

Research on regional economic high-quality development and fiscal policy regulation path based on data mining

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ABSTRACT

Supported by the theory of economic growth convergence, this paper takes the eastern, central and western regions as the research object during 2010-2020, analyzes the economic growth convergence of the eastern, central and western regions of the country, and verifies the relationship between the regulation of fiscal policy and the high-quality development of the regional economy. Analyze the relationship between regional economic development, fiscal policy and economic convergence, and put forward the analytical view that fiscal policy affects regional economic convergence. The combination of dynamic panel model and absolute β convergence analysis is used to derive the results of the absolute convergence test of regional economic growth. Convergence role test for fiscal expenditure variables, transfer payment variables. It is brought to the western region to analyze the role of government expenditure in the western development policy on the convergence of the western region's economy. Convergence σ as well as absolute β convergence is conducted for each of the eight comprehensive economic zones, and the regional economic high-quality development policies are adjusted. Relative to 2010-2015, there is no convergence in economic growth in the western region in 2016-2020, and there is a tendency to divergence, which suggests that the fiscal policy of western development has limited effect on economic convergence among regional provinces. Absolute β convergence exists for the whole country and the eight comprehensive economic zones, and the convergence coefficient is significantly negative at the 1% level. However, the speed of convergence varies for high-quality economic development.

Keywords: economic growth convergence; absolute β convergence; σ convergence; dynamic panel model; regional economy; fiscal policy

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1. Introduction

The essence of high-quality development of regional economy is to realize the economic development process of structural transformation and adjustment, transformation of old and new driving force, continuous improvement of efficiency, and continuous change of quality within the regional space [1-3]. Regional economic development in the new era must be centered on the concept of innovation, coordination, green, openness and sharing to continuously improve the quality and effectiveness of development, promote the regional economy to achieve win-win ecological and social and economic benefits, and then realize the regional economy from the unbalanced and inadequate low-level low-quality development stage to the high-quality development stage of the transition and upgrading [4-7]. And the high-quality development of regional economy is affected by the regulation of regional fiscal policy [8].

Regional fiscal policy aims to make economic and social development more balanced and sustainable by regulating fiscal revenues and expenditures. Fiscal policy is not only about economy, but also about political and social harmony and stability [9-11]. Fiscal policy regulation is the government's formulation and implementation of policies to intervene and adjust economic phenomena to achieve the purpose of promoting economic development. In terms of regional economic development, the importance of policy regulation is self-evident [12-15].

First of all, policy regulation can guide the rational allocation of resources. Different regions have different resource conditions, the government can encourage and guide the flow of high-quality resources to the regions that need more resources by formulating various policies, reducing the occurrence of resource imbalance phenomenon, ensuring the rational allocation of resources, and thus promoting the coordinated development of regional economy [16-19]. Secondly, policy regulation can synchronize the promotion of national economic development. The government can guide the economic development through various ways to promote the national economic strength [20-21]. Finally, policy regulation can optimize the regional industrial structure and improve economic efficiency. Through corresponding policy regulation, the government can stimulate the development of industries in the region, guide the direction of high-efficiency, low-consumption, environmentally friendly industries, and guide the development of industries in the direction of high-quality, high-value-added, high-technology content, so that the competitiveness and efficiency of the regional economy is gradually improved [22-25].

This paper presents the fiscal policy, regional economy, and economic convergence hypotheses, organizes the relationship between the three, and provides an overview of the two-by-two relationship (including, but not limited to, fiscal policy affecting the development of the regional economy, fiscal policy and economic convergence, and economic convergence and the regional economy), respectively. Analyze the basic model of economic growth convergence, and provide a methodological sketch of α convergence and β convergence. Use dynamic panel model for absolute β convergence analysis to verify the convergence of economic growth in each region under the implementation of fiscal policy. Fiscal expenditure and transfer payment are used as conditional convergence variables to analyze the convergence of fiscal policy on regional economy under different variables. Substitute the western development policy into the economic convergence regression model to analyze the impact of western development fiscal policy on the convergence of economic growth in the western region. Combining the elements of high-quality development of regional economy, the convergence characterization of high-quality development of regional economy is carried out.

2. Regional economies, fiscal policy, economic convergence

2.1. *Classification of fiscal policies affecting regional development*

Fiscal policy is a concept explored in the context of economics, which refers to the guiding principles and its corresponding measures for adjusting the scale of fiscal revenues and expenditures and the balance of revenues and expenditures by a government in order to realize certain macroeconomic objectives. In the market economy environment, fiscal policy has been playing an important role as the government's macroeconomic regulation and control. Fiscal policy is a part of the superstructure, which is a complete system containing both fiscal expenditure policy and fiscal revenue policy [26].

1) Fiscal expenditure policy. There are two kinds of fiscal expenditure policies that affect regional development most. One is purchasing expenditure and the other is fiscal transfer.

Purchasing expenditures are directly manifested in the government's activities of purchasing goods and services, including expenditures for purchasing goods and services needed to carry out daily governmental activities or used for national investment. In other words, in purchasing expenditures, the government, like other economic agents, engages in the activity of equivalent exchange.

Fiscal transfers differ from purchasing expenditures in that they are a gratuitous, unilateral transfer of funds. Simply put, the government redistributes the funds collected into the national treasury in the form of social welfare or financial subsidies through taxation. In fiscal transfers, there is no question of equivalence.

2) Fiscal Revenue Policy. Accordingly, there are two main fiscal revenue policies that affect regional development. One is taxation and the other is government public bonds.

Taxation is a very old economic category, which exists throughout the ancient and modern times. Taxes are simply understood as the price people pay to enjoy public services provided by the government and occur between the government and its citizens.

Government public bonds, also known as national or public debt, refer to debt raised by the central government as national debt and debt raised by local governments as public debt. Government public bonds are bonds issued by the government as the main body, through which the government raises funds and is a non-recurring nature of fiscal revenue.

