap_{it}$  is the explained variable, representing the urban-rural income gap in region  $i$  during year  $t$ .  $NQP_{it}$  is the core explanatory variable, i.e., the level of new quality productivity in region  $i$  in year  $t$ .  $Control_{it}$  represents a set of control variables that capture region-specific characteristics that do not vary over time.  $\beta_0$  is a constant,  $\beta_1$  is the coefficient of the core explanatory variable, and  $\beta_k$  are coefficients of the control variables.  $\mu_i$  denotes region fixed effects, and  $\varepsilon_{it}$  is the random error term.

Furthermore, to account for the nonlinear effects of new quality productivity on the urban-rural income gap, we extend Equation (1) by introducing the squared term of digitalization level, as shown in Equation (2):

$$Gap_{it} = \beta_0 + \beta_1 NQP_{it} + \beta_2 NQP_{it}^2 + \sum \beta_k Control_{it} + \mu_i + \varepsilon_{it} \quad (2)$$

To further investigate the mechanism through which human capital development influences the effect of new quality productivity, we construct a threshold effect model with human capital as the threshold variable, as shown in Equation (3):

$$Gap_{it} = \beta_0 + \beta_1 NQP_{it} \times I(HC \leq \gamma_1) + \beta_2 NQP_{it} \times I(\gamma_1 < HC \leq \gamma_2) + \beta_3 NQP_{it} \times I(HC > \gamma_2) + \sum \beta_k + Control_{it} + \mu_i + \varepsilon_{it} \quad (3)$$

Here,  $I(\cdot)$  is an indicator function taking the value of 1 or 0, and  $\gamma$  represents the threshold values to be estimated.

## 4.2. Variable Specification

This paper takes the urban-rural income gap (Gap) as the dependent variable, measured by the logarithm of the difference in income between urban and rural residents, i.e., the logarithm of the difference between per capita disposable income of urban residents and that of rural residents. A larger value indicates a wider urban-rural income gap.

The core explanatory variable is the level of new-quality productive forces (*NQP*). Following the framework of Ren Yuxin et al. (2024), this study measures regional new-quality productive forces across three major dimensions—laborers, labor objects, and means of production—aimed at promoting high-quality economic development. Specifically, a comprehensive evaluation index system of new-quality productive forces is constructed based on five first-level dimensions: *new economic drivers, technological innovation, green and low-carbon development, reform and opening-up, and high-level talent*<sup>[22]</sup>.

The key moderating variable is *human capital level (HC)*, measured by the proportion of individuals with higher education (HE), i.e., the ratio of the number of people with higher education to the total population in the region. This reflects the degree of human capital accumulation in the region<sup>[23]</sup>.

In line with existing studies, this paper also introduces several control variables: *digitalization level (DigEco)*, measured by the digital economy index, i.e., the number of web pages owned by each province<sup>[24]</sup>, government education expenditure (EduExp)<sup>[25]</sup>, and innovation capacity (*Patent, measured by the number of patents per capita*)<sup>[13]</sup>.

## 4.3. Data Sources and Descriptive Statistics of Variables

This study selects panel data from 31 provinces in China (excluding Hong Kong, Macao, and Taiwan) for the period 2011–2022. The data are mainly obtained from various years of the *China Statistical Yearbook* and the China National Research Data Service Platform (CNRDS), among others<sup>[26]</sup>. Descriptive statistics of all variables are presented in *Table 1*. As shown in *Table 1*, significant regional differences exist in both the level of new-quality productive forces and the urban-rural income gap, with overall development remaining imbalanced. Meanwhile, government education expenditure also displays substantial disparities. Provincial-level patent data further reveal that while some provinces generate abundant innovation outputs, most provinces still lag behind in innovation capacity. In addition, the unbalanced status of regional economic development in China is reflected in the large differences in the penetration and development level of the digital economy across provinces. Such imbalance may further affect the regional advancement of new-quality productive forces and the narrowing of the urban-rural income gap.

