STUDY ON THE RELATIONSHIP BETWEEN SECONDARY EDUCATION AND REGIONAL ECONOMY IN INNER MONGOLIA AUTONOMOUS REGION, CHINA

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Abstract: *Secondary education and regional economic development have a logical relationship of theme interaction and element coupling, which is the basis of constructing the contemporary basic education system. By constructing the comprehensive system of secondary education and regional economy evaluation index, the coupling coordination model, decoupling model and barrier factor diagnosis model are comprehensively used to study the interactive coupling relationship between secondary education and regional economy in Inner Mongolia Autonomous Region.*

The results show that: (1)The degree of coupling has been in the high-quality coupling stage since 2005, and the degree of coupling coordination indicates a consistent climbing trend, with high-quality coordination being attained in 2017. (2) The decoupling relationship is principally of the expansionary negative decoupling type, and the distribution of weak and strong decoupling is alternate, which exemplifies the emergence of synergistic interactions between secondary education and the regional economy. (3) The subsystem and index barrier factor scores both demonstrated a decreasing tendency over time. In recent years, the size of the school has served as a barrier subsystem, with enrollment, student enrollment, graduation rates and the proportion of secondary industry serving as the primary barriers.

Key words: *Secondary education; Regional economy; Coupling coordination; Degree; Inner Mongolia*

INTRODUCTION

The frontier and central problem of theoretical economics is the connection between education and the economy. The key responsibility and goal of secondary education is to promote exceptional future students for higher education. It is a crucial human resource guarantee for regional economic development as well as a vital basic education front for the comprehensive implementation of the strategy of reviving the region through science and education, supporting the nation through talent, and fostering innovation.

Optimum resource configuration for secondary school basic education, establishment of high school education and regional economic coordinated development of the benign interactive coupling mechanism, scientific regulation, and promotion of secondary school basic education are some of the objective, comprehensive mental differences between high school education and regional economic development. The minority regions of western and central China include Inner Mongolia. It is unclear how the local economy is doing overall. In particular, the friction between basic education and the regional economy is obvious.

The success of promoting the high-quality development of secondary education in Inner Mongolia, strengthening the capacity of high-tech and high-quality professionals, and recognizing the comprehensive promotion of regional economic competitiveness and the soft power of regional economic development all depend on the speedy coupled and coordinated high-quality development of secondary education and regional economy.

LITERATURE REVIEW

The American scholarly Schultz's human capital theory is recognized as the most traditional approach to inspecting how schooling contributes to economic growth in studies conducted abroad on the relationship between education and economy [1-2]. From historical statistical analysis, Dennison (1960) measured different growth-related parameters [3]. Numerous researchers, including Jorgenson, Fraumeni (1992) [4], Mankiw, Romer, Weil (1992) [5], Krueger (1998) [6], Hall,

Jones (1999) [7], and others, have done quantitative analyses of human capital in relation to economic development. Li Yining, a Chinese academic, wrote The Economics of Education, which is a great resource for learning about how education and the economy interact in China. After that, He Dan (2017) [8], Chi Jingming (2019), Hao Qian (2021), and Peng Shaolong (2021) [11] explored the internal logical connection between higher education and the local economy. Countless empirical research on the connection between vocational education and economy has been initiated by scholars such as Liu Wenjun (2007) [12], Li Changhui et al. (2008) [13], Zhou Hong (2012) [14], Wang Yi (2018) [15], Qi Zhanyong (2021) [16], and Cai Wenbo (2021] [17]. The results indicate a strong association between vocational education and regional economic growth.

Macroeducation, higher education, and secondary vocational education receive more attention from local and foreign scholars in quantitative studies on the relationship between education and economy, while secondary education receives comparatively little attention. The limited research on the connection between secondary education and the local economy focuses largely on countermeasure analysis and is insufficiently in-depth in terms of the investigation of its primary influencing elements.