2.2. *Economic convergence*

The economic convergence hypothesis is an important theory of economic growth, which derives from the concept of balanced and stable economic development proposed by the neoclassical theory of economic growth. Economic convergence refers to the negative correlation between the rate of economic growth of economies at different levels of economic development and their respective initial economic aggregates. This indicates that even though at the beginning of the period, there are different degrees of differences in their respective levels of economic development, they will eventually converge to an identical steady-state level. Existing studies have shown that economic growth exhibits various forms of convergence, which are mainly categorized into two main types: σ -convergence and β -convergence.

2.2.1. Economic growth and economic convergence:

1) Economic growth, differences in economic growth and economic convergence. The economic growth model explains the differences in economic growth between regions, arguing that the per capita output of a region will eventually converge to an equilibrium situation, i.e., economic growth shows convergence characteristics. This feature explains the long-term trend of economic growth and the disparity between regions.

2) Regional economic growth differences and their convergence. The theory of economic growth convergence shows that when a region's economic growth process convergence characteristics, indicating that the market mechanism under the role of the regional economic development gap will be reduced, which is conducive to the realization of the government's goal of narrowing the gap between the regional economy. When there is a trend of divergence in the economic growth of a region, the regional economic gap will widen, which will make it more difficult for the government to narrow the regional economic gap.

2.2.2. Factors affecting economic convergence:

1) Impact of Fiscal Expenditures on Economic Convergence. Fiscal expenditure, also known as public expenditure, refers to the government's disposal and utilization of the social resources it raises from the private sector, represented by money, in order to perform its duties. In general, government inputs play an important role in economic development, such as supply, regulating income distribution, and promoting technological innovation and human capital accumulation.

In addition, the scale and structure of government expenditure, financing methods, expected effects and other factors will also affect its role in economic convergence. And the behavior of local government investment in infrastructure, science, education, culture and health, science and technology innovation and other industries will produce positive spillover effects, thus making the economy converge.

2) The effect of policy support on economic convergence. Policy support refers to the government's policy measures in finance, taxation, finance, industry and region to give certain preferences and support to specific industries, fields and regions, so as to promote their development.

Generally speaking, policy support can have the following effects on economic convergence. It can enhance the potential and efficiency of economic growth, promote technological innovation, industrial upgrading, infrastructure construction, etc., and thus reduce the development differences between regions or industries. At the same time, policy support expands domestic demand to a certain extent, reduces dependence on external demand, and improves the stability and elasticity of economic growth.

However, policy support may also have negative effects on economic convergence. Excessive support or inappropriate support can cause an imbalance of resources, which in turn leads to a series of problems such as rigid industrial structure, lagging technological innovation, environmental pollution and so on, which in turn affects the quality of economic development.

2.3. *Theoretical analysis of regional economy, convergence and fiscal policy*

2.3.1. Regional economies. Economic region is the extension of the concept of region in economics, referring to the geographical space on which human economic activities are based. Regional economy, on the other hand, refers to the organic whole of human economic activities combined in a certain territorial space [27-28].

The subjects of regional economy include enterprises, households (residents) and public institutions (government). Enterprises and households (residents) are the micro subjects of the regional economy and the bearers of economic activities, the exchange of labor wages and the supply of goods and services. Public institutions (government) are the macro-regulators and administrators of regional economic operations, and have the dominant power to exchange labor wages with households (residents) and flow of goods and information with enterprises.

The concept of regional economy in this paper includes the concept of provincial (autonomous regions and municipalities directly under the central government) economy at the administrative level,

as well as the concept of eastern, central, western and northeastern economy at the geographic level. The division is based on a combination of geographic and economic linkages.

2.3.2. Definition of convergence. The concept of convergence was first used in mathematics in the context of series and limits, and refers to the fact that for a series $\{X_n\}$, there always exists a positive integer N such that $|X_n - a| < q$ (q being any small positive number) holds for $n > N$.

In economics, convergence mainly refers to the convergence of economic growth. From the perspective of regional development, the phenomenon that the economic gap between countries or regions shrinks over time is generally called convergence, and the phenomenon that the gap widens over time is called divergence. The concept of convergence in this paper is mainly based on the neoclassical view of economics, where convergence is defined as a negative correlation between the growth rate of an economy and the level of gross domestic product (GDP), i.e., the lower the starting point of per capita income, the higher the subsequent rate of economic growth.

2.3.3. Convergence and coordinated regional economic development. The relationship between convergence and coordinated regional economic development examined in this paper is illustrated. Provincial economic development shows convergence, indicating that less developed provinces are growing faster than developed provinces. Over time, the gap narrows and the overall economy tends to develop in a coordinated manner. The divergence pattern shows that the less developed provinces grow slower than the developed provinces, and the gap will get bigger and bigger over time, and the overall economy tends to develop in an uncoordinated way.

The economic development within the region shows a converging trend, indicating that the development differences within the region are narrowing and the economy within the region tends to develop in a coordinated manner. The diverging trend of intra-regional economic development indicates that the intra-regional development differences are expanding and the intra-regional economy tends to develop in an uncoordinated manner. The regional economy shows a converging trend, indicating that the gap of economic development between regions is narrowing, and the inter-regional economy tends to develop in a coordinated manner. The regional economy shows a divergent trend, indicating that the gap between regional economic development is widening and the interregional economy is tending to develop in an uncoordinated manner.

2.3.4. Theoretical analysis of fiscal policies affecting regional economic convergence. Differences in resource endowment, geographical location and policy preferences naturally exist between regions. Under the action of the market mechanism, capital, labor and technology flow to regions with high rates of return, resulting in differences in economic development between regions. Certain regional economic development differences are inevitable and acceptable. Therefore, the coordination of regional economic development by fiscal policy is aimed at the obvious, large, regional economic development differences that have already hindered or will soon hinder the development.

