Does Fiscal Transfer Improve the Equalization of Regional Public Health Service
Evidence from a Spatial Panel-Data Analysis in China

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Abstract. Public health service is regarded a key social resource contributing to the national health and sustainable development. Its development gap, however, exists among regions in China due to the unbalanced regional economy, and is also affected by financial distribution. With the effect of tax reform, central fiscal transfer has become a strategic approach to narrow the regional gap of public health service and improve the regional development. This paper aims to evaluate provincial public health service levels in China by applying entropy method and shows that obvious spatial imbalance of public health service level exists in Chinese provinces and such imbalance is also consistent with that of average fiscal transfer from the central government to the regional ones. The current research also looks at, by adopting spatial panel model, a model developed from economic convergence model, whether central fiscal transfer effectively helps to lower the level of public health service difference in regions and the outcome depicts that central fiscal transfer, particularly fiscal transfer for specific purposes, accelerates Chinese public health service development especially in eastern, middle and western regions. From the perspective of spatial effect, neighborhood imitation effect exists to allow completion among neighboring regional governments and therefore more investment to public health service. Compared with the pace of economic development, central fiscal transfer’s limited effect is still seen in less developed regions particularly some midland and western areas, due to the inadequate investment rooted in government’s structured expenditure plan. The implication of this research is that, apart from the attention to economic growth, the government should, with the effort of fiscal transfer, financially focus more on the area of public health service.

1 Introduction

Since implementation of reform and open policy of Chinese government, GDP of China is continuously growing in high speed, and China's social development has made a great progress. The social needs for public health service is dramatically increasing. Public health service is an important public good, it not only provides guarantees for human right, but also increases the human capital as whole society, which has huge impact on economic and social development [1].

Public health system related to every people in the society, which need huge amount of money in long term investment. Chinese public health system is managed by governments, and the health expenditure payed by government, social security and individual.

Development unbalance is common economic phenomenon, but it causes the unfair allocation of public goods. Since the reform and open policy implementation, china has achieved greatly improvement in economy and social development. Some regions developed earlier than others by the policy guidance of financial support, the regional economic development unbalance become more and more serious [2], which directly impact on the public health service equalization. The allocation of public health good emerge the phenomenon of “eastern richer than western”, the difference of eastern and western regions become clear [3-7]. The unbalance phenomenon of public health partly attributes to the fail of health market system, so central government should implement financial policy to equalize public health. In Chinese public health system, the biggest proportion of public health expenditure belong to government expenditure, social security expenditure come to second, individual expenditure is third proportion [8]. Central fiscal transfer payment is supplement to the regional finance, which redistribute the finance to region and correct the unbalance development of regions especially in public department such as public health service [9].

In modern society, the public health service is guarantees of basic human right, and every person in the society should enjoy public health service equally. Some researches on Chinese public health service shows there is inequality, and there are huge difference not only between eastern and western regional, but also between city and...
country, which is reflected by the difference of public health expenditure per capita [10]. The inequality of regional public health service is attributed to the unbalance of regional economic developments, urban-rural dual sector economic structure and fiscal decentralization system [11-13].

2 Evaluation methods on Chinese Regional Public Health Service

A lot of cases show there are the inequality in health service, to determine the degree of inequality is needs to evaluate the health system. Since health service department is a complex system, and the adequacy of health service depends on many factors. So we choose 4 variables to represent the quantity of the health service supply, and apply the entropy method on evaluation, which is less subjected to preference and scale-free. The sample data used in the paper is sourced from penal data of China mainland 31 provinces.

The health service should be evaluation from both quantity and quality aspects. Upon this point of view, the authors choose variables of public health expenditure per capita and number of medical workers per 10,000 person to present the quality of medical public health, and choose variables of number of medical institutions per 10,000 person and number of beds in health facilities per 10,000 person to present the quantity (list of variables are shown in table 1).