Successfully promoting the high quality running of secondary education in Inner Mongolia Autonomous Region and training more top-notch high-tech and high-quality professionals for regional economic development are crucial for understanding the interactive development and evolution process of secondary education and regional economy in Inner Mongolia and recognizing the main obstacle influencing factors affecting the coupling and coordinated development of the two. It is a crucial research issue that needs to be settled swiftly in order to recognize the comprehensive promotion of regional high-level human resource reserves and regional economic development soft power, and to promote new urbanization construction in the new development period of Inner Mongolia.

MATERIALS AND METHODS

The secondary education and regional economic system complete evaluation index system is constructed based on the findings of the prior study and in accordance with the criteria of regional, scientific, and data availability. The secondary education system consists of 11 indicators, three subsystems, including education scale, education teachers, and education funding (Table 1). The regional economic system consists of 5 sub-systems, comprising 13 indicators and the economic aggregate, structure, level, trade, and effectiveness sub-systems (Table 2).

Table 1. The evaluation index system of secondary education subsystem

System layer	Subsystem layer	Weight	Index layer	Units	Attribute	Weight
Secondary education subsystem	Education scale	0.3396	Number of regular secondary education	Quantity	+	0.3551
			Number of graduates	Persons	+	0.2093
			Enrolment	Persons	+	0.2035
			Student Enrollment	Persons	+	0.2322
	Education teachers	0.2046	Number of faculty	Persons	+	0.2215
			Full-time teachers	Persons	+	0.1724
			Student teacher ratio	%	+	0.6061
	Education funding	0.4558	State financial education funds	10,000 Yuan	+	0.2412
			Fiscal expenditure on education	Yuan	+	0.2286
			Average education expenditure （Local General Secondary school）	Yuan	+	0.2529
			Average education expenditure （Local regular high school）	Yuan	+	0.2773

Table 2. The evaluation index system of regional economic subsystem

System layer	Subsystem layer	Weight	Index layer	Units	Attribute	Weight
Regional economic system	Economic aggregate	0.2786	GDP	10,000 Yuan	+	0.3315
			Gross product of the secondary industry	10,000 Yuan	+	0.3292
			Gross product of the tertiary industry	10,000 Yuan	+	0.3393
	Economic structure	0.0421	Proportion of the secondary industry	%	+	0.4843
			Proportion of the tertiary industry	%	+	0.5157
	Economic level	0.2869	per capita gross national product	10,000 Yuan	+	0.3241
			urban per capita disposable income	10,000 Yuan	+	0.3413
			Average salary of urban workers	10,000 Yuan	+	0.3345
	Economic and trade	0.2338	total retail sales of consumer goods	10,000 Yuan	+	0.5917
			Total import and export trade	10,000 Yuan	+	0.4083
	Economic effectiveness	0.1587	Local budgetary revenue	10,000 Yuan	+	0.5745
			Engel coefficient of urban residents	%	-	0.2349
			urban registered unemployment rate	%	-	0.1905

Data source

This survey uses the Inner Mongolia Autonomous Region as its primary research area, and it pulls its data from the Inner Mongolia Statistical Yearbook, the China Education Statistical Yearbook, and the China Education Funding Statistical

Yearbook from 2001 to 2021. These sources can sufficiently secure the authenticity, authority and reliability of the original data.

Research method

The comprehensive evaluation approach can be used to compute the regional economic development index and the secondary education development index.

$$U(x)=\sum_{i=1}^{n} w_i x_{ij} \cdot E(y)=\sum_{i=1}^{m} w_i y_{ij}$$

$U(x)$ and $E(y)$ respectively represent the comprehensive development index of secondary education and regional economy, x_{ij} and y_{ij} are the standardized values of indicators, and w_i is the index weight computed by the entropy weight method.