Fiscal policy mainly influences regional economic development through government purchases, fiscal transfers and public debt policy. Government purchases boost regional demand and supply, fiscal transfers make up for the lack of financial resources in lagging regions, and public debt policy provides local governments with a large source of financial resources. Taxation is regulated through differentiated tax policies that regulate tax returns and production costs for taxpayers, thereby regulating regional resource allocation and industrial structure.

3. Empirical analysis of the impact of fiscal policy on regional economic disparities

3.1. Theory and basic model of economic growth convergence

3.1.1. α -convergence. α Convergence refers to the tendency for GDP per capita to converge as the gap between economies' GDP per capita narrows over time. This gap can be measured by applying the standard deviation of the logarithmic value of GDP per capita for a country or region, thus providing a more intuitive measure of the economic growth gap between regions; if the standard deviation is decreasing, it implies the existence of α convergence, and vice versa, representing divergence. The formula is:

$$\sigma_t = \sqrt{\frac{1}{n} \sum_{i=1}^n (\ln y_{i,t} - \overline{\ln y_t})^2} \quad (1)$$

where $y_{i,t}$ is the GDP per capita of i cities in year t and n is the number of cities. If the value of σ decreases over time, it indicates that there is convergence between economies, and conversely, if the value of σ increases, there is no convergence.

3.1.2. β -convergence. β Convergence includes absolute β convergence and conditional β convergence. According to the neoclassical economic growth theory, β convergence refers to the fact that among economies with the same basic economic characteristics, the less developed and poorer economies with lower per capita capital ownership have higher economic growth rates compared to the more developed and richer economies with higher per capita capital ownership.

In this section, a dynamic panel model is used for absolute β convergence analysis to verify the convergence of regional economic growth under the implementation of fiscal policy. On the other hand, it lays the foundation for the conditional β convergence analysis below.

The absolute β convergence model assumes that there are only two factors of production, i.e., labor and capital. These two factors contribute different shares according to their respective marginal productivity. The model is formulated as:

$$Y = F(K, AN) \quad (2)$$

where Y is output and A represents the level of technology. K and N represent the capital stock and the quantity of labor, respectively, and AN represents the effective quantity of labor. Since the production function is assumed to exist with constant returns to scale, the effective output per capita is:

$$f(k) = \frac{F(K, AN)}{AN} = F\left(\frac{K}{AN}\right) \quad (3)$$

If I is total national investment and saving equals investment when national income reaches equilibrium, then capital change per capita Δk can be expressed as:

$$\begin{aligned} \Delta k &= I / AN - (n + g + \delta)k = \frac{sY}{AN} \\ &= sf(k) - (n + g + \delta)k \end{aligned} \quad (4)$$

where n is the population growth rate, g is the technological growth rate, and δ is the depreciation rate.

γ_1 is the growth rate of capital per capita, then there are:

$$\gamma_1 = \frac{d(\Delta k)}{dk} = s \frac{df(k)}{dk} - (n + g + \delta) \quad (5)$$

If k^* represents the capital stock per capita at the steady state level, i.e., at $k = k^*$, $\gamma_1 = 0$. At $k < k^*$, $\gamma_1 > 0$. At $k > k^*$, and $\gamma_1 > 0$, then the growth rate of capital per capita is positive if capital per capita is less than the steady state level. Conversely, the growth rate of capital per capita is negative.

1) The formula for absolute β convergence is:

$$\frac{1}{T} \ln \left(\frac{y_{i,t+T}}{y_{i,t}} \right) = c + \beta \ln y_{i,t} + \varepsilon_{i,t} \quad (6)$$

Where, $y_{i,t}$ is the per capita GDP of i cities in t years. c is a constant, and β is an indicator of the elasticity of the regional economic growth rate with respect to the initial economic level of the region, i.e., a measure of the convergence of regional economic growth. If $\beta < 0$, there is absolute convergence, and vice versa, the economy does not converge. T is the time span of observation, and $\varepsilon_{i,t}$ is the error term.

In order to maximize the sample capacity, the time span of the panel data is generally set to one year, i.e., let $T = 1$, so that Eq. (6) is converted to:

$$\ln \left(\frac{y_{i,t+1}}{y_{i,t}} \right) = c + \beta \ln y_{i,t} + \varepsilon_{i,t} \quad (7)$$

where real GDP is calculated according to the nominal GDP and price index from 2010 to 2020.

From the regression results of equation (7), the absolute β speed of convergence s and the half-life θ can be calculated separately for resource cities, where the speed of convergence s indicates the speed of convergence of per capita income to the steady state level, and the half-life θ indicates the time needed to halve the gap between the real level of per capita income and the steady state level. The formulae for absolute β rate of convergence s and half-life θ are:

$$S = -\ln(1 + \beta) / T \quad (8)$$

$$\theta = \ln(2) / s \quad (9)$$

2) Condition β Convergence assumes that differences in exogenous factors will have some effect on economic convergence if they exist between economies. Since the marginal return to capital is higher, all other things being equal, the poorer the economy, the faster it grows, and then each economy will converge. The “conditions” for conditional convergence include: investment in physical capital, level of human capital, industrial structure, and degree of openness to the outside world.

In order to investigate whether there is conditional β convergence in regional economic growth, fixed asset investment, industrial structure upgrading, human capital investment and degree of openness to the outside world are added as control variables to the original model. Based on the absolute convergence of Condition β , we estimate the convergence of Condition β and establish the following multiple linear regression model:

$$\ln \left(\frac{y_{i,t+1}}{y_{i,t}} \right) = c + \beta \ln y_{i,t} + \alpha_1 \ln Inv_{i,t} + \alpha_2 \ln Humi_{i,t} + \alpha_3 \ln Indu_{i,t} + \alpha_4 \ln Fori_{i,t} + \varepsilon_{i,t} \quad (10)$$

where α_i measures the effect of the control variables on the logarithmic value of per capita GDP growth. x_i represents the newly added control variables, investment in fixed assets (Inv) is the share of fixed investment in GDP, investment in human capital (Humi) is the share of education expenditure in public finance expenditure in GDP. Industrial structure upgrading (Indu) is the share of tertiary industry in GDP, and the share of real utilized foreign capital (Fori) is the share of real utilized foreign capital in the current year's GDP.

