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Research on the influencing factors of inter-provincial differences in educational expenditure per student in secondary vocational education based on fsQCA method

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Abstract: This study focuses on 31 provinces in China, examining five critical indicators: regional economic development levels, industrial structure, local fiscal capacity, governmental willingness to invest, and the number of full-time teachers. Utilizing fuzzy set qualitative comparative analysis (fsQCA), the research meticulously explores the inter-provincial disparities in per-student expenditure for secondary vocational education and the underlying mechanisms at play. The findings reveal that per-student expenditures exhibit one high-expenditure pattern and two low-expenditure configurational pathways across different regions. By comparing the relationships between these high and low configurations, it becomes evident that, under certain conditions, regional economic development levels, industrial structure, governmental willingness to invest, and the number of full-time teachers are pivotal determinants influencing the funding allocations for secondary vocational education.

1. Introduction

Vocational secondary education plays a crucial role in China's educational system, supplying the nation with a large number of skilled and professionally competent talents to meet the labor demands of various industries within the national economy. Adequate financial support is vital for these schools to provide competitive human resources and adapt to the needs of national economic development. It is essential for improving school conditions and promoting high-quality development. Therefore, enhancing the basic educational facilities of vocational secondary institutions and accelerating their development are critical tasks in the current progress of education in China. However, due to significant disparities in economic development levels across regions, this has directly led to uneven development of vocational secondary education in different areas, causing some regions' vocational education not to fully align with the pace of socio-economic development. In 2015, the Ministry of Finance, along with two other departments, issued the "Guiding Opinions on Establishing and Improving the Per-student Funding System for Vocational Secondary Schools" (Caijiao [2015] No. 448), setting a goal that "by the end of 2016, all regions should establish and improve the per-student funding system for vocational secondary schools."

Particularly in central and western regions, one of the main challenges faced by vocational secondary education is the significant disparity in educational funding input between provinces and regions[1]. Academia has examined factors influencing regional differences in vocational secondary education funding from multiple perspectives, including elements affecting fund expenditures. However, existing research tends to analyze the impact of single or a few factors on the per-student cost differences in vocational education in parallel, with less emphasis on studies that consider the interplay among multiple variables. To better understand this issue, there is a need for more research based on comprehensive analysis involving multiple factors, to more thoroughly interpret the phenomenon of unequal distribution of vocational secondary education funding and its underlying causes.

2. Literature review and question raising

Research on the disparities in per-student expenditure for secondary vocational education has been approached from two primary dimensions by existing literature.

Initially, regarding the analysis of financial discrepancies within secondary vocational education, scholars have illuminated this issue from various perspectives. Zhao Yonghui and Gao Jinling, through statistical studies, discovered that the per-student expenditure on secondary vocational education in China is markedly lower than that of regular high schools[2]. Chen Xiangyang, based on panel data from Jiangsu Province between 2008-2012, indicated significant variations in per-student educational funding among different regions within the province[3]. Li Xiangyun et al., analyzing data from 31 provinces (autonomous regions, municipalities) across the nation from 2002-2011, found that the per-student expenditure on vocational education exhibits provincial disparities with a trend resembling an inverted “U” shape, wherein the concentration effect serves as the principal driving force, particularly highlighting the pronounced internal differences in eastern regions[4]. Further research by Gu Cuifeng et al. demonstrated that during 2008-2012, there was a substantial increase in per-student expenditure on secondary vocational education in western regions, resulting in a slight reduction in regional disparities; nonetheless, the gap between eastern and western areas remains conspicuous[5]. Shen Youlu's study revealed that from 2007-2016, funding for secondary vocational education consistently lagged behind that of regular high schools, exhibiting a phenomenon known as the "central collapse," while the investment levels in Beijing, Tianjin, and Shanghai far exceeded those of other regions[6]. Cai Wenbo and Zhai Liuxi's research underscored that operational and infrastructural per-student educational expenditures significantly positively influence the overall funding for secondary vocational education, although the correlation between regional economic development levels and funding inputs is relatively weak[7][8].Chen Fu and Zhang Keke’s findings indicate an expanding disparity in secondary vocational education funding among provinces, characterized by an unbalanced provincial distribution. Additionally[9], Cai Wenbo and Liu Shuang, utilizing panel data analysis from 2008-2017, discovered that the elasticity of per-student educational expenditure in eastern regions is notably higher compared to central and western regions[10]. Moreover, Liu Chao’s study highlights that the most significant variations in per-student educational expenditure are observed among the provinces within the eastern region itself[11].

