Journal of Combinatorial Mathematics
and Combinatorial Computing
www.combinatorialpress.com/jcmcc

Combinatorial Press

# Research on regional economic high-quality development and fiscal policy regulation path under big data computing analysis

Wenxi Ruan[1,✉]

[1] *Faculty of Accounting and Finance, Taizhou Vocational College of Science & Technology, Taizhou, Zhejiang, 318050, China*

ABSTRACT

Under the background of economic transformation and high-quality development strategy, the coordinated development of regional economy and precise regulation of fiscal policy have become a hot spot of concern. This paper constructs the evaluation index system of regional economic high-quality development and evaluates the level of economic high-quality development in the recent 10 years by using the entropy weight-TOPSIS method. Combined with Dagum Gini coefficient and spatial autocorrelation test, we study the spatial correlation of economic high-quality development among regions. The benchmark regression model and mediation effect model are constructed to calculate the effect of fiscal policy on the level of regional economic high-quality development, and to judge the effectiveness of fiscal policy regulation path. The study shows that the 30 provinces in China can be divided into different regions according to the level of high-quality economic development, and each region presents different types of characteristics such as "high - high", with significant differences. The variables in the benchmark regression model and the mediation effect model are correlated at the 1% level, and pass the smoothness test when the difference is of the 0th order. Fiscal policy at the regional level has a positive contribution to the level of high-quality economic development, but at the same time is affected by the original level of development of each region.

*Keywords:* entropy weight-TOPSIS method, Dagum Gini coefficient, spatial autocorrelation test, benchmark regression model, mediation effect model

## 1. Introduction

Regional economic development is an important driver of national economic growth, and fiscal policy is a key factor influencing regional economic development [1]. The multiple functions assumed by finance are crucial for maintaining healthy regional economic development, among which tax policy design, public expenditure allocation and transfer payment mechanisms are key to affecting economic

✉ Corresponding author.
*E-mail address:* ruanwx93@163.com (W. Ruan).
Received 15 January 2024; Revised 10 March 2024; Accepted 30 November 2024; Published Online 16 April 2025.
DOI: 10.61091/jcmcc127b-362

growth and social welfare [2-4]. With the acceleration of globalization and technological innovation, the reduction of external disturbances through economic and fiscal policies, as well as the efficient redistribution of wealth in income distribution, will play an increasingly important role in the high-quality development of regional economies [5-7].

Fiscal policy influences aggregate social demand and supply by adjusting the scale and structure of government expenditure to achieve stable regional economic growth [8]. On the one hand, fiscal policy can provide the necessary financial security for regional economic development by means of financial support [9-10]. The government can provide financial support for key industries, infrastructure construction and other fields in the region through financial budget, taxation and government investment to promote the rapid development of regional economy [11-13]. Secondly, fiscal policy can optimize resource allocation and promote the flow of resources to more efficient areas [14]. The government can guide the flow of resources to more needed and efficient fields through taxation, government procurement, subsidies, etc., to promote the upgrading of industrial structure and the transformation of economic development mode [15-17]. In addition, fiscal policy can play the role of incentivizing innovation and promoting technological progress and industrial upgrading [18]. The government can incentivize enterprises to increase investment in scientific and technological innovation through scientific and technological research and development investment, tax incentives, rewards, etc., to promote the research and development and application of new technologies and products, and to enhance the innovation capacity and competitiveness of the regional economy [19-21]. Based on this, the advantages of fiscal policy should be actively explored, through the establishment of an efficient financial control mechanism, to strengthen the scientific nature of the policy approach to promote and support, and effectively promote the overall regional economic development in a comprehensive and high-quality development, and make a positive contribution to the local economic development [22-25].

This paper takes big data calculation and analysis as the technical support, integrates the five dimensions of innovation, coordination, greenness, openness and sharing, and constructs the evaluation system of regional economic high-quality development. The techniques of entropy weight-TOPSIS method, Dagum Gini coefficient and spatial autocorrelation test are utilized to study the characteristics of differences in the level of high-quality development of different regional economies. Further from the perspective of fiscal policy regulation, design the regulation paths of capital investment, tax incentives and industrial upgrading. Through the construction of benchmark regression models and mediation effect models, we verify the effectiveness of regional fiscal policy regulation paths and analyze the relevance of regulation.

## 2. Construction and empirical analysis of the evaluation system for high-quality regional economic development

This chapter combines the principles of dynamism and other principles to construct the evaluation system of high-quality economic development and determine the weights of evaluation indicators. The dynamic evaluation of Province A's 2013-2022 data is carried out through the TOPSIS method. The Dagum Gini coefficient is further applied to decompose the regional differences in the province. The spatial autocorrelation test is utilized to confirm the spatial characteristics of high-quality economic development across the country, providing a regional basis for subsequent policy regulation.

### *2.1. Construction of an indicator system for high-quality economic development*

2.1.1. Principles for the construction of the indicator system. In analyzing and studying the level of high-quality development of Chinese provinces and cities, it is necessary to process the collected data and establish a set of indicator evaluation system in order to make the results credible. At the same

time, taking into account the strategic objectives of regional economic development, the selected indicators should follow the following principles in theory and practical life.

1) Principle of regionality. To analyze the movement of a target, one needs to learn to observe its strengths and weaknesses from the designated region, and to reflect the pertinence of the observed target. It should reflect the connotation and essence of high-quality economic development, and at the same time, it needs to be combined with the principles of green ecological development in different regions to fully reflect regional characteristics.

2) The principle of dynamic examination. The research objective is the process of movement, the selected indicators should not only be able to reflect the development of the research object from the static aspect, but also be able to show the development potential of the research object in the dynamic aspect. From the dynamic aspect of the research object can be examined in different time periods of change, and at the same time, the selected indicators should also have practical significance.

3) The principle of quantifiability. When observing and analyzing the research object, the authenticity and operability of the data should be guaranteed. The selected indicators should be quantifiable, and the selected indicators should be able to reflect the object of study to a high degree, and the data of the indicators can be obtained directly or indirectly through the calculation, so as to ensure that the evaluation of the object of study is operable.

4) Hierarchical principle. A number of specific sub-indicators are included in the first-level indicators. Each sub-indicator has its own specific connotation and extension, and the closely related indicators are combined into a group to form different indicator layers, which constitutes a set of indicator system that can completely reflect the research object.

2.1.2. Design of the evaluation indicator system. This paper establishes a set of high-quality development evaluation index system from the actual situation of each province and city. Table 1 shows the high-quality development evaluation index system. Among them, there are a total of five secondary indicators, which are innovation development, coordinated development, green development, open development and shared development. There are a total of 22 tertiary-level indicators, including investment efficiency, technology trading activity, patent authorization, demand structure, wastewater per unit of output, and the share of workers' compensation.

**Table 1.** Evaluation index system of high-quality development

| Primary index | Secondary index | Three-level index | Unit | Stats |
|---|---|---|---|---|
| High-quality economic development | Innovative development (X1) | GDP growth rate (X6) | % | + |
| | | R&d investment intensity (X7) | % | + |
| | | Investment efficiency (X8) | % | - |
| | | Technology trading activity (X9) | % | + |
| | | Number of patents granted (X10) | Piece | + |
| | Coordinated development (X2) | Per capita GDP level (X11) | % | + |
| | | Demand structure (X12) | % | + |
| | | Urbanization rate (X13) | % | + |
| | | Industrial structure | % | + |

| | | | | |
|---|---|---|---|---|
| | | (X14) | | |
| | | Government debt burden (X15) | % | - |
| | Green development (X3) | Energy consumption per unit of GDP (X16) | Tons / 10,000 yuan GDP | - |
| | | Elasticity coefficient of energy consumption (X17) | % | - |
| | | Wastewater per unit of output (X18) | Tons / 10,000 yuan GDP | - |
| | | Exhaust gas per unit of output (X19) | Tons / 10,000 yuan GDP | - |
| | | Forest coverage rate (X20) | % | + |
| | Open development (X4) | Dependence on foreign trade (X21) | % | + |
| | | Proportion of foreign investment (X22) | % | + |
| | | Marketization degree (X23) | % | + |
| | Shared development (X5) | Proportion of workers' compensation (X24) | % | + |
| | | Elasticity of personal income growth (X25) | % | + |
| | | Urban-rural consumption gap (X26) | % | - |
| | | The proportion of public fiscal expenditure (X27) | % | + |

2.1.3. Construction of a comprehensive evaluation model. Currently there are many kinds of comprehensive evaluation methods, combining their advantages and disadvantages, while taking into account the characteristics of the collected data, this paper adopts the entropy value method fused with the TOPSIS model of empowerment to evaluate the region, so as to make the results scientific and rigorous. The TOPSIS method is based on ranking the objectives according to their distance from the optimal solution and the worst solution, if the objective is closest to the optimal solution and is furthest away from the worst solution, then it is the best, otherwise it is not the best. It is a ranking method that approximates the ideal solution and is a commonly used method in multi-objective decision analysis, also known as the superior-inferior solution distance method.