**Table 1** Descriptive Statistics of Variables

Variable	Mean	Std. Dev.	Min	Max
<i>Gap</i>	0.726	0.355	-0.21	1.796
<i>NQP</i>	0.183	0.081	0.046	0.551
<i>Education</i>	9.106	6.339	0.642	44.991
<i>Patent</i>	7.049	11.491	0.012	87.221
<i>DigEco</i>	0.765	1.751	0	13.189

## 5. Empirical Results Analysis

### 5.1. Baseline Regression Analysis

Before conducting the formal regression analysis, this paper first performs a variance inflation factor (VIF) test (see Table 2). The results show that the VIF values of all variables are below 10, indicating that multicollinearity is not a concern in the model. Subsequently, we apply Model (1) and gradually introduce control variables to analyze the relationship between new quality productivity (*NQP*) and the urban-rural income gap.

**Table 2** Tests for Multicollinearity

Variable	VIF	1/VIF
<i>NQP</i>	3.940	0.254
<i>Education</i>	4.180	0.239
<i>Patent</i>	4.740	0.211
<i>DigEco</i>	1.660	0.602

The regression results based on Model (1) are presented in Table 3. Column (1) reports the results including only the core explanatory variable, *NQP*, while Columns (2)–(4) gradually incorporate control variables. The results reveal that, regardless of whether control variables are included, the estimated coefficient of *NQP* remains significantly positive at the 1% level, indicating robust evidence that *NQP* exerts a positive effect on the urban-rural income gap even after accounting for factors such as education, innovation, and digitalization. Specifically, an increase of one unit in *NQP* enlarges the urban-rural income gap by 1.592 units, thus verifying Hypothesis H1a. Regarding the control variables, the coefficients of education and digitalization are significantly positive, suggesting that improvements in these variables may widen the urban-rural income gap. A plausible explanation is that educational and digital resources are unequally distributed between urban and rural areas: higher education resources are predominantly concentrated in cities, and urban residents enjoy greater advantages in digital infrastructure and digital skills, thereby benefiting more from improvements in these dimensions. This asymmetry leads to a further expansion of the income gap. Conversely, the coefficient of innovation capacity is significantly negative, implying that stronger innovation capacity helps narrow the urban-rural income gap. Enhancements in innovation capacity can drive regional industrial upgrading and economic development. Rural areas may benefit through industrial transfer, the adoption of innovation outcomes, and related applications, thereby increasing their income and reducing the disparity with urban areas.

To further examine the nonlinear impact of *NQP* on the urban-rural income gap, we re-estimate the model by incorporating the squared term of *NQP* ( $NQP^2$ ) in Model (2). The results are reported in Column (5) of Table 3. The findings reveal an inverted U-shaped relationship between *NQP* and the urban-rural income gap: as *NQP* increases, the income gap first widens and then narrows, thereby supporting Hypothesis H1b. In the early stages of development, *NQP*-related resources are predominantly concentrated in urban areas, enabling cities to rapidly enhance economic efficiency and income levels. In contrast, rural areas lag behind in terms of factor access and industrial

foundation, preventing them from sharing the benefits of development, which leads to unbalanced factor allocation and an expanding income gap. However, once *NQP* reaches a certain level, its technological spillover and diffusion effects strengthen, enabling rural areas to share the benefits of development through technology adoption and digital empowerment. This process allows rural regions to participate in the development of *NQP*, thereby contributing to the narrowing of the urban-rural income gap.

