

COUPLING-COORDINATION AND DYNAMIC INTERACTION BETWEEN HIGHER VOCATIONAL EDUCATION QUALITY AND NEW-QUALITY PRODUCTIVITY

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Abstract: The new round of scientific and technological revolution has promoted the accelerated development of new quality productivity. As the core carrier of the supply of technical and skilled talents, higher vocational education has an internal relationship of mutual influence and dynamic evolution with new-quality productivity. Based on the panel data of 30 provinces in China from 2018 to 2023, this study develops a comprehensive indicator system that covers both higher vocational education quality and new-quality productivity. Multiple empirical approaches, including the entropy weight method, coupling coordination model, and panel vector autoregressive (PVAR) model, are utilized to examine the synergistic development, dynamic interactive relationship, and spatial correlation characteristics of the two systems. The empirical findings show that there is a positive correlation between the quality of higher vocational education and the new-quality productivity in China's provinces, but the regional development differentiation is obvious, and the coordination level of the two systems in the eastern region is significantly better than that in the central and western regions. The two-way interaction of the two systems presents asymmetric characteristics. The new-quality productivity can effectively promote the quality improvement of higher vocational education, but there are still blocking points in the transformation and release of the quality of higher vocational education to the new quality productivity. This study enriches the empirical evidence of higher vocational education serving the new-quality productivity, and provides a practical reference for promoting the reform of higher vocational education according to local conditions and promoting the synergy of the two systems in the region.

Keywords: Higher vocational education quality; New-quality productivity; Coupling-coordination; PVAR model

1 INTRODUCTION

Against China's pursuit of high-quality economic growth, innovation-led new-quality productivity is propelling ongoing industrial restructuring and upgrade. Human capital constitutes one essential foundation for the growth of new-quality productivity. As a key training carrier, higher vocational education is tasked with producing technically skilled personnel to serve the real economy. Beyond supplying high-calibre skilled labour, it can also promote continuous industrial technology iteration via technical service outputs. On the other hand, changes in industrial patterns and labour market demands brought by new-quality productivity compel higher vocational education to reform its institutional arrangements, including major setup, practical training infrastructure and faculty building. These mutual influences create a complex, interdependent nexus between the two systems. Unpacking their synergistic conditions, dynamic influence mechanisms and regional spatial associations can offer meaningful practical insights for promoting the coordinated progress of education, science, technology and talent.

A substantial body of research has explored the role of higher vocational education in boosting regional economies and industrial renewal, which can be grouped into three major strands: value-oriented discussion, practical constraint analysis and countermeasure design. In terms of value logic, higher vocational education supports sound regional industrial progress through skilled human-capital provision and technology transfer services. For this reason, it plays an irreplaceable educational role in cultivating new-quality productivity [1-2].

When it comes to real-world constraints, many observations point out that certain vocational colleges cannot update their major structures to match industrial changes. This results in duplicated major programmes and structural gaps between graduate output and industrial labour needs [3]. Some works also argue that current industry-education integration and university-enterprise partnerships often stay at a shallow level, which hinders deep-seated resource collaboration among multiple stakeholders [4]. Low compatibility between graduate quality and actual job demands further erodes vocational education's industrial support potential [5]. Besides, provincial distribution of vocational education resources is highly unbalanced: high-end resources are heavily concentrated in eastern provinces, and cross-regional disparities keep expanding [6]. Underdeveloped areas may even get trapped in negative cycles featuring fiscal pressure and talent outflow [7].

In response to these challenges, researchers have put forward targeted improvement suggestions. Dynamic adjustment of major arrangements should be driven by local industrial needs, so that educational output can better fit key regional industries [8]. Reform of institutional arrangements is required to construct university-enterprise cooperation platforms and shape an integrated mode connecting vocational education with local economic growth [9]. Attention should also be paid to cultivating "dual-competency" teaching staff and enhancing colleges' technical service capabilities [10], together

with perfecting multilayer implementation frameworks for industry-education integration spanning macro, meso and micro scales [11].

Even so, existing scholarship still has notable research gaps to address. Most present-day studies focus merely on the one-way effect of higher vocational education on industry and economic performance. While a handful of papers apply coupling-coordination tools to analyze relationships between vocational education and new-quality productivity [12-13], relevant evidence remains scarce. These efforts mostly focus on static synergy calculation, whereas few studies have systematically captured dynamic shock responses and time-lagged effects. Another limitation lies in empirical measurement: several studies use simple single-item proxies to reflect vocational education development. They fail to build multi-faceted assessment frameworks that cover institutional conditions, faculty resources and teaching outputs [14].