1) Data processing. Before assigning weights to the indicators, the collected data must be processed. Through observation, this paper treats the inverse indicators by taking the inverse of the positive. The

polar deviation method is used to process the data in order to eliminate the influence of the magnitude, and can make the results more scientific, the formula is shown below.

$$x_{ij} = \frac{X_{ij} - \min\left(X_{ij}\right)}{\max\left(X_{ij}\right) - \min\left(X_{ij}\right)} \tag{1}$$

$x_{ij}$ is the normalized data, $\max\left(X_{ij}\right)$ is the maximum value of $X_{ij}$ and $\min\left(X_{ij}\right)$ is the minimum value of $X_{ij}$.

2) Calculate the weight of the $i$ province $j$ indicator $P_{ij}$ and the entropy value of the $j$ indicator with the following formula.

$$P_{ij} = \frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}} \tag{2}$$

$$e_j = -k \sum\nolimits_{i=1}^{n} P_{ij} \ln P_{ij} \tag{3}$$

3) Calculate the correlation coefficient $r_{ij}$ and the standard deviation $\sigma_j$.

$$r_{ij} = \frac{\operatorname{cov}\left(x_i, x_j\right)}{\sqrt{Dx_j}\sqrt{Dx_i}} \tag{4}$$

$$\sigma_j = \sqrt{\frac{1}{n}\sum\nolimits_{i=1}^{n}\left(x_{ij} - \bar{x}_j\right)^2} \tag{5}$$

4) Calculate the weights $w_j$.

$$w_j = \frac{\left(\sigma_j + e_j\right)\sum_{i=1}^{n}\left(1 - \left|r_{ij}\right|\right)}{\sum_{j=1}^{m}\left(\sigma_j + e_j\right)\sum_{i=1}^{n}\left(1 - \left|r_{ij}\right|\right)} \tag{6}$$

5) Calculate the weighting matrix.

$$V = \begin{bmatrix} v_{11} & \cdots & v_{1m} \\ \vdots & \ddots & \vdots \\ v_{n1} & \cdots & v_{nn} \end{bmatrix} \tag{7}$$

6) Calculate the positive and negative ideal solutions.

$$V^{+} = \left(v_1^{+}, v_2^{+}, \cdots, v_m^{+}\right) = \left\{\max v_{ij}\right\} \tag{8}$$

$$V^{-} = \left(v_1^{-}, v_2^{-}, \cdots, v_m^{-}\right) = \left\{\min v_{ij}\right\} \tag{9}$$

7) Calculate the distance between the object and the ideal solution.

$$D_i^{+} = \sqrt{\sum\nolimits_{j=1}^{m}\left(v_{ij} - v_j^{+}\right)^2} \tag{10}$$

$$D_i^{-} = \sqrt{\sum\nolimits_{j=1}^{m}\left(v_{ij} - v_j^{-}\right)^2} \tag{11}$$

8) Calculate the closeness.

$$C_i = \frac{D_i^-}{D_i^- + D_i^+} \tag{12}$$

Where $0.1 \le C \le 1.1$, the larger $C$, the higher the quality of economic development of the region, when $C$ is 0.1, it indicates that the level of economic development of the region is the lowest, and equal to 1.1 indicates that the level of economic development of the region is the highest.

### *2.2. Evaluation results based on entropy weight-TOPSIS method*

Utilizing the data of relevant indicators in the recent 10 years, and taking Province A of China as an example, the level of high-quality development of the economy of Province A of China and its various cities and municipalities is comprehensively evaluated with the help of the entropy weight-TOPSIS method, respectively. Entropy weight is an objective weighting method, which determines the weights according to the amount of information contained in each indicator. The smaller the information entropy of an indicator is, the greater the amount of information it contains, the greater the role it plays in the comprehensive evaluation, and the greater the weight it should be given. According to the basic idea of the entropy value method, the results of the weights of each third-level indicator and each second-level indicator are obtained. Table 2 shows the weight of each indicator based on the entropy weight method. According to the situation of the weights of the indicators given by the entropy weight method, it can be seen that among the second-level indicators, the ones with the largest weights are green development (0.275) and shared development (0.240), which are in line with the actual situation of China's economic transformation and development in the last 10 years. The third-level indicators corresponding to the largest weights of the five second-level indicators respectively are: the GDP growth (X6), the level of per capita GDP (X11), the energy consumption Elasticity coefficient of energy consumption (X17), dependence on foreign trade (X21), and the proportion of labor compensation (X24).

**Table 2.** Each index weight is based on entropy weight method

| Secondary index | Secondary index weight | Three-level index | Three-level index weight |
|---|---|---|---|
| X1 | 0.155 | X6 | 0.060 |
| | | X7 | 0.031 |
| | | X8 | 0.030 |
| | | X9 | 0.018 |
| | | X10 | 0.016 |
| X2 | 0.170 | X11 | 0.048 |
| | | X12 | 0.035 |
| | | X13 | 0.030 |
| | | X14 | 0.029 |
| | | X15 | 0.028 |
| X3 | 0.275 | X16 | 0.057 |
| | | X17 | 0.058 |
| | | X18 | 0.052 |
| | | X19 | 0.051 |
| | | X20 | 0.057 |
| X4 | 0.160 | X21 | 0.055 |
| | | X22 | 0.052 |
| | | X23 | 0.053 |
| X5 | 0.240 | X24 | 0.065 |
| | | X25 | 0.062 |

| | | | |
|---|---|---|---|
| | | X26 | 0.060 |
| | | X27 | 0.053 |

The TOPSIS method is a commonly used method for assembling evaluation information. It measures the closeness between the evaluation object and the optimal program by constructing synthetic indicators, and the higher the closeness, the more optimal the evaluation object is and the higher the ranking result. The synthetic indicators used to measure the degree of closeness are:

$$C_i^* = S_i' \Big/ \left(S_i' + S_i^*\right) i = 1, 2, \ldots, n \tag{13}$$

Where $S_i'$ is the Euclidean distance between the $i$ th evaluation object and the worst solution, and $S_i^*$ is the Euclidean distance between the $i$ th evaluation object and the optimal solution. The larger the value of $C_i^*$, the higher the degree of closeness between the $i$ th evaluation object and the optimal program.

According to the basic idea of TOPSIS method, the evaluation results of economic high-quality development of province A in the past 10 years are obtained. Table 3 shows the evaluation data of economic high-quality development of province A. From the evaluation results in Table 3, it can be seen that the level of high-quality economic development in Province A generally shows a trend of increasing year by year, with the comprehensive situation increasing from 0.192 in 2013 to 0.733 in 2022, which is in line with the overall economic development trend of China. However, there are occasionally certain years in which the level of development in a certain aspect declines from the previous year, such as the level of green development, which was 0.494 in 2018, compared to 0.512 in 2017, showing a decline. This may be related to the deployment of decision-making by the managers of Province A, which requires further analysis of the evaluation data as a whole.