**Table 3** Regression Results of the Impact of New Quality Productivity and the Urban-Rural Income Gap

Variable	Gap				
	(1)	(2)	(3)	(4)	(5)
<i>NQP</i>	4.502*** (0.664)	1.966*** (0.563)	1.790*** (0.532)	1.592*** (0.456)	5.794*** (1.143)
<i>Education</i>		0.046*** (0.013)	0.081*** (0.009)	0.081*** (0.009)	0.065*** (0.011)
<i>Patent</i>			-0.021*** (0.006)	-0.022*** (0.006)	-0.013** (0.006)
<i>DigEco</i>				0.035* (0.018)	0.039** (0.017)
<i>NQP</i> <sup>2</sup>					-7.783*** (1.733)
<i>Constant</i>	-0.098 (0.122)	-0.055 (0.126)	-0.192* (0.098)	-0.176* (0.090)	-0.559*** (0.111)
<i>Province</i>			YES		
<i>FE</i>					
<i>R</i> <sup>2</sup>	0.460	0.628	0.689	0.694	0.726

Note: Robust standard errors are reported in parentheses; \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively. The same notation applies to the following tables.

## 5.2. Robustness and Endogeneity Analysis

To test the robustness of the baseline regression results, we employ three approaches, with the results reported in Table 4. First, we exclude special years. Considering that the COVID-19 pandemic in 2020 caused abnormal fluctuations in economic and social activities, which may have exerted atypical effects on the relationship between new quality productivity (*NQP*) and the urban-rural income gap, we re-estimate the model after excluding data for 2020. The results show that the sign and significance of the core variable remain consistent with the baseline regression, indicating that the conclusion holds even after excluding special years. Second, we adjust the sample range. Given the unique administrative attributes and resource allocation characteristics of municipalities directly under the central government, their economic patterns may systematically differ from other provinces. We therefore exclude Beijing, Shanghai, Tianjin, and Chongqing and re-estimate the model. The estimated impact of *NQP* remains consistent in direction and significance with the baseline regression, further reinforcing the credibility of our findings.

Third, we perform winsorization. To mitigate the influence of extreme values, all variables are winsorized at the 1% and 99% quantiles. The results still demonstrate a significant positive effect of *NQP* on the urban-rural income gap, confirming that the conclusion remains valid even after excluding outlier observations.

In addition, we address potential endogeneity between *NQP* and the urban-rural income gap using an instrumental variable (IV) approach. Following existing literature, we select the one-period lag of *NQP* (*L.NQP*) as the instrumental variable. The rationale is that the lagged *NQP* is highly correlated with the current *NQP* but unlikely to be directly affected by contemporaneous urban-rural income disparities, thereby satisfying both relevance and exogeneity conditions.

The IV regression results are also reported in Table 4. In the first-stage regression, the estimated coefficient of the instrumental variable ( $L.NQP$ ) is significantly positive at the 1% level, indicating a strong positive association between lagged and current  $NQP$ . The Kleibergen-Paap rk Wald F-statistic is 72, well above the critical value of 10, ruling out weak instrument concerns. In the second-stage regression, the coefficient of  $NQP$  remains significantly positive, suggesting that the positive impact of  $NQP$  on the urban-rural income gap persists even after controlling for potential endogeneity. This further corroborates the robustness of our baseline conclusions.

**Table 4** Results of Robustness Test and Endogeneity Test

Variable	Excluding 2020	Excluding Municipalities	Winsorization	IV Method	
				$NQP$	Gap
$NQP$	1.616*** (-0.462)	1.189*** (-0.406)	1.443*** (-0.514)		3.940*** (0.512)
$L.NQP$				0.893*** (0.071)	
Education	0.080*** (-0.009)	0.094*** (-0.009)	0.079*** (-0.009)		
Patent	-0.022*** (-0.005)	-0.022*** (-0.004)	-0.016*** (-0.004)		
DigEco	0.035* (-0.018)	-0.130* (-0.076)	0.028 (-0.022)		
Constant	-0.178* (-0.089)	-0.184** (-0.087)	-0.158 (-0.094)	0.021*** (0.008)	0.092 (0.072)
Province			Yes		
FE					
$N$	341	324	372	341	341
$R^2$	0.695	0.718	0.706	0.895	0.369

### 5.3. Threshold Effect Test

We first conduct a threshold effect test of human capital on regional new quality productivity ( $NQP$ ) growth, with the results presented in Table 5. As shown in the table, when human capital is used as the threshold variable, both the single-threshold and double-threshold models pass the significance tests, while the triple-threshold model does not. This indicates that the impact of regional  $NQP$  on the urban-rural income gap exhibits two threshold values, 3.420 and 167.120, implying that the relationship between the two demonstrates a three-stage nonlinear pattern as human capital levels increase.