To address the above shortcomings, the present study uses 2018-2023 panel data for 30 Chinese provincial-level jurisdictions and constructs composite evaluation indices for the two research objects. Coupling-coordination calculation and PVAR-based dynamic interaction identification are implemented to address the following questions: What is the current status of coordinated development between higher vocational education quality and new-quality productivity across provinces, and what disparities exist among eastern, central and western China? What are the dynamic shock and feedback mechanisms between the two systems? Empirical results are expected to provide empirical foundations for optimizing higher vocational education supply and advancing new-quality productivity construction in different regions.

2 RESEARCH DESIGN AND DATA PROCESSING

2.1 Data Sources

The initial sample consists of provincial panel data for 30 Chinese provinces over 2018-2023. Xizang, Hong Kong region, Macao region and Taiwan region are excluded due to data availability constraints. Higher-vocational-education-related statistics are obtained from China Educational Statistics Yearbook and provincial annual quality reports on higher vocational education. Regional economic indicators are extracted from the EPS Database and CSMAR Database. Missing values are first imputed via province-specific linear interpolation; remaining missing observations are supplemented using within-group mean imputation.

2.2 Construction of Indicator System

Following principles of systematicness, data availability and representativeness, two comprehensive evaluation systems are constructed for higher vocational education quality and new-quality productivity respectively. The higher vocational education quality system includes 12 indicators across four dimensions: school-running conditions, teaching faculty, training process and output performance (Table 1), covering scale, hardware input, faculty structure and talent-training outcomes to comprehensively measure provincial higher vocational education quality. The new-quality productivity system comprises four dimensions: innovation-driving capacity, technical efficiency, digital economy and green low-carbon transition (Table 2), incorporating indicators reflecting innovation output, industrial technology, digital-industry growth and green transformation. Logarithmic transformation is applied to indicators with skewness greater than 2 before entropy-weight calculation, mitigating biases caused by extreme values.

Table 1 Evaluation Indicator System for Higher Vocational Education Quality

Dimension	Indicators	Attribute
School-running conditions	Full-time student enrollment, Equipment expenditure per student, Practical-training workstations per student	Positive
Teaching faculty	Proportion of dual-competency teachers, Proportion of senior-title teachers, Teacher-student ratio	Positive
Training process	Fiscal appropriation per student, horizontal and vertical research funding	Positive
Output performance	Employment rate, Graduate monthly salary, Entrepreneurship rate, Three-year promotion rate of graduates	Positive

Table 2 Evaluation Indicator System for New-Quality Productivity

Dimension	Indicators	Attribute
Innovation-driving capacity	Number of granted domestic patents, Business revenue of high-technology industries, Innovation expenditure of large-scale industrial enterprises	Positive
Technical efficiency	Labor productivity of large-scale industrial enterprises, Full-time equivalent of R&D personnel in large-scale industrial enterprises, Density of installed industrial robots	Positive
Digital economy	Integrated-circuit output, Total telecommunication business volume, Internet broadband access ports, Software business revenue, E-commerce sales	Positive
Green low-carbon transition	Energy consumption per unit GDP, Fossil-energy consumption per unit GDP, Industrial water consumption per unit GDP, Industrial wastewater discharge per unit GDP, Industrial SO ₂ emission per unit GDP	Negative

2.3 Research Methods and Model Specification

2.3.1 Entropy-weight method

The entropy-weight method assigns objective weights according to indicator dispersion, avoiding artificial bias from subjective weighting. Standardized and log-transformed indicators are used to compute composite indices for higher vocational education quality (U_1) and new-quality productivity (U_2).

2.3.2 Coupling-coordination model

Coupling degree captures interaction intensity between two systems, while coupling-coordination degree further accounts for their overall development level:

$$C = 2 \sqrt{\frac{U_1 U_2}{(U_1 + U_2)^2}} \quad (1)$$

$$D = \sqrt{C \times T}, T = \alpha U_1 + \beta U_2 \quad (2)$$

where U_1 is composite index of higher vocational education quality; U_2 is composite index of new-quality productivity; C is coupling degree; T is comprehensive development index; D is coupling-coordination degree; both α and β are set to 0.5.

2.3.3 Panel vector autoregressive (PVAR) model

The PVAR model treats all variables as endogenous and suits the identification of bidirectional dynamic relationships within panel datasets. Model specification:

$$Y_{it} = A_0 + \sum_{j=1}^p A_j Y_{i,t-j} + \mu_i + \varepsilon_{it} \quad (3)$$

where Y_{it} contains U_1 and U_2 ; μ_i denotes province-specific fixed effects. Impulse-response functions characterize dynamic evolution triggered by one-unit shocks; variance decomposition quantifies the contribution share of distinct shocks.