**Table 3.** High-quality economic development evaluation data of A province

| Year | Overall situation | X1 | X2 | X3 | X4 | X5 |
|---|---|---|---|---|---|---|
| 2013 | 0.192 | 0.043 | 0.051 | 0.298 | 0.226 | 0.055 |
| 2014 | 0.265 | 0.135 | 0.076 | 0.343 | 0.374 | 0.210 |
| 2015 | 0.316 | 0.263 | 0.168 | 0.386 | 0.470 | 0.178 |
| 2016 | 0.404 | 0.336 | 0.380 | 0.475 | 0.488 | 0.313 |
| 2017 | 0.468 | 0.360 | 0.495 | 0.512 | 0.500 | 0.431 |
| 2018 | 0.511 | 0.621 | 0.597 | 0.494 | 0.435 | 0.450 |
| 2019 | 0.627 | 0.598 | 0.703 | 0.633 | 0.573 | 0.626 |
| 2020 | 0.685 | 0.706 | 0.826 | 0.626 | 0.645 | 0.704 |
| 2021 | 0.730 | 0.790 | 0.880 | 0.630 | 0.710 | 0.848 |
| 2022 | 0.733 | 0.925 | 0.929 | 0.626 | 0.544 | 0.908 |

### *2.3. Analysis of evaluation results*

2.3.1. Comprehensive development level analysis. According to Table 3, the trend of the 10-year comprehensive evaluation results of economic high-quality development in Province A is plotted. Figure 1 shows the trend of the comprehensive evaluation results of economic high-quality development in Province A. The level of economic high-quality development in Province A from 2013 to 2022 shows an overall upward trend, with the evaluation value rising from 0.192 to 0.733, a large increase, which indicates a favorable economic high-quality development trend in Province A.

The high-quality development of the economy of Province A from 2013 to 2022 is roughly divided into two stages. The first stage, 2013-2019, is a high-speed growth stage, with a rapid increase from 0.192 to 0.627, with the growth value exceeding 0.1 in most years. The reason for the high-speed growth trend is mainly due to the fact that Province A has substantially improved in all five aspects of innovation, coordination, greenness, openness, and sharing, and in particular, the coordination aspect, which has seen the largest rise in the level of development, which is attributed to the fact that in recent years Province A has The coordinated development of urban and rural areas as well as the industrial structure have been significantly upgraded.

In the second stage, 2020-2022, the bottleneck stage, after 2020, the growth rate of economic high-quality development level of Province A slows down, only from 0.685 to 0.733, with an average annual growth value of 0.016. Due to the severe domestic and international economic situation in recent years and the slowdown of the global economic growth rate, the slowdown of the high-quality development of the economy of Province A is unavoidable. Looking into its internal reasons, the rise of development in all aspects in the previous period was too large, leading to internal problems such as lack of development momentum. From the point of view of five aspects, due to the rapid economic growth, the level of development of the green aspect has declined in some years, and the development of the open aspect has likewise encountered a bottleneck. In the face of a combination of internal and external factors, the high-quality development of Province A's economy has entered a bottleneck.

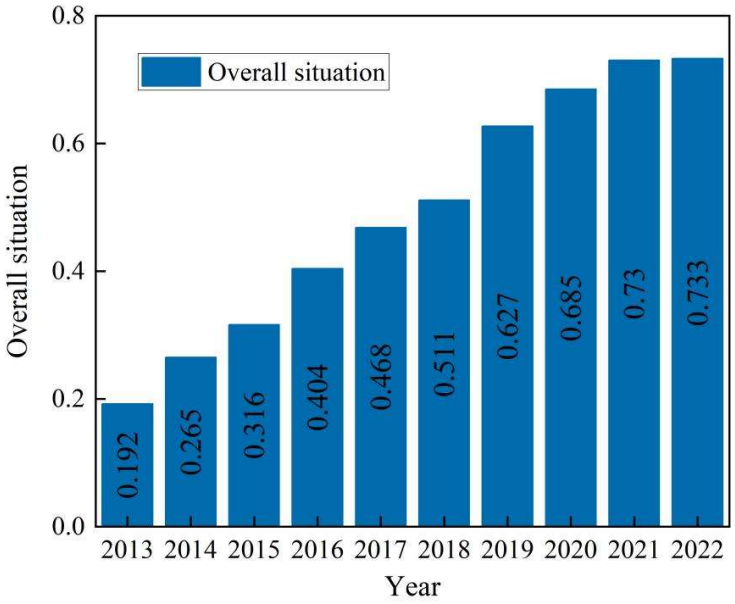


**Fig. 1.** Evaluation results of high-quality economic development in A province

2.3.2. Secondary indicator level analysis. The high-quality development of the economy of Province A is generally on an upward trend, which is the result of the comprehensive evaluation of each secondary indicator layer, and the evaluation results of each secondary indicator layer are composed of the evaluation results of the indicators to which it belongs, and the analysis of the changes in each secondary indicator layer not only reveals its impact on the comprehensive evaluation results, but also allows for a specific analysis of the indicator layer.

According to Table 3, the trend of evaluation results from 2013 to 2022 under each secondary indicator layer is plotted. Figure 2 shows the evaluation results of various aspects of high-quality economic development in Province A. In terms of innovation development, the value of the evaluation results from 2013-2022 increased from 0.043 to 0.925, with only a slight decline in the level of innovation development in 2019, which was caused by the decline in the share of R&D investment in the public budget from 5.01% to 4.85%. Overall, during this 10-year period, the share of investment

in R&D in Province A has been increasing, and the results of scientific and technological innovation outputs have also been rising. from 2013 to 2022, the share of R&D investment in the public budget rose from 2.30% to 4.96%, the share of patent authorizations rose from 200 to 480, the number of scientific and technological papers published rose from 43,813 to 50,977, and the whole society's Labor productivity rose from 37,450 yuan to 118,908 yuan, and the development of innovation capacity of Province A was significantly improved in all aspects.

In terms of coordinated development, the evaluation result value of 0.051 grew to 0.929 in 2013-2022, and all the indicators in coordinated development for three consecutive years from 2020-2022 were better than the rest of the years, with the industrial structure, urbanization rate, and demand structure all improved. Province A has continuously optimized the industrial structure, gradually narrowed the gap between urban and rural areas, and coordinated the development of the region during this decade. Until 2018, the output value of tertiary industry exceeded the output value of secondary industry in Province A. And in 2022, the advanced degree of industrial structure was 1.27, indicating that Province A actively adjusted the industrial structure and achieved certain results in the transformation and upgrading of industries. In 2022, the ratio of per capita disposable income of urban and rural residents was only 2.35, which was the lowest in the past years, and the ratio of the income of urban and rural residents was shrinking continuously. The per capita GDP rises from 27,315 yuan in 2013 to 63,429 yuan in 2022, the urbanization rate of the population rises to 58.36%, and regional development is gradually coordinated.

In terms of green development, the value of the evaluation result from 2013 to 2022 rises from 0.298 to 0.626, with a small rise. Among them, the development level declined in 2018, 2020 and 2022. Explore the reasons for this: on the one hand, with the increasing urbanization rate of the population, the area of cities and towns is increasing, which makes the green area decrease accordingly; on the other hand, the exhaust gas produced in industrial production and the increase in the number of cars in the city lead to a decline in air quality, which seriously affects the quality of life of the residents. In 2014, the percentage of air excellence was as high as 96.8%, and in 2019, the value was only 66.5%. It shows that Province A has not taken into account the problem of coordinated development with the green environment in the process of high-quality economic development.

In terms of open development, the value of the evaluation results from 2013 to 2022 increased from 0.226 to 0.544, with a low degree of development in general. Among them, in 2018 and 2022, the level of development decreased significantly. In 2018, affected by the domestic and international environment, the dependence of foreign trade of province A decreased by 2.30% compared with the previous year, only 10.78%, while the average value of dependence of foreign trade of other provinces and cities in the same period was 68.5%, and the total amount of imports and exports had a several-fold difference, so it can be seen that there is still a significant deficiency in the foreign trade of province A. In 2022, the development of openness in province A was affected by the global new coronary epidemic, and it was also affected by the global new coronary epidemic. Affected by the global new coronary epidemic, the tourism industry of Province A has been hit hard, the number of tourists will drop from 81,956,000 people in 2021 to 470,450,000 people in 2022, and the proportion of tourism income will also drop from 22.33% to 10.90%. All these are the reasons for the decrease in the development level of the open aspect.