3.2. Panel data analysis methods

The advantages of panel data are mainly in the fact that it can overcome the plague of multicollinearity, provide more information, more variation, higher degrees of freedom and more efficient estimation, and reduce covariance [29].

For the general regression equation:

$$y_{it} = \mu + x_{it}\beta + v_{it}, i = 1, \dots, N, t = 1, \dots, T \quad (11)$$

Denote $y_t = (y_{t1}, \dots, y_{tN})'$ as the dependent variable and $X_t = (x_{t1}, \dots, x_{tN})'$ as the independent variable. Where $x_{it} = (x_{it1}, \dots, x_{itK})'$ denotes that there are K explanatory variables. $\beta = (\beta_1, \dots, \beta_k)'$ denotes the parameters to be estimated. μ denotes the common mean term of the model over time and space, and v_{it} is the random error term.

The error term v_{it} can be decomposed into three variables: $v_{it} = \alpha_i + \lambda_t + u_{it}$

A. Variables that vary with individual changes in the cross-section, but not over time α_i such as gender, family background variables, etc.

B, Variables that vary over time but not with individuals λ_t such as price, macroeconomic variables, etc.

C. Variables that vary over time and cross-section of individuals u_{it} , e.g., firm sales, profits, etc.

Hypothesis:

$$\begin{aligned} Eu_{it} &= E\alpha_i = E\lambda_t = 0 \\ Ev_{it}\alpha_i &= E\alpha_i\lambda_t = E\lambda_t v_{it} = 0 \\ E\alpha_i\alpha_j &= \begin{cases} \sigma_\alpha^2 & i = j \\ 0 & i \neq j \end{cases} \\ E\lambda_t\lambda_s &= \begin{cases} \sigma_\lambda^2 & t = s \\ 0 & t \neq s \end{cases} \\ Eu_{it}u_{js} &= \begin{cases} \sigma_u^2, i = j \text{ And } t = s \\ 0, \text{ Other} \end{cases} \end{aligned} \quad (12)$$

and they are independent of x_{it} , i.e., $Ev_{it}x'_{it} = E\alpha_ix'_{it} = E\lambda_tx'_{it} = 0$.

Notating equation (11) in the form of a matrix has:

$$Y = \mu_{NT} + X\beta + V \quad (13)$$

Among them:

$$Y = \begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_N \end{pmatrix}_{N \times 1} \quad X = \begin{pmatrix} X_1 \\ X_2 \\ \vdots \\ X_N \end{pmatrix}_{N \times 1} \quad V = \begin{pmatrix} v_1 \\ v_2 \\ \vdots \\ v_N \end{pmatrix}_{N \times 1} \quad (14)$$

t_{NT} is a NT -dimensional unit vector and:

$$\begin{aligned}
 t_{NT} &= \begin{pmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{pmatrix}_{NT \times 1} \quad y_i = \begin{pmatrix} y_{i1} \\ y_{i2} \\ \vdots \\ y_{iT} \end{pmatrix}_{T \times 1} \quad \beta = \begin{pmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_K \end{pmatrix}_{K \times 1} \quad v_i = \begin{pmatrix} v_{i1} \\ v_{i2} \\ \vdots \\ v_{iT} \end{pmatrix}_{T \times 1} \\
 X_i &= \begin{pmatrix} x_{1i1} & x_{2i1} & \cdots & x_{Ki1} \\ x_{1i2} & x_{2i2} & \cdots & x_{Ki2} \\ \vdots & \vdots & \ddots & \vdots \\ x_{1iT} & x_{2iT} & \cdots & x_{KiT} \end{pmatrix}_{T \times K}
 \end{aligned} \tag{15}$$

1) Panel data model covariance analysis. The general form of the single-equation panel data model is:

$$y_{it} = \alpha_i + x_{it}\beta_i + u_{it}, i = 1, \dots, N, t = 1, \dots, T \tag{16}$$

where x_{it} is the $1 \times K$ -vector, β_i is the $K \times 1$ -vector, K is the number of exogenous variables, and $u_i \sim IID(0, \sigma_u^2)$. The coefficients in the model change over time and across individuals. Thus, it can reflect the effect of the time factor and individual difference factor which are neglected in the model.

2) Panel data model diagnosis and testing. For the general panel data model can be divided into 3 situations:

Scenario 1:

$$y_{it} = \alpha_i + x_{it}\beta_i + u_{it} \text{ (coefficient of variation model)} \tag{17}$$

Scenario 2:

$$y_{it} = \alpha_i + x_{it}\beta + u_{it} \text{ (Variable Intercept Model)} \tag{18}$$

Scenario 3:

$$y_{it} = \alpha + x_{it}\beta + u_{it} \tag{19}$$

The original assumptions of the modeling setup are respectively:

Hypothesis 1: $H_1: \alpha_i \neq \alpha_j, \beta_i \neq \beta_j$

Hypothesis 2: $H_2: \alpha_i \neq \alpha_j, \beta_i = \beta_j$

Assumption 3: $H_2: \alpha_i = \alpha_j, \beta_i = \beta_j$

There are different estimation methods for different forms of panel data models, for specific problems to be analyzed specifically. If only for the differences between individual samples, you can choose the fixed impact model, this time the F test can be used to carry out the model hypothesis testing. F The steps of the test are:

STEP1: Calculate $S_i (i = 1, 2, 3)$. S_i denotes the sum of squares of the residuals obtained by least squares estimation (OLS) for case $i (i = 1, 2, 3)$, with:

$$\begin{aligned}
 \frac{S_1}{\sigma_u^2} &\sim \chi^2(N(T-K-1)), \frac{S_3}{\sigma_u^2} \sim \chi^2(NT-K-1) \\
 \frac{S_2}{\sigma_u^2} &\sim \chi^2(N(T-1)-K)
 \end{aligned} \tag{20}$$

STEP2: Given a significance level of θ , hypothesis 3 is first tested and the test statistic is:

$$\begin{aligned}
 F_3 &= \frac{(S_3 - S_1) / ((N-1)(K+1))}{S_1 / (N(T-1-K))} \\
 F_3 &\sim F((N-1)(K+1), N(T-1-K))
 \end{aligned} \tag{21}$$

When $F_3 < F_{\theta}((N-1)(K+1), N(T-1-K))$, then the original hypothesis is accepted and the parameters in the model are considered to be independent of changes in individuals, and the model is Case 3. Otherwise, it indicates that there is a significant difference between the parameters, and the test of Hypothesis 2 is conducted.