**Table 5** Threshold Existence Test of the Impact of Regional New Quality Productivity on Income Gap under the Background of Human Capital

Threshold Variable	Threshold Number	Threshold Value	F Statistic	P Value	BS Replications	Critical Values		
						1%	5%	10%
Human Capital	Single threshold	167.120	54.270	0.050	300	81.078	53.704	45.642
	Double threshold	3.420	54.160	0.030	300	64.621	50.756	43.075
	Triple threshold	25.810	39.310	0.793	300	168.020	131.655	114.166

The threshold regression results are reported in Table 6. When the threshold variable, human capital, is below 3.420, *NQP* exerts a significant negative effect on the urban-rural income gap. When human capital falls between 3.420 and 167.120, *NQP* has a significant positive effect on the income gap. When human capital exceeds 167.120, the effect of *NQP* on the income gap remains positive, but its magnitude weakens. These findings support Hypothesis 2.

A possible explanation is as follows: when human capital is relatively low, the benefits of *NQP* development are more broadly shared across urban and rural areas. Rural regions can quickly benefit through the adoption of basic technologies, thereby narrowing the income gap with urban areas. As human capital accumulates, however, disparities in technological absorption capacity and innovation efficiency between urban and rural areas become more pronounced. Urban areas, endowed with higher levels of human capital, are better positioned to seize opportunities arising from *NQP* development, thus widening the urban-rural income gap. Once human capital reaches a sufficiently high level, the spillover and diffusion effects of technology become more pronounced. Rural areas, by upgrading their human capital and leveraging technological diffusion, can also effectively utilize the outcomes of *NQP* development. This contributes to more balanced income growth between urban and rural areas, thereby mitigating the positive impact of *NQP* on the income gap.

**Table 6** Threshold regression results of the impact of new quality productivity on the income gap between urban and rural areas

Variable	Gap
<i>Threshold variable</i> $HC < 3.420$	-4.866*** (1.016)
$3.420 < \textit{Threshold variable} HC < 167.120$	2.126*** (0.258)
$167.120 < \textit{Threshold variable} HC$	0.788*** (0.273)
<i>Education</i>	0.087*** (0.005)
<i>Patent</i>	-0.020*** (0.002)
<i>DigEco</i>	0.022* (0.013)
<i>Constant</i>	-0.271*** (0.040)
<i>N</i>	372
<i>R</i> <sup>2</sup>	0.760

#### 5.4. Regional Heterogeneity Analysis

Given that new quality productivity (*NQP*) and the urban-rural income gap exhibit differentiated distributions across regions, and that China's eastern, central, western, and northeastern regions differ significantly in terms of economic foundations, industrial structures, technological innovation capacity, and human capital accumulation, the impact of *NQP* may vary across regions. According to the heterogeneity analysis results reported in Table 7, *NQP* exerts a significant positive effect on the urban-rural income gap in the eastern, central, and western regions, with the magnitude of the effect being strongest in the central region, followed by the western region, and then the eastern region. In contrast, the positive effect of *NQP* in the northeastern region does not reach statistical significance. This pattern may be explained as follows: the central and western regions are currently in the process of industrial transformation and technological catch-up, with *NQP* concentrated primarily in urban cores. Rural areas in these regions face delays in technology adoption and resource allocation, thereby exacerbating the income gap. In the eastern region, favorable economic conditions and a higher degree of urban-rural integration allow *NQP* to generate more inclusive benefits, which limits its effect in widening the gap. In the northeast, however, industrial structures remain dominated by traditional industries, and *NQP* is still at an early stage of development, such that its impact on income distribution has not yet become significant.