In the aspect of shared development, the value of the evaluation result from 2013 to 2022 rises from 0.055 to 0.908, with a large increase. The increasing proportion of laborers' compensation, the increasing proportion of financial expenditure on people's livelihood, and the continuous improvement in social welfare, medical care levels and investment in education have led to a substantial increase in both economic development sharing and social development sharing in Province A.

Overall, in the process of high-quality economic development of Province A, the overall development momentum has been maintained. The level of innovation, coordination and sharing has increased

steadily, but there are many problems in the development process of openness and greenness, and in the process of high-quality economic development, Province A should strengthen foreign trade, promote a new round of reforms in the tourism industry, and pay attention to environmental protection and the ability to control pollution emissions.

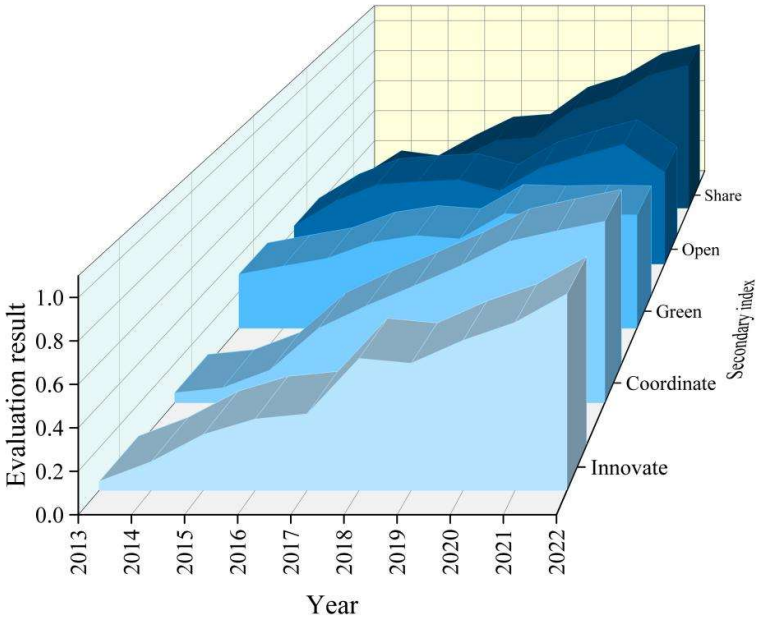


**Fig. 2.** Evaluation of all aspects of high-quality economic development

### *2.4. Analysis of spatial differences in the level of high-quality economic development*

Measuring the level of high-quality economic development and analyzing the current situation in Province A, it is found that there are obvious gaps in the level of high-quality economic development among the cities and regions in Province A, and such gaps will continue to exist. Therefore, in order to narrow the gap between cities and regions and provide reference for managers to formulate policies, it is necessary to adopt an objective and effective method to quantitatively analyze the differences in the level of high-quality development of the regional economy in Province A. For this reason, this paper analyzes the source of the difference in the level of high-quality development of the economy of Province A through decomposition with the help of Dagum Gini coefficient.

Table 4 shows the vertical ranking of cities in Province A from 2013 to 2022. Among them, municipalities 1, 7, 2, 14, 6, 16, 10, 8, and 5 are B city cluster; 3, 4, and 11 are C region; 9 and 12 are D region; and 18, 13, 17, and 15 are E region. As can be seen from Table 4, the overall difference in the level of high-quality economic development in Province A shows a downward trend, implying that the high quality of the economy in all regions tends to develop in a balanced manner. Subregionally, the Gini coefficient of City Cluster B basically remains unchanged, but is still higher than that of other regions, and its annual average Gini coefficient is higher than that of the province as a whole, which indicates that the degree of imbalance of high-quality development of the economy of several cities and municipalities within City Cluster B is much higher than that of other regions. It may be that the overall level of high-quality economic development of certain cities within City Cluster B is relatively advanced, but there are also some cities that are relatively backward in terms of development, and the better-developed cities have failed to drive the backward-developed cities, which has led to the phenomenon of polarization of development in City Cluster B, and thus caused differences in the high-quality development of the economy. the annual average value of the Gini coefficient of Economic Zone C ranked the second, and the growth of the Gini coefficient decreased by a increase in the Gini coefficient has dropped considerably compared with 2013, indicating that the high-quality

development of the economy among the C regions is becoming more balanced. The annual average Gini coefficient of region D ranks third, and its Gini coefficient has an overall upward trend, probably because the city of prefecture 9 has gradually increased its urban popularity in recent years, and its rapid economic development has widened the gap with city 12, resulting in the difference in economic development. The annual average value of the regional Gini coefficient in Area E is the smallest, and although its overall development trend shows a fluctuating change of decreasing and then increasing, it is still at the lowest level in the province, and the internal differences basically remain unchanged, indicating that the synergistic development between regions is relatively average.

**Table 4.** Longitudinal ranking of cities by region

| City ID | Year 2013 | Ranking | Year 2017 | Ranking | Year 2020 | Ranking | Year 2022 | Ranking |
|---|---|---|---|---|---|---|---|---|
| 1 | 41.26 | 1 | 50.52 | 1 | 63.14 | 1 | 67.95 | 1 |
| 2 | 30.04 | 5 | 33.66 | 8 | 38.14 | 7 | 42.03 | 7 |
| 3 | 32.93 | 3 | 38.65 | 3 | 37.81 | 10 | 41.62 | 9 |
| 4 | 26.04 | 11 | 31.52 | 9 | 37.83 | 9 | 40.06 | 13 |
| 5 | 30.86 | 4 | 36.94 | 5 | 39.63 | 6 | 40.57 | 12 |
| 6 | 28.60 | 7 | 34.75 | 6 | 41.06 | 5 | 45.16 | 5 |
| 7 | 29.07 | 6 | 37.26 | 4 | 47.38 | 2 | 53.64 | 2 |
| 8 | 21.37 | 17 | 25.71 | 18 | 33.85 | 15 | 39.40 | 14 |
| 9 | 27.03 | 9 | 31.29 | 10 | 41.60 | 4 | 46.71 | 4 |
| 10 | 24.67 | 13 | 29.32 | 12 | 36.23 | 14 | 39.35 | 15 |
| 11 | 21.83 | 16 | 26.47 | 15 | 33.11 | 16 | 36.25 | 17 |
| 12 | 21.25 | 18 | 26.46 | 16 | 36.38 | 13 | 41.65 | 8 |
| 13 | 26.89 | 10 | 29.31 | 13 | 36.78 | 12 | 40.75 | 11 |
| 14 | 33.95 | 2 | 38.70 | 2 | 44.77 | 3 | 48.94 | 3 |
| 15 | 22.61 | 15 | 26.76 | 14 | 32.13 | 17 | 36.95 | 16 |
| 16 | 27.34 | 8 | 33.74 | 7 | 37.97 | 8 | 41.11 | 10 |
| 17 | 23.79 | 14 | 26.37 | 17 | 31.51 | 18 | 34.89 | 18 |
| 18 | 25.98 | 12 | 30.21 | 11 | 37.23 | 11 | 45.00 | 6 |

### *2.5. Spatial autocorrelation test*

Combined with the previous research, it can be seen that the use of entropy weight-TOPSIS method and Dagum Gini coefficient can be used to evaluate the economic high-quality development of a province in the past 10 years, and at the same time analyze the spatial differences in the level of high-quality development of the economy that exist in the regions within the province. Following this research method and analysis process, the overall economic high-quality development and the spatial differences in the level of economic high-quality development among regions in the last 10 years from 2013 to 2022 in 30 provinces in China are analyzed one by one to derive the relevant economic development in each province and city.

Further, the spatial autocorrelation test is conducted on the economic high-quality development level of the 30 provinces in the country in the recent 10 years. Table 5 shows the results of the spatial autocorrelation test. From the test results in the table, it can be seen that the p-value of the spatial autocorrelation test of the economic high-quality development level of the 30 provinces in the country in 2013-2022 is less than the significance level $\alpha = 0.05$. Therefore, there is a significant spatial autocorrelation between the economic high-quality development level of the 30 provinces in the country under the condition of the significance level of 0.05 and it can be seen that the spatial autocorrelation of the economic high-quality development level of the 30 provinces in the country in

the period 2013-2022 can be seen. 2022, the Moran index of the level of high-quality economic development are all positive, that is, the overall level of high-quality economic development in China is spatially positively correlated.