In the study of disparities in funding for secondary vocational education, scholars have explored its influencing factors from multiple perspectives. Ran Yunfang[12], Zhang Wenjing,[13] Wu Meihong[14], and others, through the analysis of panel data, have revealed the correlations between local fiscal capacity, industrial structure, the scale of secondary vocational students, the number of full-time teachers, and per-student budgetary expenditure. Cai Wenbo and Tang Fengqiong, based on secondary vocational education funding data from five northwestern provinces between 2004

and 2014, identified that per-student personnel and operational expenditures are the pivotal factors affecting funding in this region, whereas per-student infrastructure expenditure has a relatively minor impact[15]. Furthermore, Li Xinyi[16] and Cai Wenbo[17] delved into the relationship between regional economic development levels and disparities in per-student expenditure for secondary vocational education.Wang Ben and Yan Yanyang employed a panel fixed-effects model to ascertain that economic indicators such as per capita GDP and the proportion of fiscal educational expenditure to GDP exert the most significant influence on per-student expenditure[18]. Xu Ling and Li Jiaxin's research highlighted that the scale of enrolled students, industrial structure, local fiscal capacity, and the level of economic development are critical determinants contributing to inter-provincial discrepancies[19]. Yang Guangyu and Yu Xuan also posited that industrial structure, economic development levels, governmental willingness to invest, and fiscal capacity are crucial factors leading to regional imbalances in financial inputs for secondary vocational education[20].

In summary, existing studies have multi-dimensionally confirmed the significant disparities in per-student funding for secondary vocational education across various provinces in China, and have conducted empirical analyses on multiple factors contributing to these discrepancies. These studies have laid a theoretical foundation for further exploration of the inter-provincial trends in per-student expenditure for secondary vocational education and the contributions of various influencing factors. However, current literature predominantly focuses on the impact of single or a few layers of factors on inter-provincial differences, whereas, in reality, the operation of per-student funding for secondary vocational education is often influenced by a confluence of economic, social, and policy-related factors, which interact in complex ways through different combinations.A review of the extant literature reveals that factors such as regional economic development levels, industrial structure, local fiscal capacity, governmental willingness to invest, and the number of full-time teachers are frequently cited and significantly influence per-student expenditure for secondary vocational education. Building upon this, the present study aims to examine all 31 provinces as its subjects. Utilizing fuzzy set qualitative comparative analysis, this research endeavors to delve into the multifaceted concurrent effects and intricate causal mechanisms of different influencing factors and their combinations on inter-provincial disparities in per-student expenditure for secondary vocational education. It is hoped that this approach will provide valuable insights for the sustainable development of secondary vocational education in the future.

3. Research Methods

3.1 QCA Method

QCA (Qualitative Comparative Analysis) is a method used in social science research that aims to reveal different combinations of factors that lead to a particular outcome by systematically comparing qualitative data from a relatively small sample. This method combines the depth of qualitative research with the systematicness of quantitative research, and is suitable for those social phenomena with complex correlations and diversity. The advantage of QCA is that it can cope with the complexity of relatively small samples, allowing researchers to conduct in-depth qualitative analysis in relatively small-scale studies. It is especially suitable for those situations that cannot be modeled by traditional statistical methods, such as multi-factor and highly interactive problems.

