

# New Quality Productivity Forces and Local Digital Transformation

Hongyuan Ma \*

School of International Economics and International Relations, Liaoning University, Shenyang, China, 110136

\* Corresponding Author Email: 13520034918@163.com

**Abstract.** Based on panel data from county-level cities in China 2009-2020, it constructs a new system of indicators for the development of new quality productivity and empirically examines how the development of new quality productivity affects the level of local digital transformation. The results is conducive to provincial digital transformation, and this conclusion passes a series of robustness tests. The mechanism analysis is that the new quality productivity facilitates the digital transformation of the region by increasing the level of skilled human resources and the size of the market. New quality productivity also plays a more important role in facilitating digital transformation in the eastern regions and small cities. The conclusions of this paper provide an view of the new quality productivity and digital transformation in the region and provide suggestions for the development of a higher quality regional economy.

**Keywords:** New Quality Productivity, Digitalization, digital economy.

## 1. Introduction

One of the main characteristics of new quality productivity forces, is a sufficient source for digital development and transformation. [1-2]. Subsequent expressions in this paper relating to new quality productivity are replaced by NQP. At present, the development momentum of the digital economy is fierce, and the deep penetration and wide application of technologies such as AI, blockchain, cloud computing and big data are promoting the transformation of the local industrial chain to high-end and intelligent. However, the 14th Five-Year Plan for the Development of the Digital Economy points out that “the digital divide between different industries, regions and groups has not yet been effectively bridged, and there is even a tendency for it to widen further.” This is because the NQP is led by strategic emerging industries and future industries, and its high dependence on regional digital technology and capital intensity makes it possible for some underdeveloped regions to fall into "digital depression" and find it difficult to undertake corresponding industries. To sum up, it is of practical significance to study the overall effect of NQP development on local digital transformation.

Current research on the new productivity of quality focuses on three main aspects. The first is the theoretical sources and implications of the NQP. Xu Zheng et al. (2023) pointed out that it was precisely due to the current international political and economic fluctuations and the increasing uncertainty of geopolitical economy that prompted the concept of NQP to be proposed [3]. Ding Renzhong and Li Ximing (2024) show that the development of NQP is an inevitable choice to promote Chinese-style modernization, and also a prerequisite for the continuous optimization of people's living standards. Second, the development characteristics of the NQP [4]. The formation of NQP has the characteristics of "seizing the commanding heights of development", "cultivating new competitive advantages" and "storing up new momentum for development" (Zhou Wen and Xu Lingyun, 2023) [5]. Specifically, the disruptive technology of NQP on the one hand brings higher monopoly profits with its high technical barriers, but also brings new industrial growth space. Third, about the formation of NQP practice. There are many factors affecting the development of NQP. Jiang Zhaohui and Jin Ziwei (2024) propose that education can improve NQP by promoting labor force reproduction and knowledge reproduction [6]. Zhai Xuquan and Xia Xinyu (2024) pointed out that the development of digital economy in both quantity and quality with the dual model of "data elements + digital technology" promoted the formation of NQP [7].

Academic research on local digital transformation is relatively mature. Research on the digital transformation of NQP focuses on the construction of digital countryside (Zhang Zhenyu, 2024) [8], the transformation and upgrading of manufacturing industry (Xie Baojian and Li Qingwen, 2024) [9].

Based on the above literature, we take 285 prefecture-level cities in China 2009-2020 as research samples, measures the development level of NQP = new quality labor force + new quality labor data + new quality labor object with the help of entropy weight method, and explores the impact of the development of new quality productivity on the level of regional digital transformation and its mechanism.

The innovative points and marginal contributions of this paper are as follows: First, in the research perspective. It broadens the academic research on the development of NQP to promote digital transformation, and extends the analysis of the new development concept of NQP. Second, in the index construction. This paper selects the city level index measurement; Third, this paper focuses on the skill talent effect and market scale effect of the development of NQP to promote regional digital transformation.

## **2. Theoretical Analysis & Hypotheses of the Study**

### **2.1. Analysis of new quality productivity development and digital transformation**

The cultivation and development of NQP can affect the process of regional digital transformation from three dimensions: technology penetration, resource allocation optimization and institutional coordination.

First, in terms of technological penetration. NQP is a scientific and technological revolution of traditional productivity. Through the IoT, big data, AI and other technologies, the digital management and intelligent control of the production process of traditional industries are realized. Ouguang Jun and Cheng Yujing (2025) summarized the cultivation path of China's NQP as "comprehensive driven", "technology-led" and "technology-industry collaborative"[11].