The authors apply entropy method to evaluate public health service. Since there is time effect in the time-series data of public health service, the authors follow the methods of Yang [14] to eliminate the time effect by introducing a date variable, the modified entropy measure method is process as following step:

- 1st step: index the data as \( x_{bij} \), let \( \theta \) be the year, and \( i \) be the index of regions, and \( j \) present the category of data;
- 2nd step: normalize the data, which could eliminate the dimension of data;
  - Positive indicators normalization: \( x'_{bij} = x_{bij} - \min\{x_{bij}\}/\max\{x_{bij}\} - \min\{x_{bij}\} \);
  - Negative indicators normalization: \( x'_{bij} = x_{bij} - x_{\max}/\min\{x_{bij}\} \);
- 3th step: calculate the entropy of j class data: \( e_j = -k \sum \theta \sum p_{ij} \ln(p_{ij}) \), Where \( p_{bij} = x'_{bij}/\sum \delta \sum_i x'_{bij}, k > 0, k = \ln(rn) \);
- 4th step: calculate the information utility value of j class data: \( g_j = 1 - e_j \);
- 5th step: calculate the weights of j class data: \( w_j = g_j/\sum_j g_j \);
- 6th step: evaluate regional public health service: \( H_{\theta t} = \sum_j (w_j x'_{bij}) \times 10000 \)

Table 1. Index and Weights

| 1st Categories | 2nd Categories | Weights |
|----------------|---------------|---------|
| regional public health service level | Public health expenditure per capita | 0.1948 |
| Number of medical institutions per 10,000 person | 0.0472 |
| Beds in health facilities per 10,000 person | 0.2022 |
| Number of medical workers per 10,000 person | 0.5558 |

The calculation results can be obtained from the author.

3 Fiscal Transfer on Convergence of Regional Public Health Service Level

The economic growth convergence hypothesis provides new ideas and tools to study the problem of inequality of regional public health service. Convergence degree of regional public health service development could present the degree of the equality of public health service. Based on the point, the paper analyzed the degree of inequality of regional public health service.

3.1 Space Panel data econometric model

Based on the classic econometric model of \( \beta \) absolute convergence and \( \beta \) conditional convergence proposed by Baumol and Barro[15], the authors follow the idea of Ma and Yu[16] to empirically study the impact of fiscal transfer on \( \beta \) convergence of regional public health service growth, and we applies the panel data econometric model proposed by Islam [17] and Yu and Lee [18]. The space panel model of Chinese public health service development convergence is modeled as formula 1 and 2.

\[
\frac{1}{T} \ln\frac{y_{ijt}}{y_{i,j,0}} = \alpha + \delta \sum_{t=1}^{T} \frac{\ln y_{ijt}}{T} + \beta \ln y_{i,j,0} + \mu_i + \varepsilon_{it} \tag{1}
\]

\[
\ln\frac{y_{ijt}}{y_{i,j,0}} = \alpha + \delta \sum_{t=1}^{T} \frac{\ln y_{ijt}}{T} + \beta \ln y_{i,j,0} + \gamma_{i,j} + \epsilon_{it} \tag{2}
\]

- \( i \) be the ith region,
- \( t \) is the periods of the observed time,
- \( Y \) is the level of regional public health service measured above,
- \( y_{i,j,0} \) and \( y_{i,j,T} \) are public health level of first period and last period respectively,
- \( GDP_{i,0} \) and \( TRS_{i,0} \) are GDP per capita and fiscal transfer per capita of region \( i \) in period 0,
- \( \beta \) is coefficient of convergence, where \( \beta = -\frac{1 - e^{-\theta t}}{t} \)
- \( \theta \) is rate of convergence,
- \( W \) is spatial weight matrix, which is Rook the first order contiguity matrix.

In the Baumol and Barro model, if \( \beta > 0 \), then the regional economy growth rate is positive exponential rate, which lead to regional economy grow to infinite. Since the Chinese fiscal system is based on annual budget, the central fiscal transfer budget is annual too, so the authors set the observed period as one year.
3.2 Variable

The sample data used in the paper is sourced from penal data of China mainland 31 provinces and regions from year 1995 to 2009. In order to examine the club convergence of regional public health service development, the sample data is grouped by eastern, midland and western regions. Since the fiscal decentralization system is implemented in year 1994, the sample data of year 1994 did not reflect this major policy reform, the authors sample the data in span of year 1995 to 2009 from “Annals of Chinese local governments Finance”, which is only available to date of year 2009. The sample data of GDP per capita are cited from “China Statistical Yearbook”, and the sample data of fiscal transfer are cited from “Finance Yearbook of China”.