QCA is usually divided into clear set qualitative comparative analysis (csQCA), multivariate set qualitative comparative analysis (mvQCA) and fuzzy set qualitative comparative analysis (fsQCA). fsQCA is often used to deal with the problem of relatively flexible and broad definition of conditions to more comprehensively understand the relationship between conditions. Compared with csQCA and mvQCA, the processing results of fsQCA have more explanatory effectiveness[21]. Therefore, fsQCA is used in this paper.

3.2 Data Source

This study will use panel data from 31 provinces in China in 2021 as observation samples. The data sources include the “Statistical Announcement on the Implementation of National Education Funding”and “the “Statistical Yearbook of China's Education Funding” released in 2022,“China Statistical Yearbook”and“China Financial Yearbook”.

4. Variable selection and data calibration

4.1 Variable selection

4.1.1 Outcome Variables

Business expenses per student budget refer to the education expenses calculated and allocated according to the number of each student within the budget. The per student education expense can reflect the educational resources obtained by students in a regional unit, and is an important indicator to measure the investment in education funds[22]. This indicator can help monitor and improve the resource allocation strategies of educational institutions to ensure that resources are allocated fairly and reasonably to each student. The result variable selected in this paper is the average student education expenditure (general public budget expenditure per student EXP). This study selects the average student budget expenditure (hereinafter referred to as “average student education expenditure”) of secondary vocational education in each province.

4.1.2 Conditional variables

(1) Level of regional economic development. The level of regional economic development can reflect the level of investment in education in a region. A better level of economic development usually means the construction and improvement of more educational infrastructure. There are differences in secondary vocational education funding among different provinces, mainly due to the differences in economic development levels among regions[23]. In this study, per capita GDP is selected as the key indicator to measure the regional economic development level (PGDP).

(2) Industrial structure. The economic and industrial structure of different regions determines that the demand for skilled labor is different in four degrees, and the difference of labor demand structure will directly affect the demand scale of the whole society for education, and then affect the willingness of the government and residents to invest in education[19]. In this study, the proportion of tertiary industry output value to GDP is selected as the industrial structure (TIS).

(3) Local government financial capacity. Local governments have strong financial ability and can usually provide more education funds for the construction and improvement of educational facilities, the increase of teachers' salary, the procurement and update of educational resources, etc. This helps to improve educational facilities and resources and provide better educational conditions and quality. There are great differences in the efforts of local financial capacity to secondary vocational education, which leads to the imbalance of financial input of secondary vocational education in different regions in China. In this study, per capita fiscal revenue is selected as an index to measure local fiscal capacity (LFC).

(4) The government's willingness to invest in secondary vocational education. The government's willingness to invest in education (GEI) is measured by the proportion of education fiscal expenditure to total fiscal expenditure[24].

(5) Number of full-time teachers. The number of full-time teachers is an important index of the input of educational resources. A higher number of full-time teachers usually means that the region has invested more in educational resources and can provide better educational services and teachers.

The number of full-time teachers has a significant positive impact on the average education expenditure of secondary vocational education students[14]. In this study, the number of full-time teachers (TCH) is selected as the measurement index.

4.1.3 Calibration

In fsQCA (Fuzzy-set Qualitative Comparative Analysis), “calibration” refers to converting the original data into the membership value of the fuzzy set to describe each condition and outcome variable. The degree of fuzziness or satisfaction. During the calibration process, the variable values in the original data are mapped to a continuous range between 0 and 1, where 0 means that a certain condition or result is not satisfied at all, and 1 means that it is completely satisfied. The purpose of calibration is to model and analyze fuzzy phenomena, taking into account the ambiguity and diversity of variables in the real world. In this study, three critical values were set among the overall data, namely 95% quantile, 50% quantile and 5% quantile, which represented complete membership, cross point and complete non-membership respectively. This helps ensure that the collection has a membership degree between 0 and 1 after calibration. The calibration results are shown in Table 1.