3 EMPIRICAL RESULTS AND ANALYSIS

3.1 Descriptive Statistics of Variables

The sample contains 180 observations from 30 provinces for 2018-2023. Composite indices U_1 and U_2 , coupling degree C , comprehensive development index T and coupling-coordination degree D are computed as described above. Descriptive statistics for key variables are summarized in Table 3.

Table 3 Descriptive Statistics of Major Variables

Variable	Obs.	Mean	Std.Dev.	Min	Median	Max
Educational quality(U_1)	180	0.2760	0.0767	0.1363	0.2589	0.5250
New-quality productivity(U_2)	180	0.1351	0.1096	0.0346	0.1015	0.6366
Coupling degree (C)	180	0.8918	0.0748	0.6844	0.901	0.9993
Comprehensive development index (T)	180	0.2056	0.0813	0.1013	0.1856	0.5101
Coupling-coordination degree (D)	180	0.4222	0.0877	0.287	0.4086	0.7098

U_1 averages 0.2760 with moderate cross-provincial dispersion. The mean value of U_2 (0.1351) is markedly lower, while its standard deviation reaches 0.1096 alongside a large gap between maximum and minimum values, indicating severe regional imbalance in new-quality productivity. The mean coupling degree C equals 0.8918, reflecting strong overall interaction between the two systems. Nevertheless, the average coupling-coordination degree D is merely 0.4222 (moderate coordination level), implying that insufficient overall development constrains coordination quality despite intense system-to-system interactions.

3.2 Spatiotemporal Evolution of Coupling-Coordination Degree

3.2.1 Coordination levels and development patterns

Coupling-coordination degree D is categorized into four tiers: low coordination ($D < 0.3$), moderate coordination ($0.3 \leq D < 0.5$), high coordination ($0.5 \leq D < 0.8$) and extreme coordination ($0.8 \leq D < 1.0$). Development patterns are further classified as educational-quality lag ($U_1 < U_2$) and new-quality-productivity lag ($U_1 > U_2$). Sample distributions are reported in Table 4.

Table 4 Distribution of Coupling-Coordination Tiers and Development Patterns

Classification	Category	Obs.	Percentage (%)
Coordination tier	Low coordination	3	1.67
	Moderate coordination	149	82.78
	High coordination	27	15.00
	Extreme coordination	1	0.56
Development pattern	Educational-quality lag	10	5.56

Classification	Category	Obs.	Percentage (%)
	New-quality-productivity lag	170	94.44

Most observations (82.78%) fall within the moderate-coordination tier, with only 15.00% achieving high coordination. China's higher vocational education and new-quality productivity are transitioning from moderate toward high coordination. 94.44% of samples belong to the new-quality-productivity-lag pattern, meaning higher vocational education quality outperforms local new-quality-productivity development in most provinces; underdeveloped new-quality productivity constitutes the primary bottleneck for joint advancement.

3.2.2 Regional disparities and provincial rankings

Mean values grouped by eastern, central and western regions are presented in Table 5. The eastern region outperforms central and western China in U_1 , U_2 and D . All three regions remain within the moderate-coordination range, yet eastern provinces approach the threshold for high coordination ($D=0.5$).

Table 5 Mean Coupling-Coordination Indicators across Three Regions

Region	Educational quality (U_1)	New-quality productivity (U_2)	Coupling-coordination degree (D)	Coordination tier
Eastern China	0.3137	0.2067	0.4816	Moderate coordination
Central China	0.2604	0.0961	0.3937	Moderate coordination
Western China	0.2496	0.0920	0.3834	Moderate coordination

Top-ranking provinces for coupling-coordination degree are Guangdong, Jiangsu, Zhejiang, Shandong and Beijing — all eastern coastal provinces reaching high coordination. Provinces at the bottom include Hainan, Yunnan, Heilongjiang, Jilin and Qinghai, trapped in low-end moderate coordination due to weak economic foundations and single industrial structures.

3.2.3 Visualization of spatiotemporal patterns

Scatter-plot data points for eastern Chinese provinces are mainly distributed toward the upper-right quadrant in Figure 1a, whereas observations from central and western provinces gather within the lower-left area — a pattern that reflects obvious hierarchical differences across geographic zones. From the sorting histogram of Figure 1b, we can see these differences at the provincial level more clearly. The results of the box plot (Figure 1c) show that the median and quartile values of the index D in eastern China are higher, and the internal dispersion of sample points in this region is also greater. By observing the time series results of Figure 1d, the coupling coordination score of eastern China in 2018–2023 has maintained a steady upward trend. The peak of the central region appeared in 2019, and its coordination state has since fallen back to a relatively low level. The western region fluctuated significantly throughout the research cycle, and the overall performance showed a downward trend after 2019, and the development gap between the eastern provinces was further widened.