**Table 7** Heterogeneity Analysis Results of the Impact of New Quality Productivity on the Urban-Rural Income Gap

Variable	Gap			
	East	Central	West	Northeast
<i>NQP</i>	1.878** (0.591)	2.319*** (0.495)	2.173** (0.946)	1.682 (1.363)
<i>Education</i>	0.041** (0.015)	0.066*** (0.014)	0.088*** (0.024)	0.181** (0.021)
<i>Patent</i>	-0.009 (0.006)	0.004 (0.008)	0.004 (0.031)	0.036 (0.018)
<i>DigEco</i>	0.057*** (0.010)	-0.133** (0.042)	-0.772*** (0.239)	0.278 (0.550)
<i>Constant</i>	-0.038 (0.142)	-0.408*** (0.090)	-0.175 (0.119)	-0.936** (0.188)
<i>Province FE</i>			Yes	
<i>N</i>	120	72	144	36
<i>R<sup>2</sup></i>	0.735	0.919	0.721	0.885

## 6. Conclusions and Policy Recommendations

### 6.1. Research Conclusions

Based on panel data from 31 provinces in China covering the period 2011–2022, this paper explores the mechanisms through which new quality productivity (*NQP*) affects the urban-rural income gap from the perspective of human capital. The main conclusions are as follows:

First, *NQP* exerts a significant positive effect on the urban-rural income gap, and this effect follows an “inverted U-shaped” pattern. At the early stage of development, the technological dividends of *NQP* are concentrated in urban areas, leading to an expansion of the income gap. Once *NQP* reaches a higher level of development, however, technological diffusion and policy interventions enable rural areas to share the dividends, thereby gradually narrowing the gap.

Second, the effect of *NQP* on the urban-rural income gap is subject to a human capital threshold. At lower levels of human capital, *NQP* helps reduce the income gap; when human capital reaches a medium level, the widening effect of *NQP* on the gap becomes significant; when human capital reaches a high level, the positive effect of *NQP* on the gap weakens, suggesting that higher human capital can mitigate the trend of widening disparities. Third, the effect of *NQP* on the urban-rural income gap exhibits regional heterogeneity. The positive effect is strongest in the central and western regions, weaker in the eastern region, and insignificant in the northeastern region. These differences are closely related to variations in economic foundations, industrial structures, and human capital accumulation across regions.

### 6.2. Policy Recommendations

Based on the above findings, promoting the balanced development of *NQP* and narrowing the urban-rural income gap can be pursued from three perspectives:

**(1) Phased extension of *NQP* to rural areas to achieve shared benefits.** In the early stage of technological diffusion, efforts should be made to strengthen digital infrastructure and smart agriculture, overcoming barriers to access and integration so as to quickly release initial dividends. As technologies mature, urban-rural technological collaboration networks should be established, guiding the diffusion of advanced industries into rural areas, creating employment opportunities, and raising rural incomes.

**(2) Addressing skill mismatches through differentiated human capital strategies.** For low-skilled groups, the focus should be on disseminating basic digital and agricultural knowledge to enhance job matching. For high-potential groups, greater investment should be directed toward higher education and vocational training to cultivate talent suited to smart agriculture and emerging industries. At the same time, more balanced allocation of educational resources is needed to narrow urban-rural disparities.

**(3) Formulating region-specific policies to balance efficiency and equity.** In the central and western regions, emphasis should be placed on strengthening technological access and industrial undertaking, leveraging industrial relocation and policy incentives to promote downward diffusion. The eastern region should capitalize on its advantages in urban-rural integration to foster technology and capital spillovers, forming interconnected industrial chains. The northeast should accelerate the upgrading of traditional industries, expand application scenarios for *NQP*, and strengthen human capital accumulation. Meanwhile, institutional safeguards should be enhanced to promote the free flow of production factors. These include deepening household registration (*hukou*) reform to reduce the costs of interregional labor mobility, improving public services such as healthcare and education to stabilize human capital, and establishing cross-regional mechanisms for technology and talent support to alleviate imbalances in development.

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