Secondly, in terms of resource allocation. With the vigorous promotion of digital technology, data factor, a new production factor, integrates with traditional production factors and gives birth to a new production function. Digital technology can promote the efficient flow of resources, broaden the scope of resource allocation and alleviate the distortion of resource allocation (Fu Yuanhai and Xiong Hao, 2024) [12]. The free flow of data elements will promote the coordinated flow between regions and then the flow of resources in the market, which will have a closer correlation with regional digital transformation and coordinated development of digital [13].

In addition, in terms of institutional coordination. Governments at all levels can provide a stable institutional environment for the development of NQP by formulating standardized routes for digital transformation and improving data element trading rules.

The following hypotheses are put forward in this paper.

H1: The development of NQP can promote local digital transformation.

### **2.2. Analysis of the mechanism of new quality productivity and digital transformation**

Guo Yifeng and Gao Ke (2024) note that the emergence of NQP will lead to changes in the supply of human resources and the structure of the labor force, increasing demand for skilled professionals.[14]. The development of new quality productivity has spawned the application of a large number of emerging technologies, and also spawned new industries, new forms of business, and new models. The multiplier effect of digital technology and the wide application of "data factor X" and "artificial intelligence +" have greatly enhanced the vitality and scale of the market. Through theoretical analysis, Liu Zhibiao (2024) show that under the background of the development of new quality productivity, new markets and products create more demand, thus releasing consumption potential and realizing the expansion of market scale [10].

The following hypotheses are put forward in this paper.

H2a: NQP development contributes to local digital transformation by upgrading skills.

H2b: NQP development promotes local digital transformation by increasing market scale.

### 3. Variable selection and model development

#### 3.1. Variable selection and data source

Core explanatory variables and explained variables. The core explanatory variable of this paper is the level of NQP (Npro), which is measured by entropy method. The reasons are as follows: First, the entropy method is used for objective assignment to avoid the result bias caused by statistical errors of data; Secondly, there are a large number of studies on entropy measurement in the existing literature, indicating that this method has a certain degree of recognition and scientificity.

With reference to the practices of He and Liu (2024) [15] and Han Wenlong et al. (2024) [16], three dimensions: new workforce quality, new workforce data quality and new workforce object quality and 11 specific measurement components are presented in Table 1. The explained variable of this paper is Digital, expressed by the total number of patents granted per capita.

**Table 1.** New quality productivity forces evaluation index system

Target layer	dimensionality	element	interpretation	unit	direction	
New quality productivity level	new workforce quality	Number of employees	Number of employees in emerging industries	Ren	+	
		personal ability	Average wage of working staff	Yuan	+	
		Staff quality	Quantity of colleges	Suo	+	
	new workforce data quality	infrastructure	Internet broadband access	Quantity of users	Qian hu	+
			Total telecommunication services		billions	+
		future development	Robot mounting density	/	+	
		ecological environment	Investment in environmental pollution control		billions	+
			Carbon trading, energy rights trading, Total emissions trading		billions	+
			Non-hazardous treatment rate of domestic waste		/	+
	new workforce object quality	Technology research	The ratio of scientific expenditure to local fiscal expenditure	/	+	
		Innovation output	The quantity of inventions	Jian	+	

			The quantity of utility models	Jian	+
		intelligente	Quantity of AI enterprises	Ge	+
		greenization	Quantity of green inventions	Jian	+
			The quantity of green utility models	Jian	+
		Data element	The word frequency related to data assets of listed companies +1 is logarithm	/	+
			There is a data trading platform to take 1, otherwise 0	/	+

### 3.2. Description of other variables

The degree of skilled personnel. The exponential growth of the demand for skilled personnel by the government and enterprises has also contributed to high-quality development, using the number of employees as an indicator of the level of skilled personnel. (2) Market size. Market size and market effectiveness are the key factors to ensure the stable operation of economy. This paper uses the logarithm method of total retail sales of urban social consumer goods to measure the market size.

Regulating variable. Fiscal transparency (CZTMD) is measured by the ratio of fiscal expenditure to fiscal revenue disclosed by the government each year.

Control variable. The level of gross domestic product per capita ( $\ln\text{pgdp}$ ) is expressed as the logarithm of the regional gross domestic product per capita. (2) Regional population size ( $\ln\text{pop}$ ), expressed as the logarithm of population. (3) The proportion of the value added of the secondary industry ( $\text{twogdp}$ ) is the ratio of the secondary industry to the gross local product. The tertiary industry value added ratio ( $\text{threegdp}$ ) is the ratio of the tertiary industry to the gross local product.