STEP3: Next test hypothesis 2, the test statistic is:

$$F_2 = \frac{(S_2 - S_1) / (N-1)K}{S_1 / (N(T-1-K))}, F_2 \sim F((N-1)K, N(T-1-K)) \quad (22)$$

When $F_2 < F_{\theta}((N-1)K, N(T-1-K))$, then the original hypothesis is accepted that there is no significant difference between the slope coefficients of the models and the model is Case 2. otherwise the model is Case 1.

3.3. Empirical analysis of the impact of fiscal policy on regional economic disparities

In order to examine the convergence of regional economic growth, this paper begins with provinces as the basic regional unit of analysis. The 29 provinces, autonomous regions and municipalities directly under the central government in the paper exclude the Tibet Autonomous Region, the Hong Kong and Macao Special Administrative Regions and Taiwan Province.

3.3.1. Results of the absolute convergence test for regional economic growth. In this paper, NLS regression was conducted, and the NLS results of absolute convergence of the regional economy are shown in Table 1. From the regression results, it is seen that within the sample interval, the absolute convergence coefficient β value of interprovincial economic growth is -0.052, which is statistically more significant, which indicates that overall regional economic growth does not show the nature of absolute convergence. Despite the differences in the sample intervals, such a conclusion is basically consistent with the research of many scholars.

However, it is also seen from the empirical results that, according to the usual method of regional division, the absolute convergence coefficient β values of the eastern and central regions are 0.085 and 0.031, respectively, indicating that during the period of 2010-2020, the economic growth of these two regions has shown a phenomenon of convergence, and that the gap between the economic growth of the provinces in the region has been gradually narrowing. In addition, compared with the East and Central regions, there is no convergence phenomenon in the Western region, whose absolute convergence coefficient β value is -0.071.

This shows that while the overall regional economy is not converging, there is economic convergence within the different subregions, which is indicative of the fact that the regional development gap is widening rather than narrowing among the different subregions.

Table 1. NLS results of an absolute convergence of regional economies

Model	Whole country	East	Middle	West
Intercept	-0.018(-0.793)	0.274**(2.336)	0.139*(1.524)	0.101(0.712)
β	-0.052** (-3.296)	0.085*(1.824)	0.031*** (5.006)	-0.071* (-1.913)
R^2	0.317	0.596	0.499	0.264
D.W. testing	3.569	1.893	1.921	1.856

3.3.2. Conditional convergence test results: impact analysis of fiscal expenditures. According to the difference between the conditional convergence regression model and the absolute convergence regression model, in order to reflect the influence of fiscal expenditure on the convergence of the regional economy, this paper adds fiscal expenditure as a control variable in the absolute convergence

regression model, thus establishing the following conditional convergence regression model, where g represents the government expenditure in the region.

$$(1/T) \log(y_{i,t}/y_{i,t-T}) = a_0 - \left[(1 - e^{-\beta T}) / T \right] \cdot \log(y_{i,t-T}) + \alpha_1 g_{i,t} + \mu_{i,t-T} \quad (23)$$

In this study g denotes the arithmetic mean of the ratio of fiscal expenditure to the real GDP of the year during the period under examination. Of course, for a given state variable, changes in any of these variables (e.g., government policy variables) can affect the growth rate.

The fiscal expenditure variable is used as a control variable to analyze its role in constituting the convergence of economic growth across provinces and across economic regions. The same grouping method is used to test the overall, East, Central and West respectively. The results of the NLS for convergence of regional economic conditions are shown in Table 2.

The inclusion of fiscal spending did not fundamentally change the convergence of regional economies. Firstly, from the national situation, although the inclusion of the fiscal expenditure variable improves the overall goodness of fit of this equation, with the R^2 value of the equation increasing from 0.317 to 0.577, the value of the convergence coefficient β changes from -0.052 to -0.069, which suggests that rather than facilitating the narrowing of the regional economic gap, fiscal expenditure plays a negative role and accelerates the divergence of the regional economy.

According to the estimation results, several other subregions are similar to the national situation, and the western region has the most significant trend of regional economic gap widening under the effect of fiscal expenditure, with the convergence coefficient changing from -0.071 to -0.079. The convergence coefficients of the eastern and central regions have been slightly reduced, but the nature of the convergence has not changed essentially.

Table 2. Regional economic conditions convergence NLS results

Model	Whole country	East	Middle	West
Intercept	-0.006(-0.854)	0.182*(1.554)	0.119(0.825)	0.096(0.893)
β	-0.069** (-3.669)	0.096(0.901)	0.037** (2.074)	-0.079** (-2.305)
g	0.013*(2.031)	-0.005 (-0.803)	-0.019* (-1.703)	0.019(0.976)
R^2	0.577	0.159	0.662	0.243
D.W. testing	3.692	2.327	1.855	1.965

3.3.3. Analysis of the role of transfer payments on regional convergence. As transfer payments increase allocations to backward regions, they facilitate the flow of capital to the underdeveloped central and western regions. If the transfer payment is effective, it should promote the development of the backward regions and thus reduce the regional gap. In this way, when considering the factor of intergovernmental transfers, the role of transfers in reducing regional disparities can be analyzed by replacing government expenditures with transfers in the conditional convergence equation. That is, the control variable transfer payment rate TP is added to the regression equation for regression, which constitutes the following regression equation:

$$(1/T) \log(y_{i,t}/y_{i,t-T}) = a_0 - \left[(1 - e^{-\beta T}) / T \right] \cdot \log(y_{i,t-T}) + \alpha_1 TP_{i,t} + \mu_{i,t-T} \quad (24)$$

The results of the conditional convergence NLS for the regional economy are shown in Table 3. From the estimation results of the model, it is seen that the estimation of the conditional convergence equation after the inclusion of the transfer payment rate is not very satisfactory, and some of the estimation results are not illustrative in the statistical significance.