Table 1 Indicator description and calibration of each variable

Variable category	Variable name	Full affiliation (95%)	Intersections (50%)	Not affiliated at all (5%)
Outcome Variables	Education expenditure per student	40678.75	16482.14	9409.13
Conditional variables	Regional Economic Development Level (PGDP)	155334.5	65026	48236
	Industrial Structure (TIS)	67.4	51.3	45.15
	Local Government Fiscal Capacity (LFC)	21308	6251	4073
	Government willingness to invest in secondary vocational education (GEI)	19.755	15.91	11.165
	Number of Full-time Teachers (TCH)	52589	18693	3000.5

5. Analysis of study results

The consistency threshold is set to 0.8. At the same time, referring to the suggestions of Du Yunzhou et al., the threshold of PRI consistency (proportional reduction in inconsistency) is set to 0.70, and the case threshold is set to 1[21].

5.1 Necessity Analysis of Single Condition

Before fsQCA analysis, each individual condition variable must be analyzed for necessity to verify whether it constitutes a necessary condition for the outcome variable. Consistency is a key indicator to evaluate the necessity of a variable. If the consistency of a conditional variable exceeds 0.9, it means that the conditional variable is the necessity condition that causes the outcome variable, and the variable needs to be eliminated in subsequent analysis. It can be seen from Table 2 that the consistency of all conditional variables affecting the average student's education expenditure is less than 0.9, indicating that none of the five conditional variables analyzed constitutes the necessary conditions for the average student's education expenditure and the average student's education expenditure, which further confirms that the average student's education expenditure is not affected

by a single factor, but the result of the coupling and linkage of multiple factors.

Table 2 Necessity analysis of conditional variables

Variable name	Education expenditure per high school student		Education expenditure per non-high school student	
	Consensus rate	Coverage rate	Consensus rate	Coverage rate
High regional economic level	0.760	0.727	0.591	0.666
Low regional economic level	0.650	0.575	0.758	0.788
High proportion of tertiary industry	0.741	0.743	0.580	0.684
Low proportion of tertiary industry	0.685	0.581	0.782	0.780
High local financial capacity	0.793	0.815	0.548	0.663
Low local financial capacity	0.672	0.558	0.847	0.828
High government's willingness to invest in secondary vocational education	0.610	0.573	0.678	0.750
Low government's willingness to invest in secondary vocational education	0.734	0.660	0.615	0.649
High number of full-time teachers	0.562	0.535	0.720	0.806
Low number of full-time teachers	0.796	0.708	0.585	0.611

5.2 Configuration analysis

In the qualitative comparative analysis of fuzzy sets, three types of solutions can be obtained, including complex solutions, parsimonious solutions and intermediate solutions. Among them, a key advantage of the intermediate solution is that it does not allow the elimination of necessary conditions. Generally speaking, the intermediate solution shows superior performance over the two other solutions. The core condition and edge condition of the configuration are divided according to the parsimonious solution and the intermediate solution: if a prerequisite exists in both the parsimonious solution and the intermediate solution, 6 then it is regarded as the core condition because it has an important influence on the result; If this condition only appears in the intermediate solution, then it is regarded as a marginal condition because it plays a certain contribution to the auxiliary[21].

Through counterfactual analysis, the intermediate solution is obtained, that is, assuming that each conditional variable has a high level of per-student education expenditure, it can be concluded that there is one configuration path for high per-student education expenditure (see Table 3). The consistency rate of the results is 0.925, which shows that among all the cases that meet this configuration, 92.5% of the areas have higher average education expenditure per student. Results The coverage rate is 0.397, which shows that this configuration can explain 39.7% of the cases with high per student education expenditure.

At the same time, assuming that the absence of each conditional variable may lead to a low level of per-student education expenditure, there are five conditional configurations of low per-student education expenditure. These five configuration paths can explain 68.2% of the provinces and regions with low average education expenditure per student; Moreover, among all the cases that meet these five configurations, 92.8% of the districts have low per student education expenditure.