### 3.3. Data sources & Descriptive statistics

Data were obtained from the State Intellectual Property Office, China Urban Statistical Yearbook, China Industrial Statistical Yearbook, CSMAR database, EPS database, and government business reports. Missing values were replaced by ARIMA interpolation. Results are shown in Table 2.

**Table 2.** Descriptive statistics

notation	Obs.	AVG	SD	MIN	MAX
Digital	3420	0.01	0.02	0.000	0.361
Npro	3420	0.05	0.07	0.002	0.569
$\ln\text{pgdp}$	3420	10.62	0.63	4.595	13.056
$\ln\text{pop}$	3420	5.73	0.93	1.609	7.882
$\text{twogdp}$	3420	0.47	0.11	0.107	0.897
$\text{threegdp}$	3420	0.41	0.10	0.098	0.839
tech	3420	0.02	0.02	0.001	0.207
fdi	3201	62.18	152.22	0.002	3478.778
cztmd	3420	2.96	2.04	0.649	21.531
techtalents	3420	0.06	0.09	0.005	1.143
$\ln\text{market}$	3411	15.47	1.09	5.472	18.886

### 3.4. Model Setting

In order to analyze the impact of the NQP level on the digital transformation of prefecture-level cities, this paper constructs the following model based on H1 to investigate its impact:

$$Digital_{it} = \alpha_0 + \alpha_1 Npro_{it} + \alpha_2 \sum_{j=1}^n Controls_{jit} + \lambda_i + \tau_t + \varepsilon_{it} \quad (1)$$

where the symbols  $i$  and  $t$  denote the city and year, respectively.;  $Digital_{it}$  is an explanatory variable representing the level of digital transformation of city  $i$  in year  $t$ ;  $Npro_{it}$  is an explanatory variable representing the level of development of NQP of city  $i$  in year  $t$ ;  $Controls_{jit}$  denotes a series of control variables including the level of gross domestic product per capita ( $lnpgdp$ ), the size of the regional population ( $lnpop$ ), and the share of value-added in the secondary industry ( $twogdp$ ), tertiary industry value added share ( $threogdp$ );  $\lambda_i$  is individual-fixed effects,  $\tau_t$  is time-fixed effects;  $\varepsilon_{it}$  is the error term.

## 4. Analysis of empirical results

### 4.1. Baseline regression analysis

Table 3 shows the basic regression of NQP on the degree of digital transformation of cities at prefecture level, with the coefficient of the central explanatory variable ( $Npro$ ) being significantly positive at the 1% level.

According to the results in column (4), the coefficient of the core explanatory variable is 0.4275, indicating that the level of local digital transformation increases by 0.4275 units on average, and hypothesis H1 is verified.

**Table 3.** Baseline Regression

	(1)	(2)	(3)	(4)
	Digital	Digital	Digital	Digital
Npro	0.4530*** (7.956)	0.4346*** (9.251)	0.4291*** (9.423)	0.4275*** (9.512)
lnpgdp		-0.0034** (-2.207)	-0.0062** (-2.380)	-0.0055** (-2.342)
lnpop		0.0312** (2.484)	0.0302** (2.451)	0.0304** (2.466)
twogdp			0.0269** (2.349)	0.0093 (1.276)
threogdp				-0.0227 (-1.464)
Constant	-0.0110*** (-4.039)	-0.1531** (-2.287)	-0.1293** (-1.973)	-0.1204* (-1.878)
Observations	3,420	3,420	3,420	3,420
R-squared	0.913	0.915	0.917	0.917
cluster	√	√	√	√
Year FE	√	√	√	√
City FE	√	√	√	√

#### 4.2. Robustness analysis

To account for the impact of the 2020 global health event, the sample data for 2020 is removed in this paper and the regression results are presented in column (1) of Table 4. The coefficient of NQP is 0.390 and remains significantly positive at the 1% level.

Panel data may contain extreme values, which may affect the estimation results. In this paper, tail reductions were performed for variables in the upper and lower 5% range, and the results are presented in column (2) of Table 4. The results are the same.

Increasing control variables. Many factors affect local digital transformation, and the problem of missing variables must be taken into account. In this paper, the following control variables have been added: (1) Level of science and technology (tech), the ratio of scientific expenditure to financial expenditure. (2) Foreign direct investment (FDI), the ratio of foreign direct investment to local GDP. The results are presented in column (3) of Table 4. The coefficient of the main explanatory variable is 0.415, representing a significant positive value. Replace the explained variable. This paper recalculates the digital transformation level by using the ratio of the total number of urban invention licenses to the total population at the end of the year. The regression results are shown in column (4) of Table 4, which are basically consistent with the conclusions obtained from the above baseline regression.