However, from the direction of the coefficients of the estimated parameters, similar to the role of the ratio of government expenditures to GDP, the transfer payment also did not have a fundamental impact on the convergence of the regional economy, and even made the individual regional economy from convergence to divergence. Combining the above empirical results, it can be judged that transfer payments, as an important means for the government to help the development of backward regions, have not achieved the purpose of promoting the coordinated development of regional economies.

Table 3. Regional economic conditions convergence NLS results

Model	Whole country	East	Middle	West
Intercept	0.000(0.053)	0.047**(1.798)	0.024(0.567)	0.037(0.995)
β	-0.084(-1.210)	-0.006* (-1.745)	0.007*(1.399)	-0.029 (-0.752)
TP	-0.009*(-2.045)	0.013(0.747)	-0.001** (-2.008)	0.027(0.513)
R^2	0.196	0.236	0.469	0.024
D.W. testing	2.735	2.087	1.897	1.757

3.4. Analysis of the Impact of Policies on the Convergence of Economic Growth in the Western Region

3.4.1. Description of data sources and processing. Collect the total value of GDP, the value of GDP per capita, the total investment in fixed assets, the total value of industrial output, the total value of industrial output of state-owned enterprises and their controlling enterprises, and the total amount of local fiscal expenditures of provinces and municipalities across the country at the current year's prices for the period 2011-2020. Total exports and imports of the country's provinces and municipalities in current year dollars, 2011-2020. Total population and per capita GDP index at the end of the year for all provinces and municipalities in the country, 2011-2020. Exchange rate of the United States dollar expressed in RMB, 2011-2020.

Since the implementation of the Western Development Policy, the State has continuously increased its investment in the western region. In May 2020, the Western Development Strategy formed a new pattern. By the end of 2020, various types of financial transfers had accumulated nearly 200 billion yuan. These inputs have strongly promoted the economic development of the western region. However, if the government invests too much, it will have a crowding out effect, crowding out private investment so that it is not conducive to the coordinated development of the economy. The key is that there should be a standard for the level of government expenditure, above or below which will reduce the growth rate of the economy. Here, this paper adopts the proportion of local fiscal expenditure of each province to the GDP of each region as the measure of this variable.

3.4.2. β -convergence analysis of panel data models. For β conditional convergence analysis, the same conditional convergence equation derived earlier is used. On the basis of the above model and considering the actual situation of the western development policy. This paper intends to establish a regression equation to analyze the important factors affecting the conditional convergence of economic growth in the western provinces and regions using the panel data from 2010 to 2020, and in this way to test the impact of the western development policy on economic growth in the western region.

The data from 2010 to 2015 were substituted into the conditional convergence regression equation to obtain the regression results. Table 4 shows the results of the econometric test of the convergence of inter-provincial economic growth in western China from 2010 to 2015, which includes the population growth rate, fixed capital investment rate, number of college students, industrialization

degree index, marketization degree index, openness index and government expenditure level index during the sample period.

After adding other variables, the coefficient of the variable GDP per capita is still negative and also significant. This indicates that during the period of 2010-2015, the economic growth of the western provinces shows obvious conditional convergence.

Specifically, Model I introduces three variables, human capital level, investment rate, and population growth rate, resulting in a good model fit. The per capita coefficient is significantly negative, which initially confirms the conditional convergence characteristics of economic growth in the western region, and the coefficient of the investment rate is also very significant, which indicates that the economic growth in the western region mainly relies on the fixed asset investment drive.

Model II and model III, although the coefficient of per capita GDP is very significant. But the explanation of the whole equation is not strong, the p-value is greater than 0.5, and the coefficients of several other variables introduced into the model are not significant, so these two models can be ignored.

The coefficients of the other four variables in Model IV, except for the level of human capital, are all significant at the level of. This indicates that the growth rate of per capita GDP in the western provinces not only remains negatively correlated with per capita GDP in the previous year. And both the increase in fixed asset investment and the acceleration of industrialization have positively contributed to the growth of the economy.

Table 4. The results of the convergence of economic growth in western China in 2015

Interpretation variable	I	II	III	IV	V
Per capita real GDP	-0.1563 (0.0321) [-5.01]**	-0.0437 (0.0221) [-3.07]*	-0.0755 (0.0336) [-5.12]**	-0.1521 (0.0556) [-4.98]	-0.1367 (0.0362) [-5.35]**
Human capital level	0.0135 (0.0109) [-0.78]	0.0089 (0.0075) [0.75]	-0.0052 (0.0153) [-0.39]	0.0093 (0.0067) [1.65]	-0.0057 (0.0146) [-0.42]
Human growth rate	-0.0786 (0.1524) [-0.79]	-0.1579 (0.1306) [-1.65]	-0.1236 (0.1514) [-0.76]		-0.628 (0.1116) [-0.55]
Investment rate	0.4254 (0.1375) [4.96]			0.5976 (0.1314) [5.67]**	0.6754 (0.1122) [7.64]**
Degree of industrialization		0.0587 (0.04662) [1.63]		0.0854 (0.0337) [3.56]*	0.0456 (0.0327) [1.41]
Market degree			-0.1567 (0.0583) [-1.89]		-0.1793 (0.0755) [-3.04]
Trade dependency		-0.0093 (0.0224) [-0.32]		-0.0965 (0.0331) [-2.98]**	0.0327 (0.0563) [-0.59]
Government expenditure level			-0.0699 (0.0896) [-0.81]		-0.3012 (0.1457) [-2.66]*
<i>Wald χ^2</i>	25.69	8.54	9.26	32.34	65.69
P value	0.003	0.1869	0.0758	0.0000	0.0000
Sample size	235	235	235	235	235

Using the data information for the period 2016-2020, the convergence of economic growth in the western region is analyzed and the following regression results are obtained. The results of the econometric test of the convergence of economic growth among the western provinces in 2016-2020 are shown in Table 5. Relative to 2010-2015, the convergence of economic growth in the western region no longer exists after 2016. And there is also a slight trend of divergence, which indicates that the western development policy has not promoted economic convergence among the provinces in the western region well.