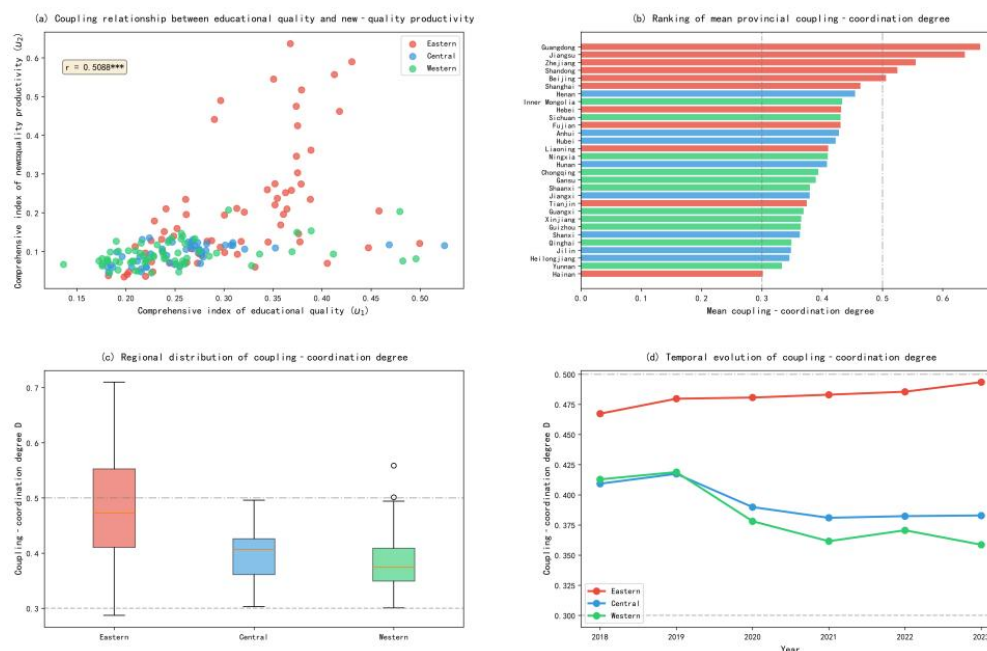


Figure 1 Spatiotemporal Evolution of Coupling-Coordination Degree between Higher Vocational Education Quality and New-Quality Productivity

Figure 2 displays how weights are allocated among higher vocational education quality metrics, alongside the classification matrix constructed for coupling-coordination assessment. As shown in Figure 2a, practical-training workstations per student, total full-time enrollment and equipment expenditure per student account for nearly 60% of total weight, suggesting that hardware conditions and scale dominate provincial differences in higher vocational education quality. By contrast, weights for employment rate, research funding and dual-competency teacher ratio are relatively low, indicating limited discriminatory power of these metrics across provinces. The quadrant classification matrix in Figure 2b partitions provinces into four groups: high-education-high-productivity (mainly eastern advanced provinces), low-education-high-productivity (educational lag), high-education-low-productivity (productivity lag, most central-western provinces) and low-education-low-productivity (disadvantaged western provinces). This matrix visualizes the structural contradiction observed across most provinces: relatively advanced vocational education paired with lagging new-quality productivity.

