Push Down the "Berlin Wall" in 2021

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Abstract: We analyze the various indicators of the German higher education system. We compute the total Gini coefficient of education in Germany in the past ten years and found that the fairness of the Germany higher education system needs to be improved. To explore the reasons for the lack of equity, we decompose the educational Gini coefficient and concluded that the cause is the uneven distribution of educational resources between East and West Germany.

Therefore, we focus our policy on balancing the educational resources of East and West Germany. We establish a resource transfer matrix to alleviate the uneven distribution of educational resources. Finally, we verify that the policies we proposed can improve the German education system well and have a profound impact on society and the country.

Keywords: Coupling model; The decomposition of the Gini coefficient ; Redistribute Education Resource Model

1 The vision of German education system

As we all know, Germany was able to rise from the ashes of World War II, and the German education system was indispensable. The German education system has continuously provided talents for the development of the German economy. Simultaneously, Germany's developed economy has also strongly promoted the development of the German education system.

2 The analysis of German education system

The main problem of the German education system is the imbalance distribution of educational resources between East and West Germany and the difference in education level of the citizens of East and West Germany due to the difference in economic development levels between East and West Germany. Just as the results in the previous part of the article, in terms of education equity, the performance of the German education system is not satisfactory. Since World War II, Germany has split into East and West Germany, leading to significant differences in the level of economic development, the quality of life of the people, the distribution of medical resources, and the education level of citizens in the eastern and western regions of Germany. The picture below can fully show that 30 years have passed since the reunification of the two Germanys, but the difference in economic development between two parts of Germany is still very apparent.

In addition, the refugee crisis in Germany in recent years has also caused some trouble to the German education system. The figure below shows that in this European refugee crisis, Germany was the first to bear the brunt and suffered the most.

2.1 Decomposing the Education Gini Index

Firstly, according to the Gini coefficient model of education in the previous article and the current situation of education system in Germany, we compute the Education Gini index of Germany as the following pictures.

It can be seen that the overall Gini coefficient of higher education in Germany has decreased over the years, which shows that the degree of equity in higher education has continued to improve, but there is still room for improvement.

Therefore, through the decomposition of the Gini coefficient of German higher education, we find that we should focus our policy on how to eliminate or reduce regional differences, that is, eliminate or reduce the differences in the degree of higher education received by East German citizens and West German citizens.

We could see the results of Education Gini index decomposition in the following pictures:

In those pictures above, the orange area represents the difference between groups. If the proportion of the orange area is larger, it means that under this classification method, the difference in the degree of higher education received by different groups is greater. Therefore, the orange area is the area we need to focus on. Obviously from the above pictures, we can get some information from the three pictures that gender differences, immigration background differences, and regional differences all exist, but compared to regional differences, gender differences and immigration background differences are very small, and gradually decrease over time.

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2.2 Coupling coordination degree model

Coupling degree is used to evaluate the degree of coordinated development among multiple system elements. If the two subsystems of higher education and economic development of a country are properly coordinated, it can promote a virtuous circle

of society, thereby enhancing the national competitiveness. In order to describe the "high-quality" economic development more accurately, this article uses the total factor productivity (TFP) of each country to show its economic development indicators. The data comes from the OECD database. The higher education level is expressed by the education score calculated by the inner and outer circle model in the previous part of this article.

We will show our steps of Coupling coordination degree model in the following:

STEP1: Calculate the coupling expression $C = \dfrac{f(x)g(y)}{((f(x)+g(y))/2)^2}$

f(x) and g(y) are the scores of the higher education system and economic development system, respectively, where f(x) is the education score calculated according to the above model (to ensure the comparability of the parameters, the original score is divided by 100), g(y) is the total factor productivity index after normalization. The smaller the dispersion of f(x) and g(y), the higher the degree of coupling between the two systems. C is the degree of coupling, with a value between 0-1, the greater the value of C, the greater the degree of coupling.

STEP2: Calculate the coordination function

In order to evaluate the coordination level of the two systems, this paper introduces the coordination degree function: $\begin{array}{l} D=\sqrt{CT} \\ T=\alpha f(x)+\beta g(y) \end{array}$

D represents the degree of coupling coordination, with a value between 0 and 1. The larger the value of D, the higher the level of coordination between the two systems. T is the comprehensive level of the higher education system and the economic development system, with a value between 0 and 1. α and β are undetermined coefficients, which represent the importance of the higher education system and the economic development system, respectively. Since higher education and economic development are equally important in the social development process, this article takes α = β = 0.5.

After we plug in the parameter and coefficients, we could get the Coupling Degree of Germany higher education system in the past few years, just as the following chart. We could get the conclusion that the education system and economic system in Germany 'cooperate' with each other really well. The sustainability performance of higher education system in Germany is excellent.

3 Policy Analysis

3.1 Redistribute Education Resource Model

In the following part we will formulate a series of reasonable policies to reduce the difference in educational resources between East Germany and West Germany, balance the distribution of educational resources, and promote their health.

Suppose the current educational resource levels of the 16 German states are (ordered from high to low):
$S_0 = [s_1, s_2, s_3, ...s_{16}]$ $\quad 0 \le s_j \le s_i \le 1 \quad \forall 1 \le i \le j \le 16$

In order to express the transfer of educational resources, now we establish a one-step resource transfer matrix TPM:

$$P = \begin{pmatrix} p_{1,1} & p_{1,2} & \cdots & p_{1,16} \\ p_{2,1} & p_{2,2} & \cdots & p_{2,16} \\ \cdots & \cdots & \cdots & \cdots \\ p_{16,1} & p_{16,2} & \cdots & p_{16,16} \end{pmatrix}$$

When P is the identity matrix, it means that no educational resources will be transferred.

Considering the operability of actual policy implementation, the educational resources of a state are only allocated to one state in the same policy. Therefore, compared with the unit matrix, we only have two different data in each row.

At the same time, as for 6 states in East Germany, we observe that only Berlin has educational resources above the average level, and the remaining five states are at the lowest level. Therefore, each time only the top five states with current educational resources are allocated α% to other states in East Germany except Berlin.

According to the above rules, we calculate the first resource transfer matrix as:

$$P = \begin{pmatrix} \alpha & 0 & ... & 0 & 1-\alpha \\ 0 & \alpha & ... & 1-\alpha & 0 \\ ... & ... & ... & ... & ... \\ 0 & 0 & ... & 1 & 0 \\ 0 & 0 & & ... & 0 & 1 \end{pmatrix}$$

So after the first policy is implemented, the resource allocation of the education system becomes:

$S_1 = S_0 + P_1$

After a few times of policy implement, the resource allocation of the education system becomes:

$S = S_0 \times P_1 \times P_2 \times P_3$

At this time, we found that the resource allocation of the education system has stabilized, and the impact of this kind of policy is negligible, so we stop policy implementation at this time. Then we could see the whole process as the following figure:

It can be clearly seen that the chromatic aberration between the regions is gradually decreasing, indicating that our policy is effective. At the same time, we found that the colors of the last two pictures no longer changed, indicating that it is not meaningful to continue to implement this policy, so we stopped further policy implementation in the fourth stage.