In order to eliminate the correlation problem in the clustering, the robust standard error of the clustering at province level is used for the regression analysis. The results are shown in column (5) of Table 4. The coefficient of the main explanatory variable is 0.427 and is significant at the 1% level.

**Table 4.** Robust analysis

	(1)	(2)	(3)	(4)	(5)
	change time window	shrinkage treatment	rise control variable	interchangeability explanatory variable	change clustering hierarchy
Npro	0.390***	0.197***	0.415***	0.062***	0.427***
	(7.46)	(7.32)	(8.72)	(8.12)	(6.44)
Constant	-0.126**	-0.011	-0.134*	0.013	-0.120
	(-2.12)	(-0.33)	(-1.94)	(1.35)	(-1.66)
Observations	3,135	3,420	3,200	3,420	3,420
R-squared	0.916	0.923	0.919	0.903	0.917
Control	√	√	√	√	√
Year FE	√	√	√	√	√
City FE	√	√	√	√	×
Province FE	×	×	×	×	√

#### 4.3. Instrumental variable method

On the one hand, the endogenous nature of the results may lead to distortions; on the other hand, there may be a reciprocal causal relationship between the degree of digital transformation and the productivity forces of the new quality..Based on this, learn from the idea of Lin Boqiang, Tan Ruipeng (2019) and Wang Jiao et al. (2021) to construct instrumental variables, and use the level of surface fluctuation (fluctuate) of each prefecture-level city[17-18]. The reasons are as follows: First, the development of productivity is affected by the Earth-sun mutual position, sea and land position, and terrain elevation (Fan Jie et al., 2025) [19]. Second, the degree of topographic relief exists objectively and does not have an impact on the digital transformation of a region. Therefore, the exclusivity requirement of instrumental variables is satisfied. In addition, the cross-multiplication term of GDP is added to exclude the effect of time trends. The results were shown in Table 5, and the endogeneity test passed.

**Table 5. Instrumental Variables**

	(1)	(2)	(3)	(4)
VARIABLES	Npro	Digital	Npro	Digital
IV	-0.006***		-0.006***	
	(-3.55)		(-4.01)	
Npro		0.580***		0.538***
		(3.98)		(4.15)
Kleibergen-Paap rk LM		9.384		11.943
		[0.002]		[0.0005]
Cragg-Donald Wald F		50.722		62.969
Observations	3,420	3,420	3,420	3,420
R-squared	0.015	0.432	0.018	0.465
Control	√	√	√	√
Year FE	√	√	√	√
City FE	√	√	√	√

## 5. Further Analysis

### 5.1. Mediation effect test

This paper takes techtalents and lnmarket as the mediating variables to study the transmission mechanism of the development of NQP on the level of local digital transformation, and the regression results are shown in Table 6. (1) is the baseline regression result. The results of columns (2) - (3) show that NQP promotes urban digital transformation by improving the level of skilled personnel. Suppose H2a is true. In column (4) and (5), the intermediation effect passed the Sobel test, proving the mediating role of market size. On the one hand, emerging technologies accelerate technology diffusion, local economies of scale are gradually formed, and the level of digital technology is improved. On the other hand, driven by both technology and innovation, NQP expands the externalities of market size and promotes local digital transformation. Suppose H2b is true.

**Table 6. Intermediation effects**

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Digital	techtalents	Digital	lnmarket	Digital
Npro	0.427***	0.635***	0.421***	0.963***	0.427***
	(9.51)	(3.86)	(10.55)	(3.30)	(9.52)
techtalents			0.010		
			(0.38)		
lnmarket					0.000
					(0.64)
Constant	-0.120*	-0.318*	-0.117*	10.848***	-0.125*
	(-1.88)	(-1.76)	(-1.86)	(9.15)	(-1.93)
Sobel test		Z=10.390>0.97		Z=10.390>0.97	
		[0.000]		[0.000]	
Percentage of intermediary effects		25.75%		20.05%	
Observations	3,420	3,420	3,420	3,411	3,411
R-squared	0.917	0.905	0.917	0.956	0.917
Control	√	√	√	√	√
Year FE	√	√	√	√	√
City FE	√	√	√	√	√

### 5.2. Adjustment effect test

Using fiscal transparency (CZTM) as a moderating variable, the results are shown in Table 7. In column (1), the core explanatory variable of NQP development level is significantly positive at the 1% level, and in column (2), the adjustment variable is added, and the interaction term (Npro×CZTM) coefficient is -0.028, passing the significance test at the 10% level, indicating that fiscal transparency has a negative regulatory effect between the development level of NQP and local digital transformation.