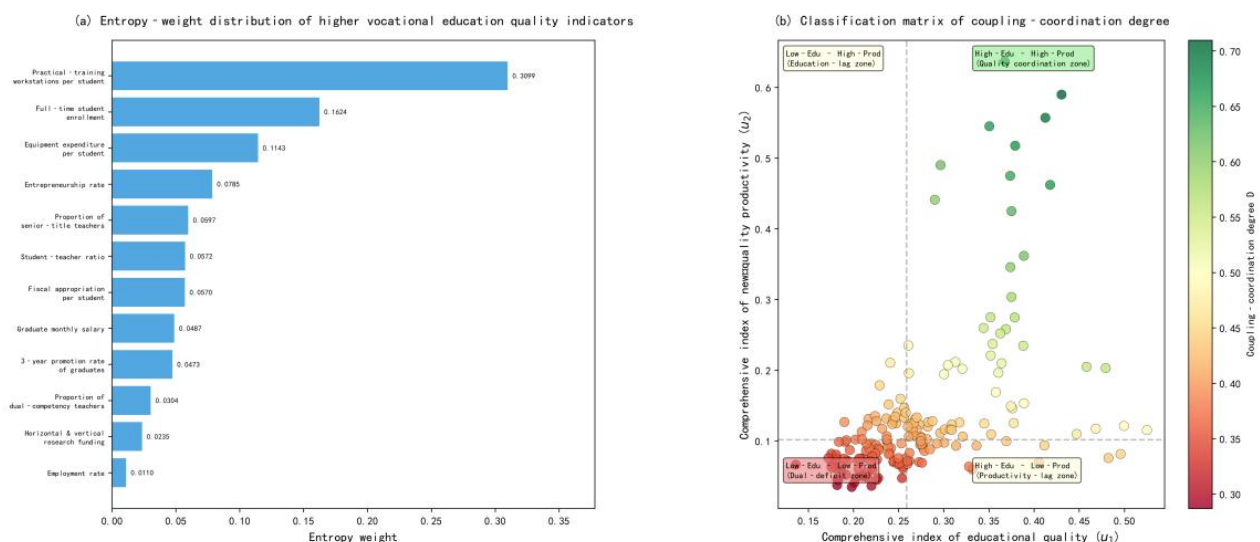


Figure 2 Entropy-Weight Distribution of Higher Vocational Education Quality Indicators and Classification Matrix of Coupling-Coordination Degree

3.3 Correlation Analysis and Regression Estimation

3.3.1 Correlation analysis

Pearson correlation coefficients are calculated for the full sample and three sub-regions (Table 6). Nationwide, U_1 correlates positively with U_2 ($r=0.5088$, $p<0.01$) and with D ($r=0.7509$, $p<0.01$). Correlation between U_1 and U_2 is strongest in eastern China ($r=0.5263$), followed by central ($r=0.4687$) and western China ($r=0.4029$), all statistically significant at the 1% level. The correlation between U_1 and D peaks in central China ($r=0.8068$), implying that coordination improvement in central provinces depends heavily on higher vocational education quality.

Table 6 Sub-Regional Correlation Analysis

Group	U1-U2	Correlation	U1-D Correlation	Observations
National	0.5088***		0.7509***	180
Eastern	0.5263***		0.7305***	66
Central	0.4687***		0.8068***	48
Western	0.4029***		0.7774***	66

Note: *** denotes significance at the 1% level.

3.3.2 Baseline OLS regression

OLS regressions are implemented: Model 1 and Model 2 take U_2 as the dependent variable (Model 2 incorporates control variables including per-capita GDP, industrial structure, openness, FDI and educational fiscal expenditure); Model 3 uses coupling-coordination degree D as the dependent variable (Table 7).

Table 7 Baseline OLS Regression Results

Variable	Model 1 (U_2 as dependent variable)	Model 2 (U_2 as dependent variable)	Model 3 (D as dependent variable)
U_1	0.7274*** (0.2688)	0.3653*** (0.1359)	0.6035*** (0.0944)
Per-capita GDP	—	0.0735* (0.0405)	0.0532** (0.0239)
Industrial structure	—	-0.0704 (0.1248)	-0.0119 (0.0748)
Openness	—	-0.0025 (0.0068)	0.0013 (0.0048)
FDI	—	0.0130 (0.0119)	-0.0010 (0.0068)

Variable	Model 1 (U_2 as dependent variable)	Model 2 (U_2 as dependent variable)	Model 3 (D as dependent variable)
Educational fiscal expenditure	—	0.0549* (0.0284)	0.0436** (0.0177)
Constant	-0.0656 (0.0600)	-0.5841 (0.8389)	-0.5414 (0.5121)
Adjusted R2	0.2547	0.4886	0.7220
N	180	180	180

Note: Standard errors in parentheses; ***, **, * represent significance at 1%, 5%, 10% levels respectively. All control variables are log-transformed.

Regardless of whether the control variables are added, the quality of higher vocational education has a significant positive impact on new-quality productivity. In Model 2, for one-unit increase in U_1 , U_2 increases by 0.3653 units. The coefficient of U_1 for D reaches 0.6035 ($p < 0.001$, $R^2 = 0.7313$), which confirms that the quality of higher vocational education is the core driving factor for the improvement of coupling-coordination. Among control variables, the coefficients of per-capita GDP and education fiscal expenditure are significantly positive, while the industrial structure, openness and FDI do not have statistical significance.