**Table 5.** Spatial autocorrelation test results

| Year | Moran index | Mean value | Standard deviation | Z test | P-value |
|---|---|---|---|---|---|
| 2013 | 0.254 | -0.035 | 0.119 | 2.441 | 0.008 |
| 2014 | 0.247 | -0.035 | 0.119 | 2.394 | 0.007 |
| 2015 | 0.193 | -0.035 | 0.118 | 1.961 | 0.021 |
| 2016 | 0.197 | -0.035 | 0.119 | 1.977 | 0.023 |
| 2017 | 0.218 | -0.035 | 0.119 | 2.159 | 0.017 |
| 2018 | 0.235 | -0.035 | 0.119 | 2.294 | 0.001 |
| 2019 | 0.197 | -0.035 | 0.118 | 1.974 | 0.026 |
| 2020 | 0.185 | -0.035 | 0.118 | 1.881 | 0.027 |
| 2021 | 0.207 | -0.035 | 0.119 | 2.077 | 0.018 |
| 2022 | 0.221 | -0.035 | 0.118 | 2.195 | 0.015 |

Figure 3 shows the Moran scatterplot in 2020. Taking the Moran scatter plot in 2020 as an example to observe the spatial distribution characteristics of China's economic high-quality development level, it can be seen from the figure that the country's 30 provinces are divided into four quadrants. Among them, the first quadrant, i.e., the “High-High” category, contains six provinces, namely, City A, City A1, City A2, Province A3, Province A4, and Province A5, which represent not only their own high level of high-quality economic development, but also the high level of high-quality economic development of the surrounding provinces, and it can be found that all of these provinces are close to the capital city or are the eastern coastal provinces, which are closer and more distant. Eastern coastal provinces, which are close and interact with each other. The second quadrant, that is, the "low-high" category, includes 6 provinces, including province B, province B1, province B2, autonomous region B3, province B4, and province B5. The third quadrant, i.e., the "low-low" category, includes 16 provinces, including C, C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, and C15, which belongs to the less developed regions and is far away from the first-tier provinces or the eastern coastal provinces, so it belongs to the "low-low" category. The fourth quadrant, i.e., the "high-low" category, includes two provinces, D1 and D2, which represent a high level of high-quality economic development of their own provinces, but a relatively low level of high-quality economic development of surrounding provinces. From the spatial autocorrelation test, it can be judged that there is a correlation between the economic development level of different provinces and cities and the surrounding provinces and cities, and the regulation of fiscal policy in a province and city to promote the high-quality development of the economy of that province and city will also enhance the economic development level of the corresponding province and city in the same quadrant.

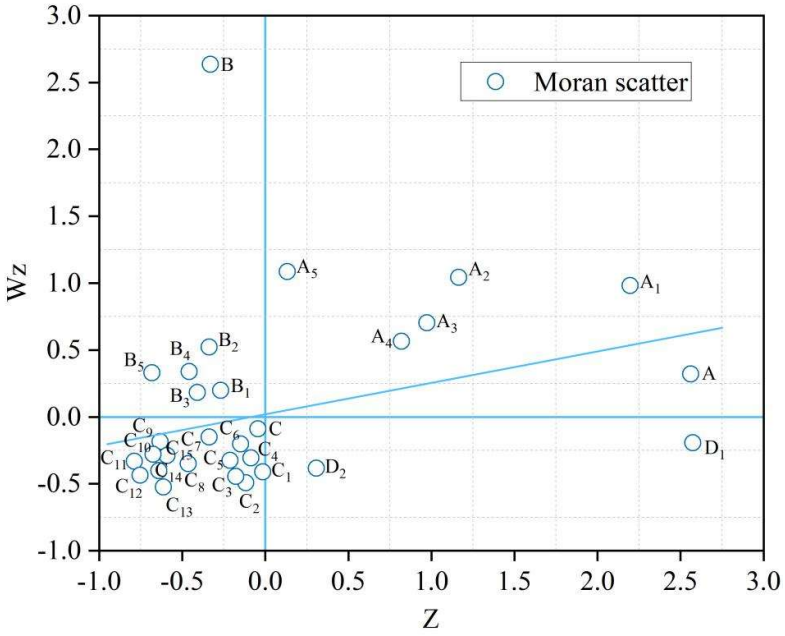


**Fig. 3.** The Moran scatter plot for 2020

## 3. Fiscal policy regulation path modeling and empirical testing

This chapter focuses on the regulatory role of fiscal policy on the high-quality development of regional economy. Through the establishment of special funds to support the upgrading of traditional industries, technological innovation in emerging industries and tax incentives, a regulatory model is constructed that includes the fiscal policy index, enterprise development scale and other variables. The relevant variables of the model are tested to determine the actual regulatory effect of fiscal policy on the high-quality development of the economy at the regional level.

### *3.1. Fiscal policy contributes to the path of high-quality development of the regional economy*

3.1.1. Financial investment to support industrial upgrading. The financial sector can arrange special funds to support technological upgrading and equipment renewal in traditional industries such as coal, iron and steel, and can also improve resource utilization efficiency and reduce environmental pollution by encouraging enterprises to adopt advanced energy-saving and emission-reduction technologies. For example, the financial sector subsidizes enterprises that improve the coal recovery rate through the adoption of new coal mining technologies to promote the development of the coal industry in the direction of safety, high efficiency and greenness. The financial sector can support traditional industries to extend their industrial chain and increase the added value of their products. Through financial subsidies and incentives, the financial sector can guide enterprises to develop projects such as deep processing of coal and new materials for iron and steel, and promote industrial diversification. For example, the financial sector can help enterprises improve product competitiveness by giving loan subsidies to enterprises investing in and constructing coal and chemical integration projects.

3.1.2. Support for scientific and technological innovation in emerging industries. The financial sector can increase its financial investment in strategic emerging industries, such as new energy, new materials, information technology and biomedicine. Through the establishment of development funds for emerging industries, social capital can be attracted to participate and then jointly support the R&D, production and promotion of emerging industry projects. Taking the new energy automobile industry as an example, financial funds can be used to support the construction of its charging piles and other infrastructures, enterprise technology research and development and industrialization projects, and

subsidies are given to new energy power generation projects, thus encouraging enterprises to increase their investment and promoting the transformation of the energy industry in the direction of cleanliness and low carbon. The financial sector can also give tax incentives, financial subsidies and enterprise R&D cost subsidy policies to enterprises in emerging industries. For example, the financial sector of the R & D investment in sales revenue accounted for a certain proportion of enterprises, to give the corresponding financial incentives to stimulate the enthusiasm of enterprise innovation. The financial sector can also encourage these enterprises to innovate and develop by rewarding enterprises that have won national and provincial scientific and technological awards, and by providing financial subsidies for new products with independent intellectual property rights developed by enterprises.

3.1.3. Implementing the supportive role of tax incentives. First, the implementation of precise tax incentives. Through the implementation of precise tax and fee concessions, the local economy can effectively reduce the tax burden of small and microenterprises and resolutely put an end to indiscriminate collection and abuse. Second, give full play to the role of special funds. The local economy should give full play to the role of provincial special funds for the development of small and medium-sized enterprises to guide and support the development of entrepreneurship and innovation, upgrading and upgrading, "specialization, specialization and innovation" development, standardization of shareholding reform, service system construction, development zones, small and medium-sized enterprise parks and other aspects of sustained efforts. Third, strengthen government procurement support. Local economies should strengthen government procurement support for MSMEs and ensure that payments are made on time.