Specifically, after regression result I introduces the three variables of human capital level, investment rate, and population growth rate, the coefficient of the human capital variable changes from non-significant to significant in the 2010-2015 time period. This indicates that after 2016, human capital began to play a positive role in driving economic growth. In Model II, only the variable of the degree of industrialization is significant, but the fit of the whole model is still high. Of the five variables introduced in Model III, only the coefficients of two indicators, real GDP per capita and the degree of marketization, are significant. Model IV in addition to per capita GDP in the other four variables, the level of human capital and investment rate of the two variables are still significant. Model V is to put all the variables into the model, but the effect is not good. In addition to the investment rate of a variable is significant, the other originally significant variables are no longer significant, and therefore no longer explain too much of this model.

Table 5. The economic growth of the western province of 2016-2020

Interpretation variable	I	II	III	IV	V
Per capita real GDP	0.0076 (0.0135) [0.62]	0.0351 (0.0164) [1.73]	0.0317 (0.0124) [2.09]	0.0185 (0.0157) [1.49]	0.0089 (0.0175) [0.68]
Human capital level	0.0089 (0.0032) [4.58]**	0.0045 (0.0024) [1.55]	0.0012 (0.0019) [0.75]	0.0086 (0.0031) [3.59]**	0.0056 (0.0048) [1.35]
Human growth rate	0.1354 (0.1758) [0.89]	0.1029 (0.1967) [0.66]	0.1576 (0.1825) [0.88]		0.2176 (0.1598) [1.36]
Investment rate	0.1214 [0.0335] [4.57]**			0.1124 (0.0125) [4.47]*	0.1314 (0.0357) [4.31]**
Degree of industrialization		0.0359 (0.0187) [3.21]		0.0129 (0.0217) [0.77]	0.049 (0.0163) [0.35]
Market degree			-0.0725 (0.0336) [-2.39]**		-0.0054 (0.0316) [-0.21]
Trade dependency		-0.1263 (0.0751) [-2.03]		-0.0896 (0.0741) [-1.23]	-0.0896 (0.0658) [-1.39]
Government expenditure level			0.0329 (0.0185) [1.75]		-0.0585 (0.0337) [-1.66]
$Wald \chi^2$	48.96	27.65	17.27	55.06	49.61
P value	0.0001	0.0003	0.0051	0.0000	0.0000
Sample size	235	235	235	235	235

3.5. Convergence characteristics of high-quality regional economic development

3.5.1. High-quality development of the regional economy. It is concluded that high-quality economic development is mainly manifested in the steady growth of economic scale, reasonable distribution of economic structure and optimization of production efficiency, fully reflecting the requirements of the new development concept and meeting the growing needs of the people for a better life. Therefore, it is divided into four parts: economic scale (eg), economic structure (es), economic efficiency (ee) and economic benefits (eb) to construct a regional evaluation index system for the level of high-quality economic development. The indicator system for the level of high-quality economic development is shown below.

Economic scale (eg): value added of industry, total assets of industrial enterprises above large scale, gross regional product, GDP per capita, general public budget expenditure, consumer price index, fixed asset investment price index, industrial producer factory price index.

Economic structure (es): the proportion of added value of secondary/tertiary industries to regional GDP, the ratio of consumption levels of urban and rural residents, the consumption level of urban residents, the consumption level of rural residents, per capita disposable income of residents, the total amount of import and export of goods, and foreign exchange earnings from tourism.

Economic efficiency (ee): public transportation vehicles per 10,000 people, railroad mileage, highway mileage, total retail sales of consumer goods, the number of beds in medical and health institutions, the number of in-service employees of enterprises participating in pension insurance, the

area of green space in parks, the urban green coverage rate, and the emission of sulfur dioxide from exhaust gases.

Economic efficiency (eb): labor productivity, year-end urban registered unemployment rate, sewage treatment capacity, harmless treatment capacity of domestic garbage.

3.5.2. Analysis of α -convergence results. The coefficients of variation of the level of high-quality economic development of the whole country and the eight comprehensive economic zones are calculated according to the convergence formula, and the trends of the coefficients of variation are analyzed by using the H-P filtering method.

The coefficient of variation of the level of high-quality economic development of the whole country shows a fluctuating upward trend, with large fluctuations from 2008 to 2011. With the transformation and development of economic structure, the coefficient of variation tends to stabilize, but the end value of the period is higher than the beginning value, and there is no α convergence feature. The trend of coefficient of variation in the east coast, south coast, middle reaches of the Yellow River and the comprehensive economic zone of the Great Northwest is similar to the overall trend of the whole country, and the magnitude of change is similar. The coefficient of variation in the middle reaches of the Yangtze River fluctuates more. Overall, the end-period values of the coefficient of variation of the level of high-quality economic development of the eight comprehensive economic zones are all larger than the beginning-period values, and there is generally no α -convergence.

3.5.3. Absolute beta convergence analysis. In this paper, the Northeast, North Coast, East Coast, South Coast, Middle Yellow River, Middle Yangtze River, Great Southwest, and Great Northwest comprehensive economic zones are selected as samples, and the study interval is 2002-2020. The data in this paper are all from the China Statistical Yearbook of past years, the CEIC database and the China Marketization Index database.