Table 3 Configuration of average education expenditure for high and low students

Conditional variables	Configuration of Average Education Expenditure for High School Students	Configuration of low-per-student education expenditure				
	H1	NH1	NH2	NH3	NH4	NH5
Regional Economic Level (RGDP)	•	•		⊗	⊗	•
Industrial Structure (TIS)	•	⊗	⊗	•	⊗	•
Local Fiscal Capacity (LFC)	•			⊗	•	•
Government willingness to invest in secondary vocational education (GEI)	⊗		•	•	•	•
Number of Full-time Teachers (TCH)	⊗	•	•			⊗
Original coverage	0.397	0.460	0.550	0.404	0.338	0.220
Unique coverage	0.397	0.071	0.076	0.010	0.020	0.007
Consensus rate	0.925	0.991	0.956	0.954	0.977	0.953
Coverage of solution	0.397			0.682		
Uniformity rate of solutions	0.925			0.928		

"•" Represents the existence of the core condition; "•" Represents the presence of edge conditions; "⊗" Representative Core Condition Missing; "⊗" Represents marginal condition absence; Blank indicates that the condition does not affect the results.

5.2.1 Configuration of generating high education expenditure per student

(1) H1: RGDP*TIS*LFC*~GEI*~TCH. This configuration shows that under the conditions of high regional economic development level, high industrial structure, low local financial capacity, low government willingness to invest and small number of full-time teachers, the probability of average education expenditure for high school students is high. Regional economic development level and industrial structure are the core existing variables in this configuration, local financial capacity is the marginal missing variable, and the government's willingness to invest and the number of full-time teachers are the core missing conditions. This configuration can explain 39.7% of the areas where the average education expenditure per student is high, and 39.7% of the areas can only be explained by this configuration. Beijing is a typical representative area of this configuration. As the region with the richest educational resources in China, all vocational schools in the field of secondary vocational education in Beijing are comprehensively promoting the comprehensive reform of "three-round education", and are committed to establishing a training system with full collaboration, full coverage and all-round penetration. Improve the management mechanism, innovate the work carrier, open up educational channels, implement the responsibility system,

strengthen the construction of class spirit, study style and school spirit, and effectively improve technical and technical talents. Since 2017, the average expenditure of secondary vocational education students in Beijing has increased year by year. The continuous growth of financial investment per student provides an important material guarantee for the high-quality development of secondary vocational education in Beijing.

5.2.2 Configuration of low-per-student education expenditure

(1) NH1: RGDP*~LFC*TCH. This configuration shows that under the condition of high regional economic development level, low local financial capacity and large number of full-time teachers, the probability of low-per-student education expenditure is high. The level of regional economic development and the number of full-time teachers are the core existing variables in this configuration, and the industrial structure is the core missing variable. At the same time, the local financial capacity and the government's willingness to invest in secondary vocational education have no impact on the results in this configuration. This configuration can explain 46% of the areas with low per student education expenditure, and 7.1% of the areas can only be explained by this configuration. Anhui Province is a typical representative area of this configuration.

(2) NH2: ~TIS*GEI*TCH. This configuration shows that when the industrial structure is low, the government's willingness to invest in secondary vocational education is high, and the number of full-time teachers is large, the probability of educational expenditure per student is high. The number of full-time teachers is the core existing variable in this configuration, and the industrial structure is the core missing variable. The government's willingness to invest in secondary vocational education is a marginal variable. This configuration can explain 55% of the areas with low average education expenditure per student, and 7.6% of the areas can only be explained by this configuration.