The improvement of government financial transparency may cause the government to face the problem of information overload, which will affect the decision-making analysis of policies and the investment in digital infrastructure. However, this inhibition is only short-term. The coefficient of the core explanatory variable in column (2) is 0.383, that is, when the financial transparency is taken to the sample mean level, the average increase of local digital transformation is 0.383 units for every unit increase in the development level of NQP. In areas with high financial transparency, although the progress may be affected by information asymmetry and cumbersome material review in the initial stage, with the improvement of relevant facilities, the positive role of NQP will gradually emerge and promote urban digital transformation.

**Table 7.** Adjustment effects

	(1)	(2)
VARIABLES	Digital	Digital Fiscal transparency
Npro	0.427*** (9.51)	0.383*** (11.16)
cztm		-0.001** (-2.24)
Npro×cztm		-0.028* (-1.88)
Obs.	3,420	3,420
R <sup>2</sup>	0.917	0.918
Control	√	√
Year FE	√	√
City FE	√	√

### 5.3. Heterogeneity analysis

Based on the difference of NQP level in four regions of China. The eastern and central regions have great differences in social structure, economic level, resource factors and so on. In order to further identify the regional heterogeneity of the impact of quality productivity forces development on local digital transformation. The cities were divided into eastern cities and central and western cities, and the regression results were shown in Table 8. The results of columns (1) and (2) in Table 8 show that new quality productivity has a regional heterogeneity effect on the digital transformation of eastern and central and western cities, and new quality productivity has a significant positive enabling effect on the regional digital transformation. However, from the point of view of the coefficient value of the core explanatory variable, the coefficient of the eastern region (0.441) is larger than that of the central and western region (0.228), and has passed the inter-group difference test.

**Table 8. Results of geographic location heterogeneity test**

	(1)	(2)
Urban geographic heterogeneity		
VARIABLES	eastern part Digital	Central and Western region Digital
Npro	0.441*** (8.68)	0.228*** (8.18)
Constant	-0.288*** (-2.94)	0.061*** (2.71)
Test for difference in coefficients between groups	0.213 [0.000]	
Observations	1,452	1,968
R-squared	0.922	0.891
Control	√	√
Year FE	√	√
City FE	√	√

Based on the differences in the size of Chinese cities. In order to explore the difference of NQP forces development on urban digital transformation in city scale, the results show that there is heterogeneity of new quality productivity for urban digital transformation of different scales. This means that a new, high-quality production force has the effect of facilitating digital transformation. From the perspective of impact degree, the effect coefficients of NQP on the digital transformation are 0.179, 0.298, 0.384 and 0.447, respectively. New quality productivity contributes most to digital transformation in small and medium-sized cities.

**Table 9. Heterogeneity of city size**

	(1)	(2)	(3)	(4)
Urban scale heterogeneity				
VARIABLES	mega Digital	mega Digital	mega Digital	medium-sized Digital
Npro	0.179 (1.79)	0.298*** (5.48)	0.384*** (3.96)	0.447*** (5.60)
Constant	-0.681 (-0.89)	0.242 (0.56)	-0.156 (-1.65)	0.016 (0.80)
Obs.	84	168	972	2,172
R <sup>2</sup>	0.974	0.920	0.874	0.882
Control	√	√	√	√
Year FE	√	√	√	√
City FE	√	√	√	√

## 6. Research conclusions and policy recommendations

Based on panel data for prefecture-level cities in China 2009-2020, the paper empirically investigates the facilitating effects and mechanisms of the impact of NQP development on local digital transformation using bilateral fixed effects, intermediate effects and regulation effects, and draws the following conclusions (1). (2) NQP promotes local digital transformation by increasing the level of skilled labor and market size. (3) The effect of NQP on the level of local digital transformation exists with regional heterogeneity and city-scale heterogeneity.

Based on this, the study makes the following policy recommendations:

First, the level of local digital transformation should be improved more effectively by continuing to actively promote and develop new quality productivity and encouraging the development of NQP.

Second, the mechanism for transferring the role of NQP development in localities' digital transformation should be improved. On the one hand, the government should strengthen vocational education and training and establish a "government-university-enterprise" trinity.

Third, cities of all sizes and regions should adopt different strategies to play a differentiated role in digital transformation. The Eastern region should strengthen its leading and exemplary role, while the Central and Western regions should compensate for their shortcomings and strengthen connectivity.

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