### *3.2. Model Setting and Variable Selection*

3.2.1. Model setup:

1) Benchmark regression modeling. This study takes data from 30 provinces in China during the period 2013-2022 as an example to analyze how fiscal policy affects high-quality economic development in different regions. At the same time, we will also explore whether such policy impacts exhibit differences in the time dimension at different stages of development. In order to quantify these impacts, we take the level of high-quality economic development in each of China's 30 provinces, measured by the entropy method, as the explanatory variable in the model, and fiscal policy as the core explanatory variable, so as to construct a panel data to further study the relationship between high-quality economic development and fiscal policy, and the empirical model is set up as follows:

$$index\_HQED_{it} = \alpha_0 + \alpha_1 policy_{it} + \alpha_2 X_{it} + \delta_i + \mu_t + \varepsilon_{it} \tag{14}$$

Where: the explanatory variable $index\_HQED_{it}$ is the level of high-quality economic development of the region $i$ in the year $t$, and the core explanatory variable $policy_{it}$ is the fiscal policy of the region $i$ in the year $t$. Here $X_{\mathrm{it}}$ is a set of control variables related to fiscal policy, specifically including the level of education, the level of openness to the outside world, the population density, and the economic growth rate. Finally $\alpha_0$, $\delta_i$, $\mu_t$, and $\varepsilon_{it}$ are the intercept term, the time- and region-fixed effects, and the random perturbation term, respectively.

2) Mediating effects modeling. In mechanism analysis, mediating effects analysis provides a way to understand the interactions between variables and is suitable for exploring how the independent variable affects the dependent variable through one or more mediating variables. This analytical framework contributes to an in-depth understanding of the mechanism of action between variables. In the study, the impact of fiscal policy on the level of high-quality economic development in each region of China's 30 provinces is realized through two intermediary variables, namely, the scale of

enterprise development and industrial structure upgrading. In other words, fiscal policy influences the scale of enterprise development and industrial structure, which indirectly promotes the high-quality development of the economy. This analysis not only helps us understand the direct impact of fiscal policy, but also reveals the internal transmission mechanism through which policy affects the level of high-quality economic development.

On the basis of the benchmark model, test the scale of enterprise development and industrial structure and the intermediary role of fiscal policy to promote high-quality development of the economy, the intermediary effect model selected three-stage model for testing. The main steps of the model are: first, based on the benchmark model to test the main effect; second, the explanatory variables and intermediary variables $(M)$ to test; third, the explanatory variables and intermediary variables at the same time into the model to test. Combined with the variable settings in this paper, the specific form of the mediating effect model is:

$$M_{it} = \beta_0 + \beta_1 policy_{it} + \beta_2 X_{it} + \delta_i + \mu_t + \varepsilon_{it} \tag{15}$$

$$index\_HQEDL_{it} = \theta_0 + \theta_1 M_{it} + \theta_2 policy_{it} + \alpha_2 X_{it} + \delta_i + \mu_t + \varepsilon_{it} \tag{16}$$

Among them, the explanatory variable $index\_HQEDL_{it}$ denotes the level of high-quality economic development of the region $i$ in the year $t$, and the core explanatory variable $policy_{i,t}$ is the fiscal policy of the region $i$ in the year $t$. The $M_{it}$ is the mediating variable, enterprise development scale and industrial structure, respectively; here $X_{it}$ is a set of control variables related to the fiscal policy, specifically including the education level, the level of openness to the outside world, the population density, and the economic growth rate. Finally $\alpha_0$, $\delta_i$, $\mu_i$, $\varepsilon_{it}$ are the intercept term, the time and area fixed effects and the random perturbation term respectively.

3.2.2. Selection of relevant variables:

1) Core Variables:

(1) Explained variable-economic high-quality development level $(HOED)$. The scores of the level of high-quality economic development in each region of 30 provinces in China calculated based on the entropy method are used as indicators of high-quality economic development. In order to improve the reliability of the empirical analysis, total factor productivity is chosen as a proxy variable for the explanatory variables, and robustness tests are conducted.

(2) Explanatory variables-fiscal policy index. Based on the weights measured by the entropy method, the composite index measured by the fiscal policy is used as the independent variable and synthesized into an index through the entropy method to quantify the degree of easing or tightening of the fiscal policy environment.

2) Mediating variables:

(1) Enterprise development scale. The enterprise development scale here chooses enterprise development width and enterprise development depth as measurement indicators. Among them, the width of enterprise development is mainly reflected by the score of the number of enterprises, which measures the overall scale and economic vitality level of enterprises in a region, and represents the business environment, market attractiveness, and the breadth of industry coverage in the region. The depth of enterprise development is measured by the number of trademark registrations score, which reflects the investment and effectiveness of enterprises in brand building, innovation and market competitiveness. The two indicators, the number of enterprises score and the number of trademark registrations score, are derived from the China Regional Innovation and Entrepreneurship Index. The index provides a scientific method to evaluate the width and depth of enterprise development by

comprehensively assessing the number of enterprises and trademark registrations in a region, providing reliable data support for the scale of enterprise development in this study.

(2) Level of industrial structure upgrading. Industrial structure production and usually refers to now with the continuous development of the economy, the three industries along the primary, secondary and tertiary regular changes, this change is not only a natural process of economic evolution, but also by the significant impact of fiscal policy, especially the policy for resource allocation and prioritization of the development of the field of the guiding role. In studying the relationship between fiscal policy and high-quality economic development, industrial structure upgrading manifests itself as a key intermediary mechanism that can affect the quality and level of economic development in the Northeast. Therefore, this paper specifically chooses the index of industrial structure upgrading $\left(Industry_1\right)$; the coefficient of industrial structure hierarchy $\left(Industry_2\right)$; and the index of industrial structure rationalization $\left(Industry_3\right)$. The three indices are weighted and summed by the entropy weight method to obtain the variable $\left(Industry\right)$ characterizing the level of industrial structure upgrading in each region of 30 provinces in China. Among them, the industrial structure upgrading index $\left(Industry_1\right)$ is measured by the ratio of the output value of the tertiary industry to the output value of the secondary industry. The industrial structure hierarchy coefficient is the proportion of the three industries $W_i$ multiplied by the corresponding weight $q$ with the following formula:

$$Industry_2 = \sum_{i=l}^{3} w_i^* q \tag{17}$$

The coefficient of variation of the three industries is calculated by summing up the absolute values of the three industries' shares at the beginning of the period minus the end of the period, and the formula is as follows:

$$Industry_3 = \sum_{i=l}^{3} \left| w_{it} - w_{it-1} \right| \tag{18}$$

3) Control variables:

(1) Level of education. The choice of education level as a control variable for fiscal policy on high-quality economic development is based on the fact that education level is an important component of human capital, which plays a key role in economic development and productivity enhancement through the knowledge, skills, and abilities possessed through education and training. High-quality labor force can promote innovation, improve productivity, and promote high-quality economic development. This paper chooses the ratio of the number of students enrolled in higher education to the total population of the region.

(2) Marketization Level. The level of marketization is chosen as a control variable because it can reflect the degree of market orientation of a region's economic operation, including the efficiency of resource allocation, the autonomy of enterprise operation, the convenience of market access and the fairness of the legal environment. By using the level of marketization as a control variable, the study can more accurately identify the impact of fiscal policy on specific outcomes of economic development and exclude the interference of differences in the marketization process on the results of the study.

(3) Population Density. Population density largely affects sustainable economic development and resource allocation efficiency. High population density areas face challenges such as limited land resources and environmental pressure, while sparsely populated areas may face problems such as insufficient market size and employment opportunities. Therefore, controlling population density can help accurately assess the impact of fiscal policy on high-quality economic development, taking into account the potential impact of demographic factors on economic development.

(4) Economic growth rate. The rate of economic growth is an important indicator of a region's economic growth, but the pure pursuit of speed may neglect the concern for economic quality. Controlling the rate of economic growth can help assess the impact of fiscal policy on economic structure, innovation capacity, and environmental protection, ensuring that economic growth is harmonized with high-quality development and achieving sustainable economic development.

### *3.3. Variable testing and model determination*

3.3.1. Correlation analysis. Correlation analysis is done to test the degree of correlation between the variables. Table 6 shows the results of the correlation test. Table 6 shows that the P-value between the explanatory variable of fiscal policy, the explanatory variable of the level of high-quality development of the economy, the mediator variable of the scale of development of enterprises, the level of industrial structure upgrading, as well as the control variables of the level of education, the level of marketization, the density of the population, and the rate of economic growth are all less than 1%, which indicates that there is a correlation between the two variables, and that the next regression can be carried out.