Table 2. Variable And Its Representation

| Representation                        | Variable      |
|---------------------------------------|---------------|
| Evaluation of public health service   | Y             |
| Per capita GDP                        | gdp           |
| Per capita fiscal transfer payments   | trs           |
| Per capita duty drawback              | trst          |
| Per capita general transfer payments  | trsf          |
| Per capita special transfer payments  | trss          |

3.3 Econometric result analysis

Comparing to the result of penal data model, the spatial autocorrelation model has better estimated result and fitting degree in the national, eastern, midland and western sample data, so it is suitable to model the convergence of Chinese regional public health service.

3.3.1 β absolute convergence model of public health service level

In order to estimate the impact of fiscal transfer on the Chinese regional public health service development convergence, we first applied spatial β absolute convergence model of regional public health service, the result of spatial autocorrelation penal data model is estimated as table 3 show, which shows regional public health service did not β converge in national and regional model with sample data from year 1995 to 2009.

Table 3. Absolute Convergence of Public Health Service

| Variable And Its Representation | National | Eastern | Midland | Western |
|----------------------------------|----------|---------|---------|---------|
| α                                | 0.8326***| 0.9403***| 1.1437***| 0.8778***|
|                                  | (12.9698)| (11.5638)| (14.6075)| (8.6176) |
| β                                | 0.0247***| 0.0224***| 0.0510***| 0.0211***|
|                                  | (9.7171 )| (6.3180 )| (9.4884 )| (5.6083 )|
| δ                                | 0.0247***| 0.0510   | -0.2361***| 0.1070   |
|                                  | (9.7171 )| (6.4688 )| (-2.8167)| (1.0557 )|
| obs                              | 434      | 154     | 112      | 168      |
| Rsquared                        | 0.4640   | 0.3480  | 0.4075   | 0.3726   |
| llh                               | 371.4228 | 371.4228|        |         |
| Note: * means p<0.01, ** means p<0.05, *** means p<0.1. |

3.3.2 Central fiscal transfer and regional public health service β conditional convergence

In order to study if central fiscal transfer and the growth of GDP have impacts on the convergence of public health service, we introduced variables of GDP growth, central fiscal transfer and its payment structure into convergence model, and the econometric results shows as following tables.

Table 4. Central Fiscal Transfer Model

| Variable      | National | Eastern | Midland | Western |
|---------------|----------|---------|---------|---------|
| a             | 0.6482***| 0.6892***| 0.5634***| 0.6503***|
|              | (11.8888)| (8.0432)| (3.8033)| (7.1964 )|
| β             | -0.0376***| -0.0320***| -0.0352***| -0.0557***|
|              | (-5.7608)| (-3.6163)| (-2.8788)| (-4.5054)|
| Δ              | 0.1120*  | 0.0470  | -0.2361***| 0.0900   |
|              | (1.8166 )| (0.6496)| (2.8597)| (0.9361 )|
| lntrns        | 0.0250***| 0.0441***| 0.0085   | 0.0064   |
|              | (5.6194 )| (6.8311)| (5.5989)| (0.7223 )|
| lnGdp         | 0.0467***| 0.0207** | 0.1032***| 0.0920***|
|              | (5.0746 )| (1.6322)| (3.4660)| (5.3851 )|
| obs           | 434      | 154     | 112      | 168      |
| R-squared     | 0.5753   | 0.5485  | 0.6114   | 0.5040   |
| llh            | 396.8271 | 377.5228|        |         |
| Note: * means p<0.01, ** means p<0.05, *** means p<0.1. |
Table 4 and 5 show that national, eastern, midland and western public health service models all have β conditional convergence after introduce the variable of GDP growth and central fiscal transfer. The econometric results show western region model has the fast convergence rate of 0.5%, it follows by the convergence rates of midland region and eastern region which both are higher than 0.3%. Since the improvement of western regions, public health service, the difference between eastern and western regions has been narrowed down, which lead to the convergence of the national public health service. The rate of convergence of the national public health service is higher than eastern and midland regions.

The econometric results also show that the growth of per capita GDP has more impact on public health service improvement than per capita payment of central fiscal transfer, with 4.67% contribute of per capita GDP growth comparing to 2.5% contribute of per capita payment of central fiscal transfer.