3.3.3 Regional heterogeneity

Grouped regressions for three regions are reported in Table 8. When predicting U_2 , U_1 yields significant positive coefficients for eastern China (0.3615, $p < 0.05$) and western China (0.1553, $p < 0.05$), whereas the coefficient of central China (0.0329) is insignificant. This shows that the conversion efficiency of vocational education quality to new-quality productivity in central China is low, which may be due to the structural mismatch between talent supply and industrial demand. For coupling-coordination degree D , coefficients of U_1 are significantly positive across all regions, and the order of influence intensity is eastern > western > central.

Table 8 Regression Results for Regional Heterogeneity

Region	Dependent Variable	Coefficient of U_1	R2	Obs.
Eastern	U_2	0.3615**	0.8631	66
	D	0.5218***	0.9534	66
Central	U_2	0.0329	0.5617	48
	D	0.3670***	0.8184	48
Western	U_2	0.1553**	0.4810	66
	D	0.4820***	0.7793	66

Note: *** and ** denote significance at 1% and 5% levels.

3.3.4 Fixed-effects models

In this study, the individual fixed effect model and the two-way fixed effect model are used to test the robustness, and the corresponding estimation results are shown in table 9. The coefficient of the core explanatory variable is still positive, and the statistical significance level is high, which is consistent with the results of the benchmark OLS regression. After excluding the interference of unobservable heterogeneity factors and time heterogeneity factors at the provincial level, both industrial structure upgrading and regional openness are proven to exert prominent positive effects on the growth of new-quality productivity.

Table 9 Fixed-Effects Regression Results

Variable	Entity Fixed-Effects (LSDV with clustering)	Two-Way Fixed-Effects (LSDV with clustering)
Higher vocational education quality		
U_1	0.4544*** (0.0601)	0.4411*** (0.0601)
Per-capita GDP	-0.0540 (0.0405)	-0.2146** (0.1038)
Industrial structure	0.2911*** (0.0834)	0.1817 (0.1221)
Openness	0.0217** (0.0091)	0.0208** (0.0090)
FDI	-0.0060** (0.0030)	-0.000021
Educational fiscal expenditure	0.0878 (0.0555)	0.1138* (0.0624)
Constant	-2.3698** (0.9417)	0.3532 (2.0416)
R2	0.9689	0.9710
Adjusted R2	0.9613	0.9627
N	180	180

Note: Clustered robust standard errors in parentheses; ***, **, * denote significance at 1%, 5%, 10% levels.

3.4 PVAR Model Estimation

3.4.1 PVAR estimation and stationarity test

A bivariate PVAR model containing U_1 and U_2 is constructed. AIC, BIC and HQIC criteria select lag order 1. Helmert forward-mean-difference transformation eliminates individual fixed effects; system-GMM is applied for parameter estimation (Table 10).

Table 10 PVAR Model Estimation Results

Equation	Variable	Coefficient	Std. Error	t-statistic	p-value
Equation 1: U1 (t)	Constant	-0.0031	0.0022	-1.417	0.1565
	U1 lag 1	0.1235	0.1028	1.2016	0.2295
	U2 lag 1	0.5276**	0.2101	2.5112	0.0120
	R2	0.1072	—	—	—
Equation 2: U2 (t)	Constant	0.0014	0.0021	0.6701	0.5028
	U1 lag 1	-0.025	0.0352	-0.7096	0.4779
	U2 lag 1	0.6498***	0.0390	16.6469	0
	R2	0.4508	—	—	—

Note: *** and ** represent significance at 1% and 5% levels.

According to the estimation results, in the Equation (1) with higher vocational-education quality (U_1) as the dependent variable, yields a one-period lag coefficient of 0.5276 for new-quality productivity. This estimate is statistically significant at the 5% level, indicating that the improvement of new-quality productivity has a significant positive spillover effect on the quality of higher vocational education. The demand for technical and skilled talents generated by the development of new-quality productivity can in turn promote the improvement of higher vocational education. By contrast, the autoregressive lag term for education quality stands at 0.1235 without statistical significance. This reflects that the self-accumulation effect of higher vocational education quality is weak.

In the Equation (2) with new-quality productivity (U_2) as the dependent variable, the one-period autoregressive coefficient reaches 0.6498, which is highly significant at the statistical level of 1%. The results show that the development of new-quality productivity has strong path-dependence and self-reinforcement characteristics. Meanwhile, the lagged coefficient of vocational-education quality is -0.0250 and remains insignificant. It suggests that the direct driving force of education quality on new-quality productivity has not yet materialized in the short run, hampered by time lags and practical conversion frictions. In addition, the stability test results show that the modulus of all characteristic roots is less than 1, which fully meets the stability conditions of the PVAR model.