**Table 6.** Results of correlation test

| | Policy | HQED | Company | Industry | Education | Market | Population | Sgdp |
|---|---|---|---|---|---|---|---|---|
| Policy | 1 *** | | | | | | | |
| HQED | 0.637 *** | 1 *** | | | | | | |
| Company | 0.409 *** | 0.495 *** | 1 *** | | | | | |
| Industry | 0.506 *** | 0.58 *** | 0.313 *** | 1 *** | | | | |
| Education | -0.504 *** | -0.533 *** | -0.315 *** | -0.612 *** | 1 *** | | | |
| Market | -0.357 *** | -0.299 *** | -0.222 *** | -0.214 *** | -0.234 *** | 1 *** | | |
| Population | -0.362 *** | -0.392 *** | -0.192 *** | -0.246 *** | -0.276 *** | -0.275 *** | 1 *** | |
| Sgdp | -0.336 *** | -0.375 *** | -0.215 *** | -0.210 *** | -0.320 *** | -0.263 *** | -0.3 *** | 1 *** |

Note: *** represents a significance level of 1%, with a P-value of 0.000.

3.3.2. Stability tests. In order to prevent "pseudo-regression" and get more accurate regression results in the future model, the selected variables should be tested for smoothness, and this paper chooses the ADF and IPS tests, which are mainly used to analyze whether the time series is smooth or not. Table 7 shows the results of ADF test for variables. Table 8 is the result of IPS test. From the data in Table 7 and Table 8, it can be seen that the selected variables are all in the difference of order 0, the significance of the P-value shows significance, rejecting the original hypothesis that the time series is not smooth, indicating that the variables are all smooth time series variables, which can be carried out in the next step of the data regression.

**Table 7.** Variable ADF test results

| Variable | Difference order | T | P | AIC | Threshold | | |
|---|---|---|---|---|---|---|---|
| | | | | | 1% | 5% | 10% |
| Policy | 0 | -8.121 | 0.001*** | -268.484 | -3.452 | -2.873 | -2.575 |
| HQED | 0 | -5.088 | 0.001*** | -677.879 | -3.450 | -2.874 | -2.571 |
| Company | 0 | -4.111 | 0.000*** | -513.276 | -3.450 | -2.874 | -2.571 |
| Industry | 0 | -4.760 | 0.001*** | -832.238 | -3.452 | -2.873 | -2.575 |
| Education | 0 | -5.892 | 0.001*** | -930.593 | -3.450 | -2.874 | -2.571 |
| Market | 0 | -4.243 | 0.000*** | -1566.620 | -3.450 | -2.874 | -2.571 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Population | 0 | -4.739 | 0.001*** | -2151.491 | -3.450 | -2.874 | -2.571 |
| Sgdp | 0 | -8.121 | 0.001*** | -268.480 | -3.452 | -2.873 | -2.575 |

Note: *, ** and *** represent the significance levels of 10%, 5% and 1%, respectively.

**Table 8.** Variable IPS test results

| Variable | Difference order | T | P | Threshold | | |
|---|---|---|---|---|---|---|
| | | | | 1% | 5% | 10% |
| Policy | 0 | -2.493 | 0.001*** | -2.483 | -2.385 | -2.331 |
| HQED | 0 | -2.780 | 0.001*** | -2.483 | -2.385 | -2.331 |
| Company | 0 | -2.445 | 0.001*** | -2.483 | -2.385 | -2.331 |
| Industry | 0 | -2.012 | 0.016** | -2.483 | -2.385 | -2.331 |
| Education | 0 | -3.014 | 0.001*** | -2.483 | -2.385 | -2.331 |
| Market | 0 | -3.581 | 0.001*** | -2.483 | -2.385 | -2.331 |
| Population | 0 | -4.765 | 0.0039*** | -2.483 | -2.385 | -2.331 |
| Sgdp | 0 | -2.493 | 0.001*** | -2.483 | -2.385 | -2.331 |

Note: *, ** and *** represent the significance levels of 10%, 5% and 1%, respectively.

3.3.3. Robustness Tests. In testing the robustness of the above study, this paper uses three methods to test it.

First, the replacement variable method, replacing HQED with GDP for the robustness test, to further test whether the conclusions of the above study are stable; second, the replacement sample method, using the sampling regression method, randomly selecting 70% of the sample, and once again conducting the fixed-effects model regression, to test whether the conclusions of the above study are stable; and third, the instrumental variable method, in order to exclude possible endogeneity problems in the underlying model, the This paper applies the instrumental variable method, taking fiscal policy as an instrumental variable and conducting a two-stage least squares regression to test whether the conclusions above are stable.

Table 9 shows the results of the three robustness tests. As can be seen from Table 9, whether it is the replacement variable method, instrumental variable method, or sample replacement method, the regression coefficients of the core variables from the test are still significantly positive (P>0), the coefficients of the mediating variables are still positive (P>0), and the coefficients of the control variables are still negative (P<0), which indicates that the influence of each variable on the high-quality development of the economy remains unchanged. And the relative size of the coefficient values corresponding to each variable has not changed significantly, indicating that the model and data selected in this paper are reasonable and the conclusions obtained are robust. Meanwhile, the results of regression using two-stage least squares are significant, proving that the results are still robust after removing the endogeneity problem.

**Table 9.** Robustness test results of three methods

| Variable | Replace HQED with GDP | Sampling regression: Sampling 70% sample | | Two-stage least squares regression |
|---|---|---|---|---|
| | | B1 | B2 | |
| Intercept | 0.251***<br>(33.109) | 0.278***<br>(32.476) | 0.247***<br>(15.658) | 0.385***<br>(22.347) |
| Policy | 0.225***<br>(36.380) | - | - | 0.098***<br>(7.001) |
| HQED | - | 0.246***<br>(49.802) | 0.239***<br>(12.930) | 0.372***<br>(21.460) |

| | | | | |
|---|---|---|---|---|
| Company | 0.041***<br>(3.300) | 0.035**<br>(2.931) | 0.035*<br>(2.343) | 0.051***<br>(2.852) |
| Industry | 0.097***<br>(4.285) | 0.106**<br>(2.862) | 0.097**<br>(2.941) | 0.057**<br>(2.341) |
| Education | -0.123***<br>(-8.186) | - | - | -0.090***<br>(-7.211) |
| Market | -0.300**<br>(-2.527) | - | - | -0.096***<br>(-7.017) |
| Population | -1.627***<br>(-5.961) | - | - | -0.175<br>(-1.611) |
| Sgdp | -1.631***<br>(-6.920) | - | - | -2.910***<br>(-10.00) |

Note: *, **, and *** represent significance levels of 10%, 5%, and 1%, respectively, with t statistics in parentheses.

### *3.4. Analysis of the impact of fiscal policy on high-quality economic development at the regional level*

Due to the different development directions between the different regions of China's 30 provinces and cities and the different geographic environments in which they are located, etc., there are large differences in the enactment of fiscal policy and the level of high-quality economic development among the three major regions of the eastern, central and western regions, so is there a difference in the role of the fiscal policy regulation in this paper on the high-quality development of the economy? This part addresses this question by dividing the 30 provinces and cities into three regional samples in the east, center and west, and using the model of this paper to verify the impact of fiscal policy on economic high-quality development in different regions.

Table 10 shows the validation results. According to the results in Table 10, it can be seen that the model for the eastern region is:

HQED=0.299+0.046Policy+0.023Company+0.176Industry-0.162Education-0.371Market-0.270Population-0.235Sgdp.

The model for the central region is:

HQED=0.169+0.038Policy+0.163Company+0.100Industry-0.245Education-0.271Market-0.213Population-0.228Sgdp.

The model for the western region is:

HQED=0.251+0.008Policy+0.196Company+0.073Industry-0.293Education-0.135Market-0.282Population-0.274Sgdp.