In the regions, both growth of GDP and payment of central fiscal transfer improve eastern, midland and western regional public health service. To the richer regions of eastern, the fiscal transfer and growth of GDP have already the same contribution to improvement of public health service, and per capita payment of fiscal transfer has slightly more contribution than growth of GDP. To the poorer regions of midland and western, the growth of GDP have scientifically more contribution to the improvement of public health service than per capita payment of fiscal transfer, contributions of growth of GDP in midland and western regions are 10.3% and 9.2% respectively, and contributions of fiscal transfer in midland and western regions are 8.5% and 6.1%, which are only the 8.25% and 6.63% proportion of the contributions of growth of GDP. Although central fiscal transfer should emphasis on western regions after the implementation of western development policy, but it seems to have little contributions to public health service improvement. The phenomenon could be explained as: first, although the proportion of government expenditure on public health increase, but the total number is still low, and the expenditure of social security and individual on public health are relatively low; second, the payment structure of central fiscal transfer did not incline to public health service, which lead to the phenomenon.

From table 5 of central fiscal transfer payment structure model, increase of per capita payments of special fiscal transfer improve public health service of all the national, eastern, midland and western regions, but per capita duty drawback only works on the eastern regions, and has negative impact in midland and western regions. Also per capita financial transfer payment has the same effect of duty drawback.

The phenomenon could be explained as: the midland and western regions are relatively poorer, and less limited on financial capacity, the finance transfer from central government and saved by duty drawback has been used in local governments routine expenditure, therefor the central fiscal transfer has less effects in the public health service than the special fiscal transfer [19]. The phenomenon implies fiscal transfer with special purpose on public health service is more helpful to the regional public health department. The phenomenon that growth of GDP’s contributions to public health service is bigger than
central fiscal transfer could be explained as individual would have more money spent on health.

From the viewpoint of spatial effects, public health service of eastern and western regions has “neighborhood imitation effect”. Since the competition of regional governments, the improvement of neighbor regions public health service would incentive region government to increase the expenditure on theirs. Meanwhile, the midland regions have negative spatial effects, which implies the increase neighbor regions public health service could lead to the local decrease in public health service expenditure. The phenomenon could be explained as: firstly, the public health service expenditure has spillover effect, people of neighbor regions could move to the region of higher public health service level for medical care because of the convenience of transportation in midland regions; secondly, the promotion tournament of china political system could incentive regional government put more money to improve GDP rather than public health service, which could come into better political performance for the chief of the local government.

4 Conclusions

By the result of evaluation on Chinese regional public health service, it is characterized as spatial clusters, and the trend of spatial clusters become more and more significant with time. The distribution of public health resource become less from west to east, and become more from south to north. The distribution of public health resource is coincided to the financial income distribution. With increasing of fiscal transfer to western regions after western development policy, the public health of western regions has significant improvement.

By the econometric analysis above, the central fiscal transfer has been driven the national, eastern, midland and western regional public health service to convergence, and promoted the equality of regional public health service. Comparing to the significant impact of growth of GDP on public health service, central fiscal transfer has limit impact on narrowing the difference between regional public health service, especially in the poorer midland and western regions. And the impact of general fiscal transfer on public health service is less than special fiscal transfer on public health, because the general fiscal transfer would spend mainly on GDP relate program rather than public health. This phenomenon could attribute to the socialized and commercialized reform of public health system that reduce the duty of government expenditure, thereby the public health expenditure rely more on the individual income.

With the incentive of Chinese style of fiscal federalism, fiscal decentralization and political promotion tournament, which could explain the miracle of China's economic growth [20-21]. From the spatial effect viewpoint, the regional governments incline to imitate neighbor region on policy of public health service, which aggravate the characterization of spatial cluster of public health service.

From the view of public health service quantity, the difference of eastern and western regions is small, which is attributed to the increasing of fiscal transfer to western regions. However on the quality aspect, the difference of eastern and western regions is still big, the quality of public health service majorly depended on the regional economy and the expenditure of individual. With massive growing demand of public health service, to narrow down the gap of regional public health service is the priority duty of regional government. And central government should increase more special fiscal transfer on public health service rather than general fiscal transfer, which could improve the national public health service and equalize the nationwide and regional public health service.

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