The results of the absolute β convergence test for the level of high-quality economic development of the eight comprehensive economic zones are shown in Table 6, which shows that:

- 1) Absolute β convergence exists in both the whole country and the eight comprehensive economic zones, and the convergence coefficient is significantly negative at the 1% level. Indicates that without considering the impact of socio-technical factors on high-quality economic development, the country and the eight comprehensive economic zones of high-quality economic development in the convergence of the development of the situation, the lower level of high-quality economic development in the economic region of the high level of development of the region has a "catching-up effect".
- 2) The speed of convergence of high-quality economic development varies. The East Coast and Middle Yangtze River Economic Zones are higher than the overall convergence rate of the country, while the other six comprehensive economic zones are lower than the overall convergence rate of the country.
- 3) Both explanatory and interpreted variables have spatial lag effects. The level of high-quality development of the regional economy in the national, northeastern, northern coastal, middle reaches of the Yangtze River and the Great Northwest Comprehensive Economic Zone has a positive spatial spillover effect. Other comprehensive economic zones show negative spatial spillover effects.

Table 6. Test results of regional economic high quality development level

	<i>ed</i>	<i>w*ed</i>	ρ	Fixed effect	R^2	$v(\%)$
Whole country	-0.76*** (-4.56)	0.69*** (4.56)	0.52*** (13.07)	Individuals	0.26	7.89
Northeast	-0.69*** (-4.06)	0.51*** (2.35)	0.77*** (86.95)	individuals	0.08	5.21
Northern coast	-0.53*** (-3.29)	0.59*** (3.01)	0.63*** (7.01)	Individuals	0.03	4.69
Eastern coast	-0.91*** (-7.78)	-1.48*** (-6.25)	-1.35*** (-20.79)	Two-way	0.21	12.03
South coast	-0.56*** (-10.36)	-0.79*** (-12.53)	-0.76*** (-5.26)	Two-way	0.15	4.65
Yellow River swim	-0.32*** (-3.09)	-0.59*** (-3.58)	-1.29*** (13.96)	Two-way	0.23	2.23
Yangtze river	-0.95*** (-20.34)	0.47*** (7.01)	0.22*** (16.11)	Individuals	0.38	14.57
Southwest	-0.42*** (-2.96)	-0.96*** (-2.04)	-1.96*** (-7.89)	Two-way	0.09	2.39
Northwest	-0.09*** (-5.65)	0.012*** (6.33)	0.49*** (14.65)	Individuals	0.01	0.64

4. Adaptation of policies for quality development of regional economies

In the context of high-quality development, regional economic policy is based on changes in the regional economic landscape in the new era, with the overall regional economic development strategy as its outline, and with the goal of promoting the up-to-date and synergistic improvement of regional innovation systems, public service systems and linkage and opening-up mechanisms, and with the direction of promoting coordinated quantitative and qualitative growth of regional economies and realizing the relatively high-quality development of regional economies.

Regional economic policy is a series of regulations and measures formulated to promote the coordinated development of regional economy under the guidance of national regional economic development strategy. It is a basic tool to promote the differentiated and individualized economic development of each region, improve the quality of regional economic growth, and achieve relatively balanced regional economic growth.

The evolution path of regional economic policymaking is along the regional economic development strategy in different periods, based on the policymaking direction of “low-level balanced development of the region - unbalanced development - high-quality balanced development”.

Currently, we are in the critical stage of old and new kinetic energy transformation under the superposition of the deep-water period of supply-side structural reform and the strategic opportunity period of the “14th Five-Year Plan”. The formulation of regional economic development policies should adhere to the people-centered problem orientation and the “Four Comprehensives” as the overall strategic guideline. Taking the new development concept as the theoretical basis and the new kinetic energy and technology of the new economy as the endogenous driving force, the economic quality of regional development in the dimensions of innovation, openness and greenness should be improved. Eliminate inter-regional and intra-regional institutional barriers, and establish a linked and integrated gradient innovation mechanism, an inclusive and equalized digital public service system, and a joint ecological synergistic protection mechanism. Better adapt to and promote the formation of regional economic patterns in the new era, realize the sharing of inter- and intra-regional development results, and achieve the policy effect of coordinated economic development.

5. Conclusion

This paper introduces the theory of economic growth convergence and uses α convergence and β convergence to establish an empirical analysis model of fiscal policy on regional economic development. By taking fiscal expenditure and transfer payments as conditional convergence variables, the conditional convergence test of regional economy is carried out for the overall, east, center and west respectively.

1) The results of the regression of absolute convergence of the regional economy from 2010 to 2020 show that the value of the coefficient β of absolute convergence of inter-provincial economic growth is -0.052 within the sample interval, which is statistically significant. This indicates that overall regional economic growth does not exhibit an absolutely convergent nature. From the national situation, the addition of the fiscal expenditure variable improves the overall goodness of fit of the model, and the value of equation R^2 rises from 0.317 to 0.577. However, the value of the convergence coefficient β decreases, which indicates that the fiscal expenditure not only does not contribute to the reduction of the regional economic disparity, but also plays a negative role in accelerating the dispersion of the regional economy. At the same time the role of transfer payments in regional economic development is not obvious.

2) Taking the western region as an example, the panel data analysis for the period of 2010-2015 and 2016-2020 obtains that relative to 2010-2015, the convergence of economic growth in the western region no longer exists after 2016. And there is also a trend of slight dispersion, which indicates that the fiscal policy in the western development has a limited effect on the economic development among the provinces in the western region, and has not effectively promoted the economic convergence among the regional provinces.

3) Clarify the elements and indicators of high-quality development of the regional economy, the whole country and the eight comprehensive economic zones have absolute β convergence, and the convergence coefficient is significantly negative at the level of 1%.

To summarize, we clarify the reality of high-quality development of regional economy, and formulate the relevant strategies of high-quality development of regional economy and fiscal policy control from the route of "low-level balanced development of the region - uneven development - high-quality balanced development".

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