Coupling degree is the degree of interaction and mutual influence between systems. By applying coupling theory in physics to the two systems of secondary education and regional economy, the coupling degree of the system can be obtained as follows:

$$C=\sqrt{\frac{U(X)\cdot E(y)}{\left(\frac{U(X)+E(y)}{2}\right)^2}}$$

The greater the value of the coupling degree C, the closer the connection between the systems is, otherwise, the looser the connection between the systems is.

The pairing coordination degree model is presented [18] in order to precisely calculate the degree of development of synergistic connection between the two systems of secondary education and regional economy:

$$T=\alpha U(x)+\beta E(y);\ D=\sqrt{C\times T}$$

Where D is the degree of coupling coordination; T is the comprehensive system development index; α and β respectively represent undetermined coefficients, and $\alpha+\beta = 1$. This paper believes that secondary education in the complex system is as important as regional economy, so $\alpha = \beta = 0.5$.

To more adequately capture the dynamic evolution process of the two, the Tapio decoupling elasticity coefficient formula [19] is used to assess the link between secondary education and regional economic system.

$$DI_t = \frac{(E_t - E_{t-1})/E_{t-1}}{(U_t - U_{t-1})/U_{t-1}}$$

Where: DI_t represents the decoupling degree of regional economy to the development of secondary education in period **t**; E_t and E_{t-1} represent the regional economic composite index of year ***t*** and year ***t-1*** respectively. U_t and U_{t-1} represent the comprehensive index of secondary education in year ***t*** and year ***t-1***, respectively. $\triangle E = (E_t — E_{t-1})/ E_{t-1}$, represents the change rate of the regional economic composite index in year ***t***; $\triangle U = (U_t — U_{t-1})/U_{t-1}$ indicates the change rate of the composite index of secondary education in year ***t***.

The primary influencing variables that affect the coordinated development of secondary education and regional economic system are objectively analyzed and recognized using the obstacle factor diagnosis model, and the calculation method is as follows:

$$O_j = \frac{I_j \times \omega_j}{\sum_{j=1}^{m} I_j \times \omega_j}$$

Where: ω_j is the weight of the JTH index; I_j is the difference between the optimal target value and the actual value of each index, which can be expressed as $1 — r_{ij}$ (the difference between the normalized value of each index and 1).

RESULTS AND ANALYSIS

Time series analysis of the degree of coupling between secondary education and the regional economy

The regional economic system and secondary education system of Inner Mongolia exhibited a consistent and sustained growth trend from 2000 to 2020, achieving a maximum value of 0.8163 in 2020, which still has a significant difference with the degree of coupling and degree of coupling coordination. The high-level coupling stage widened between 2000 and 2005, although the degree of coupling of the high-quality coupling stage lingered for a considerable time after that. The local economic system and the secondary education system are continually involved in a

process of mutual integration, promotion, coordination, and synchronous development evolution, according to the average coupling degree of 21a, which was 0.9324 and depicted the characteristics of high quality coupling. The regional economic system and the secondary education system are recognized to have reached a high quality coupling level in their cooperative interaction.

The coupled coordination curve exhibited an upward trend from 0.1411 in 2000 to 0.9748 in 2020, with an increase value of 0.8337 and an average annual growth of 3.97%. The coupling coordination degree during the preceding 21a was on average 0.6332, and the coordination type exhibited signs of reduced coordination. Pairing coordination experience from 2000 to 2020: Since 2017, the stages of high-quality coordination (2017–2020), moderate coordination (2011–2016), satisfactory coordination (2011–2016), and extreme imbalance have all been finished (2000-2002). The full index of secondary school education and regional economic system during the preceding 21 years also serves as an illustration of the evolution of advanced secondary education (2000-2010) and advanced regional economy (2011-2020).