3.4.2 Granger causality test

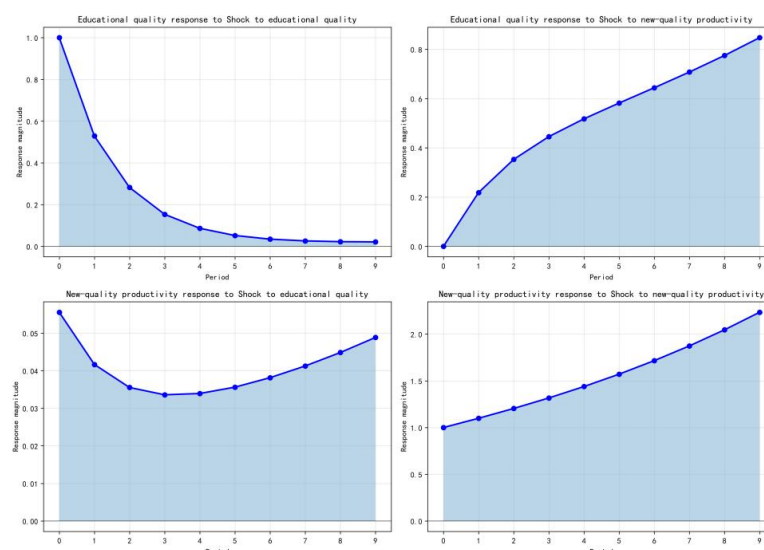
In order to clarify the endogenous causal relationships between the two variables, we conducted Granger causality tests under the PVAR framework. The results are reported in Table 11. The null hypothesis that there is no Granger causality between new-quality productivity and the quality of higher vocational education is significantly rejected ($p < 0.001$). In contrast, we cannot reject the competing null hypothesis corresponding to the causal path of higher vocational education quality pointing to new-quality productivity ($p = 0.2268$). Taken together, these test results confirm that the interaction between the two variables is asymmetric. New-quality productivity can effectively promote the quality of higher vocational education, but the reverse causal transmission effect is weak, showing obvious one-way causal characteristics.

Table 11 Granger Causality Test

Null Hypothesis H0	F-statistic	p-value	Conclusion
New-quality productivity does not Granger-cause higher vocational-education quality	15.5676***	0.0000	Reject H0
Higher vocational-education quality does not Granger-cause new-quality productivity	1.5030	0.2268	Fail to reject H0

Note: *** denotes significance at the 1% level.

3.4.3 Impulse-response function

**Figure 3** Impulse-Response Functions of the PVAR Model

The confidence interval is generated by 500 Monte Carlo simulations, and Figure 3 shows the response path obtained by tracking. The positive impact on the quality of higher vocational education will immediately produce a peak effect, and then the effect will decay rapidly. Such behaviors suggest vocational education systems can only generate short-lived self-reinforcement. A positive shock coming from new-quality productivity drives a sustained rise in higher vocational education quality as time progresses. It illustrates that industrial and technological advances can exert growing, long-lasting pressure to reshape local educational arrangements. Conversely, shocking higher vocational education quality produces barely any perceptible movement in new-quality productivity; its response stays near zero, meaning hardly any short-term effect can be detected. New-quality productivity, by comparison, builds up self-reinforcing growth after receiving its own positive shock.

3.4.4 Variance decomposition

Table 12 reports variance-decomposition results that quantify each shock's contribution to forecast-error variance. For higher vocational education quality, the fraction of variance explained by new-quality-productivity shocks rises gradually from 0.21 % at period 1 to 35.58 % at period 9. This result tells us that new-quality-productivity disturbances gain greater explanatory power for vocational-education quality as we extend the forecast window. When turning to new-quality productivity, its own shocks dominate variance contributions throughout all periods, accounting for 99.33 % by period 9. Contributions traced back to higher vocational education quality keep below 1 % in every period. This further confirms poor transfer efficiency when translating improvements in vocational-education quality into actual new-quality-productivity growth.

Table 12 Variance Decomposition for Selected Horizons

Response Variable	Horizon (Period)	Contribution from higher-vocational-education-quality shocks (%)	Contribution from new-quality-productivity shocks (%)
Higher vocational-education quality	1	99.79	0.21
	3	97.29	2.71
	5	90.47	9.53
	7	78.93	21.07
	9	64.42	35.58
New-quality productivity	1	2.02	97.98
	3	1.23	98.77
	5	0.91	99.09
	7	0.75	99.25
	9	0.67	99.33

4 MAIN CONCLUSIONS AND POLICY IMPLICATIONS

4.1 Main Conclusions

Drawing upon provincial-level panel data covering 30 Chinese administrative units over 2018-2023, alongside a suite of econometric approaches, this study explores the coupling-coordination status, dynamic interplay and spatial distribution features linking higher vocational education quality and new-quality productivity. Major empirical findings are outlined as follows.