At the regional level, fiscal policy contributes to the high quality level of the economy in different regions, but in different ways. This is mainly because the eastern region compared to the central and western regions developed earlier, the role of fiscal policy regulation to play focused on science and technology and other high-end industries and people's welfare, and the eastern region itself has relatively strong economic strength and resources, the regulation of fiscal policy can quickly activate the region's economic vitality. The central and western regions develop late, the economic level is relatively low, their own market environment is not enough to respond to the regulation of fiscal policy as quickly and effectively as in the eastern region, so the level of economic development of high quality to enhance the effect is also significant, but in general, not as good as in the eastern region. This also proves that the active regulation of fiscal policy has a greater role in promoting the development of regional economic quality, but the regulation effect itself will be constrained by the original level of economic quality development in the region.

**Table 10.** Regression results of textual model, middle and western regions

| Variable | Eastern region | Central region | Western region |
|---|---|---|---|
| Intercept | 0.299*** | 0.169*** | 0.251*** |
| | (21.203) | (16.18) | (21.107) |
| Policy | 0.046*** | 0.038*** | 0.008*** |
| | (20.245) | (14.10) | (21.160) |
| Company | 0.023*** | 0.163*** | 0.196*** |
| | (0.770) | (3.901) | (3.378) |
| Industry | 0.176*** | 0.100*** | 0.073*** |
| | (7.661) | (3.557) | (3.107) |
| Education | -0.162 | -0.245* | -0.293** |
| | (-1.330) | (-1.750) | (-2.430) |
| Market | -0.371*** | -0.271*** | -0.135 |
| | (-6.056) | (-5.070) | (-0.281) |
| Population | -0.270*** | -0.213*** | -0.282*** |
| | (-5.011) | (-6.016) | (-2.434) |
| Sgdp | -0.235*** | -0.228*** | -0.274*** |
| | (-4.056) | (-4.578) | (-2.610) |

Note: *, **, and *** represent significance levels of 10%, 5%, and 1%, respectively, with t statistics in parentheses.

## 4. Conclusion

In this paper, we study the data related to the level of high-quality economic development in each region of China, and construct benchmark regression models and mediation effect models to reveal the dynamic trends, spatial differences, and the paths of fiscal policy regulation in high-quality regional economic development. The model is correlated at the 1% significance level, which proves that fiscal policy and other variables have an impact on the level of high-quality economic development. In the smoothness test, the model variables in this paper have smooth P-values at the 1% level when the difference is of order 0. Using 3 different ways to test the model, the model is still robust. The 30 provinces in China are divided into 3 economic regions for modeling, and it is found that the level of high-quality development of each region's economy shows a positive enhancement of the development effect under the regulation of fiscal policy. At the same time, there are regional differences, presenting a spatial pattern of “eastern agglomeration, central and western lag”.

In the future, we should further optimize the effect of fiscal policy control, prioritize green technology research and development through financial subsidies, strengthen cross-regional industrial collaboration, and promote high-quality synergistic development of the regional economy. At the same time, transfer payments and tax incentives can also be increased for the central and western regions to effectively enhance the level of high-quality development of the central and western regional economy.

## References

[1] Efayena, O. O., & Olele, E. H. (2024). Moderating the effect of institutional quality on the fiscal policy and economic growth nexus: what evidence exists in Sub-Saharan Africa?. Journal of the Knowledge Economy, 1-23.

[2] Yang, Z. (2023). The impact of green finance on high-quality economic development in China: vertical fiscal imbalance as the moderating effect. Sustainability, 15(12), 9350.

[3] Madni, G. R., & Chaudhary, M. A. (2017). Economic growth in context of institutions and fiscal policy. Pakistan Economic and Social Review, 55(1), 107-126.

[4] Wang, G., Wang, D., & Zhang, L. (2023). Assessing the Impact of Government Behavior on Regional High-Quality Development: A Case of Fiscal Expenditures on People's Livelihoods in China. Land, 12(10), 1924.

[5] Stoilova, D., & Todorov, I. (2021). Fiscal policy and economic growth: Evidence from Central and Eastern Europe. Journal of Tax Reform, 7(2), 146-159.

[6] Nurmukhametov, N. N., Islyam, G. I., Zhamieva, A. E., Bordiyanu, I. V., & Suieubayeva, S. N. (2023). The influence of fiscal factors on the sustainability of the regional economy development. RIVISTA DI STUDI SULLA SOSTENIBILITA', (2023/1 T.).

[7] Hongzhong, Z. R., Jianbang, W. H., & Tanchev, X. D. (2023). Efficacy of Fiscal Policy in Stimulating Economic Growth During Recession in China. Journal of Economics, 7(1), 1-11.

[8] Chugunov, I., & Makohon, V. (2019). Fiscal strategy as an instrument of economic growth. Baltic Journal of Economic Studies, 5(3), 213-217.

[9] Rickman, D., & Wang, H. (2020). US state and local fiscal policy and economic activity: Do we know more now?. Journal of Economic Surveys, 34(2), 424-465.

[10] Dawid, H., Harting, P., & Neugart, M. (2018). Fiscal transfers and regional economic growth. Review of International Economics, 26(3), 651-671.

[11] Pasichnyi, M. (2020). Fiscal policy and economic development. University Economic Bulletin, (44), 153-164.

[12] Basuki, A. T., Purwaningsih, Y., Soesilo, A. M., & Mulyanto, M. (2020). The Effect of Fiscal Policy and Foreign Direct Investment on Regional Economy in Indonesia. Jurnal Ekonomi & Studi Pembangunan, 21(1), 53-68.

[13] Baccini, L., Li, Q., Mirkina, I., & Johnson, K. (2018). Regional competition, business politicians, and subnational fiscal policy. Business and Politics, 20(3), 410-437.

[14] Zhou, Y., He, X., & Li, S. (2023). Research on the coordination of fiscal structure and high-quality economic development: An empirical analysis with the example of Anhui province in China. Plos one, 18(6), e0287201.

[15] Yu, Z., Wu, Y., & Zhu, Z. (2023). Fiscal decentralization, environmental regulation and high-quality economic development. Sustainability, 15(10), 7911.

[16] Wang, D., Zhang, E., & Liao, H. (2022). Does fiscal decentralization affect regional high-quality development by changing peoples' livelihood expenditure preferences: Provincial evidence from China. Land, 11(9), 1407.

[17] Liu, Y. (2020). Research on fiscal expenditure structure and high-quality economic development: An empirical study based on panel data from Chinese provinces from 2007 to 2017. American Journal of Industrial and Business Management, 10(2), 232-249.

[18] Li, C., & Qi, Y. (2023). Driving effect of fiscal policy on regional innovation efficiency. Economic research-Ekonomska istraživanja, 36(1), 767-785.

[19] Chen, J. (2021). The influence of fiscal and financial policies on upgrading of regional industrial structure. Open Access Library Journal, 8(11), 1-17.

[20] Zhao, G., Guo, Y., & Bo, L. (2023). High-quality economic growth and carbon emissions in Chinese cities: the moderating role of fiscal policies. Digital Economy and Sustainable Development, 1(1), 19.

[21] Andrián, L., Hirs-Garzón, J., Urrea, I. L., & Valencia, O. (2024). Fiscal rules and economic cycles: quality (always) matters. European Journal of Political Economy, 85, 102591.

[22] Zhou, Y. (2023). Integrated development of industrial and regional economy using big data technology.

Computers and Electrical Engineering, 109, 108764.

[23] Wu, S. (2023). Application of Big Data Technology in Regional Economic Tax Regulation in the Era of Digital Economy. Internet Finance and Digital Economy: Advances in Digital Economy and Data Analysis Technology, 917-930.

[24] Zhou, B., Zeng, X., Jiang, L., & Xue, B. (2020). High-quality economic growth under the influence of technological innovation preference in China: A numerical simulation from the government financial perspective. Structural Change and Economic Dynamics, 54, 163-172.

[25] Martynenko, V., Kovalenko, Y., Chunytska, I., Paliukh, O., Skoryk, M., & Plets, I. (2022). Fiscal policy effectiveness assessment based on cluster analysis of regions. International Journal of Computer Science & Network Security, 22(7), 75-84.