Analysis of the degree of decoupling between secondary education and regional economy

The Inner Mongolia autonomous region's secondary enrollment and regional economic decoupling degree are essentially expansionary negative decoupling, strong decoupling, weak decoupling, expansionary connection, strong negative decoupling, and other five types of decoupling states. These states are characterized by recurrent interactions between secondary enrollment and the adaptive adjustment process of the regional economic system. Strong and weak decoupling were the second types of decoupling states, and the average decoupling index over the previous 21 years was 1.1443, implying a dilated negative decoupling link. The following portrays the decoupling evolution process: The expansionist and negative decoupling states of 2000–2006, 2007–2012, and 2015–2017 demonstrate that secondary education exhibits positive growth characteristics and that the capacity for regional economic

development is still robust. Although the two are evolving in tandem and in concert, the growth potential of secondary education is greater than that of the local economy.

The growth amplitude is essentially the same, which is represented in the evolution of collaborative growth, throughout the period of 2012–2013, which implies the synchronous growth of secondary education and regional economy. Weak decoupling was seen in the years 2014 to 2015 and 2018 to 2019. The regional economy and secondary enrollment both experienced rapid growth, but the growth rate disclosed that the regional economy was less robust than the secondary enrollment. From 2006 to 2007, 2013 to 2013 and 2017 to 2018, there was a substantial decoupling between regional economic growth and a decrease in secondary education. Due to the effects of COVID-19, there was a substantial negative decoupling from 2019 to 2020, with secondary education and the local economy showing a sharp decline.

Diagnosis of secondary education and regional economic barriers

The key barriers subsystems and variables indicate stage differences, and the barriers of each subsystem to the coordinated growth of secondary education and regional economy in Inner Mongolia frequently exhibit a tendency of fluctuation and reduction.

1) The secondary education in the Inner Mongolia Autonomous Region had rapid growth from 2000 to 2010, which was the time of highest enrollment, graduation, and student numbers. Economic growth in the region lags far behind progress in secondary education. Due to the steady expansion of the economy in the area, the distance between the two has shrunk year by year. At this time, the main barrier subsystems affecting the coupling coordination degree of the system were academic professors and educational benefits. The key challenges were the student to teacher ratio, spending on financial education, and local fiscal budget revenue.

2) Between 2011 and 2020, there was a solid trend of continuous growth in the transformation and upgrading of regional economic structure, and the regional economic development elevated the investment of secondary education funds year by

year. At the time, economic structure reform was in an essential stage of iterative improvement, and the scale problem with education became the main barrier subsystem. This dilemma is particularly prevalent in the secondary education system. The key challenges are secondary enrollment, student and graduate numbers, the proportion of secondary and tertiary industry, and the unemployment rate in metropolitan areas.

CONCLUSIONS

This research establishes a detailed evaluation index system for the composite system of secondary education and regional economy on the basis of collaborative development. The comprehensive system development level, coupling coordination evolution process, and decoupling degree of the Inner Mongolia Autonomous Region are explored from 2000 to 2020 utilizing the entropy weight method, coupling coordination degree, decoupling model, obstacle factor diagnosis, and other models. The main challenges to the coordinated development of the two entities are thoroughly assessed. The following are the main conclusions:

1) When viewed from the perspective of coupling degree and coupling coordination degree, secondary school education and regional economy show a gradual evolutionary development trend from low level to high level, gaining high quality coupling in 2005 and high quality coordination in 2017. The two have grown more interacting and synergistic;

2) Secondary school education and regional economy exhibit a complex evolution trajectory from expansionary negative decoupling, strong decoupling, expansionary connection, strong decoupling, weak decoupling, expansionary negative decoupling, strong negative decoupling, and strong negative decoupling when viewed from the perspective of the correlation and change trend between secondary school education and regional economy. It exhibits the complex, interactive and dynamic evolution traits of regional economic influence on secondary school education.

3) From the perspective of the principal barrier factors, the subsystem and index barrier factors' scores displayed a deterioration trend over time, and the educational scale and economic structure progressively replaced academic teachers and educational benefits as the barrier subsystem. The number of enrollments, students enrolled in school, graduates, the proportion of secondary industry, the proportion of tertiary industry, and the urban registered unemployment rate have been the main barriers in the last ten years.

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