(3) NH3: ~RGDP*TIS*~LFC*GEI. This configuration shows that under the conditions of low regional economic development level, high industrial structure, low local financial capacity and high government willingness to invest in secondary vocational education, the probability of education expenditure per student is high. The government's willingness to invest in secondary vocational education is the core existing variable in this configuration, and the regional economic development level is the core missing variable. The industrial structure is marginal with variables. Local financial capacity is lacking marginal conditions. This configuration can explain 40.4% of the areas with low average education expenditure per student, and 1% of the areas can only be explained by this configuration. Sichuan is a typical representative area of this configuration.

(4) NH4: ~RGDP*~TIS*LFC*GEI. This configuration shows that under the circumstances of low regional economic development level, low industrial structure, high local financial capacity, and high government willingness to invest in secondary vocational education, the probability of low-per-student education expenditure is high, this configuration shows that under the circumstances of low regional economic development level, low industrial structure, high local financial capacity, and high government willingness to invest in secondary vocational education. The government's willingness to invest in secondary vocational education is the core existing variable in this configuration, and the regional economic development level is the core missing variable. Local financial capacity is a marginal variable. The industrial structure is lacking marginal conditions. This configuration can explain 22% of the areas with low average education expenditure of 8 per student, and 0.7% of the areas can only be explained by this configuration.

(5) NH5: RGDP*TIS*LFC*GEI*~TCH. This configuration shows that under the circumstances of high regional economic development level, high industrial structure, high local financial ability, high government willingness to invest in secondary vocational education, and small number of full-time teachers, the probability of low per student education expenditure is higher. Industrial structure

and the government's willingness to invest in secondary vocational education are the core existing variables in this configuration, while the regional economic development level and local financial capacity are the core missing variables. The number of full-time teachers is the core condition. This configuration can explain 33.8% of the areas with low average education expenditure per student, and 2% of the areas can only be explained by this configuration. Chongqing is a typical representative area of this configuration. In recent years, under the great attention and correct leadership of the municipal party committee and municipal government, vocational education in Chongqing has developed rapidly, and the reform of system and mechanism has achieved remarkable results. First, policy support is strong. Second, the scale of development continues to expand. Third, the connotation is constantly improving.

6. Conclusion and implications

Secondary vocational education plays an irreplaceable role in improving the quality of labor force, promoting economic development, personal career development and social diversity. It aims to provide students with practical vocational skills so that they can successfully enter specific industries or fields. This helps to reduce the gap between job seekers and the job market and improve employment opportunities. Students can choose their own career path according to their own interests and abilities, and achieve personal career development and achievements. It is necessary to take various measures to increase the investment of secondary vocational education in various regions of China and narrow the gap among different regions. Here are some suggestions:

6.1 Increase support for poverty-stricken areas

The government can support the development of secondary vocational education in poverty-stricken areas by increasing financial transfer payments and setting up special funds. At the same time, enterprises and social organizations are encouraged to donate or invest in secondary vocational schools in poverty-stricken areas, and provide more education financial support.

6.2 Strengthening regional cooperation and coordinated development

Strengthen exchanges and cooperation between secondary vocational schools in different regions, and promote resource sharing and complementary advantages. Through the establishment of regional vocational education alliances and other forms, we will jointly promote the development of secondary vocational education and reduce regional differences and imbalances.

6.3 Improve the efficiency and quality of running schools

Schools should pay attention to the reform of education and teaching, strengthen the construction of teachers, improve the teaching quality and efficiency, and enhance the attraction and competitiveness of schools.

6.4 Optimize resource allocation

When allocating funds for secondary vocational education, we should fully consider the actual situation and needs of different regions and schools, optimize the allocation of resources, and avoid waste and redundant construction.

In short, increasing the investment of secondary vocational education in various regions of China and narrowing the gap among different regions require the joint efforts of the government, society,

schools and other aspects. By strengthening the support for poor areas, strengthening regional cooperation and coordinated development, improving the efficiency and quality of running schools, establishing and perfecting the mechanism of fund use and management, and optimizing the allocation of resources, we can gradually raise the level of fund input of secondary vocational education in various regions of China and promote the healthy development of secondary vocational education.

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