At the national level, the coupling-coordination degree of the two systems stays within the moderate-coordination range and shows a tendency to move toward better coordinated status. For the majority of provinces, underdeveloped new-quality productivity constitutes the main constraint holding back their coordinated progress. Obvious regional gradient differences can be observed: eastern provinces display much better synergistic performance relative to central and western areas. When looking at time-varying patterns, coordination degrees keep improving steadily across eastern China. By comparison, central-western regions fail to gain adequate growth impetus, and disparities across different regions show an enlarging tendency.

Regarding the influencing effects, higher vocational education quality can boost new-quality productivity as well as overall system coupling-coordination, though such influences differ substantially across geographical zones. Eastern and western regions can benefit notably from these promotional effects. Nevertheless, central China faces noticeable conversion obstacles. This situation may originate from structural misalignment between local talent output and actual industrial demands. A series of robustness tests further confirm this positive influence exerted by higher vocational education quality.

The two systems also present asymmetric two-way dynamic relationships. Driven by industrial upgrading and updated talent demands, new-quality productivity produces feedback forces that facilitate improvements in higher vocational education and propel corresponding educational adjustments. On the other side, the favourable influence of higher vocational education quality on new-quality productivity is delayed and modest in the short term. Various practical frictions prevent educational resources from being efficiently translated into tangible productivity gains. From a long-term perspective, new-quality productivity accounts for a growing share of variations in higher vocational education quality. Meanwhile, vocational education quality can hardly offer strong explanatory power for changes in new-quality productivity.

4.2 Policy Implications and Recommendations

Based on the above empirical results, targeted regional measures are required to reduce cross-regional disparities and facilitate the effective translation of educational outputs into practical productivity gains. Local authorities, vocational institutions and industry participants need to tackle context-specific constraints and foster internally-driven collaborative potential. Concrete policy suggestions are put forward below.

First, differentiated regional strategies ought to be adopted so as to shrink gaps in coordinated development across provinces. Benefiting from industrial clustering and solid innovation foundations, eastern areas can further advance integration between higher vocational education and high-end manufacturing, digital economy businesses as well as strategic emerging industries. New study programmes should be created for newly-emerging job roles, while industry-education cooperation platforms need to be constructed to sustain their already favourable coordination status. Central and western areas, by contrast, ought not to simply replicate the development paths adopted in eastern China. Greater emphasis needs to fall on strengthening infrastructure construction, technological innovation capacity and industrial frameworks that underpin new-quality productivity. Mechanisms such as counterpart support programmes and cross-regional industrial cooperation may help draw high-quality eastern industry-education resources inward and nurture technically-skilled personnel suited to local conditions. As for central provinces suffering from notable supply-demand mismatches, periodic investigations into industrial talent shortages can guide flexible updates to majors and course systems. Outdated training programmes that no longer fit local industrial evolutionary trends ought to be gradually phased out.

Second, streamline channels for translating educational outputs to mitigate lagged empowering performance. Higher vocational colleges should highlight practical orientations, deepen college-enterprise collaborative education, and jointly build practical-training bases, R&D centers and industrial colleges. Enterprise technical standards and real-world innovation projects should be embedded throughout talent-training workflows to shorten the adaptation cycle for graduates entering the labor market. Application-oriented R&D, process improvement and technical services oriented toward local industrial transformation should be encouraged. Dedicated incubation platforms for vocational-college technical outputs can alleviate problems such as idle educational resources, market-detached research and under-realized talent value, enhancing both short-term and long-term contributions of higher vocational education to new-quality productivity.

Third, construct bidirectional dynamic adaptation mechanisms to foster virtuous interactive cycles. Industrial parks and leading enterprises should maintain active communication with higher vocational colleges, transmitting updated information about industrial upgrading, technological iteration and job-profile shifts to drive iterative improvements in vocational-education curricula and training schemes. Meanwhile, efforts should shift vocational education from passively adapting to industrial demands toward actively supporting industrial upgrading. Targeted cultivation of innovative, compound-type technical-skilled talent for key domains of new-quality-productivity development facilitates a self-reinforcing cycle: improvements in higher vocational education promote advances in new-quality productivity, and such advances subsequently stimulate further educational reform.

COMPETING INTERESTS

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