How Government's Fiscal Spending Would Affect Epidemic Diseases

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Abstract. This paper aims to discuss whether the government's fiscal spending would affect the possibilities that people will be infected by epidemic diseases. The paper mainly utilizes empirical analysis to discuss the relationship between the two variables and implements the fixed effect into the model. The empirical analysis has considered the fixed effects and add controlled variables to the analysis, which aims to simulate the real-world scenario and make the result more comprehensive and convincing. Also, it constructs t-tests to verify the significance of the coefficients. Then, the paper limited the scope for analysis, which means it separates all regions into East, Middle, and West, and then does the empirical analysis respectively to make conclusions more specific to certain conditions. After the analysis, the test results display the significance for linear relationship between two variable. Therefore, this paper concludes that government fiscal spending would inversely affect the rate people would be infected by infectious diseases.

Keywords: medical spending; Epidemic diseases; disease control; government expenditure; region difference.

1. Introduction

Nowadays, the world population is proliferating and never has the sign to be slower. Based on the statistics, the world population has been already increased from 1.6 billions to 7 billions in the last 100 years and is expected to continue its growth to 9 billion in 2050. Therefore, as more and more people live in the world, interactions between humans inevitably increase, which provides great opportunities for infectious diseases to spread and immediately expand their infectious scope. Especially in some developing countries, due to their less advanced healthcare, infectious diseases are significantly an typical public health issue. In the global scope, even if human's health care techniques are more and more advanced and effective, how to control the spread of infectious disease still seems to be a big challenge for all world's governors and medical practitioners and the impact of the spread of infectious disease is huge. The typical example is the covid-19. During the early winter of 2020, this epidemic became prevalent worldwide. The emergence of covid-19 largely interfere people's regular life: people are not allowed to go outside. More deeply, the whole country's economy was destroyed -- factories closed, workers could not work, so people could only live with their existing resources. Based on statistics, the covid-19 has brought approximately 14 trillions dollars loss in The United States, which displayed its countless destruction to the world [1].

Entering the twenty-first century, all countries have paid more attention to public health, especially for the popular and widespreaded epidemic diseases. Therefore, most governments have placed the prevention of epidemic diseases as their primary goals, which forced them to raise their inputs in fiscal spending of medical treatment. However, the fiscal spending on medical treatment could vary significantly in different countries or even between different regions within the same nation. For developing countries and regions, GDP per capita is far less than wealthy countries. For example, according to the data from the International Monetary Fund (IMF) , Switzerland has a GDP per capita of $104900 while China only has a GDP per capita of $13690 [2]. Therefore, as people and governments are less wealthy, they are not able to spend as much as funds on public healthcare, which means less treatments are used to deal with the spread of infectious diseases. In general, public health fiscal spending played an important role. This kind of spending could not only provide residents opportunities to get more advanced medical treatment, its scope is not only about medical treatments, but have relation to all kinds of aspects in public health, such as vaccination, health education, and

products testing, which contribute impressively to the prevention of diseases from spreading. According to a search, each dollar spent on vaccination has the effect of saving $44 in the future, which strongly supports the effectiveness of promoting vaccination [3].

This research paper mainly analyses the relationship between the amount of governments' fiscal spending in healthcare and rate of definite diagnosis of infectious diseases. In analysing relationships, least square regression analysis is used. Also, since different regions have different wealth levels and each region faces distinct situations, the normal OLS operates by combining fixed effects. As a result, a linear line representing the relationship between medical spending and diagnosis, which is followed by the statistics testing for verification and we could conclude whether there is a relationship. The results of this paper contribute to society a lot. Firstly, these results offer governments strategic advice for how to prevent epidemic diseases from spreading as increased medical spending is a potential approach. Thereby, this paper could be a reference for governments' fiscal policies making and healthcare institutions' financial input. Aligned with the effect we generated, the United States Government made a Morbidity and Mortality Weekly Report, announcing that a child regular vaccination program they held has already saved over 1 million lives and saved approximately 540 billion dollars for the government[4]. This finding strengthens our confidence that there is a correlation. Moreover, as the results could show whether there is a causational effect, this paper could give residents a relevant conclusion of which region to live has a lower possibilities to be infected.

2. Empirical Design

2.1 Model Introduction and Explanation

In order to test whether there is a linear relationship between the governments' spending on public healthcare and the rate of diagnosis for infectious disease, we designed a significance test to verify the significance of the results.

Therefore, we constructed a measurement model to display the relationship we anticipate to find.

$$Y_i = \beta_0 + \beta_i X_i + \sum \beta_j Z_{ji} + \epsilon_i$$

In this model, i and t represent the corresponding number for provinces and years, respectively. Yi represents the rate of diagnosis of the infectious diseases, which is the number of people who are absolutely sure have infectious diseases in total of 1 million people. X values denotes governments' fiscal spending on public healthcare and Z represents a series controlled variables that is going to influence the diagnosis rate. δ means the fixed effects brought by difference areas in China and different years. Finally, ε represents the error term.

This model is a multivariable regression model and we insert fixed effects of time and space in it, which provides more precision for the final prediction. In the model, we consider the medical spending as the major influencer to people's diagnosis of infectious disease. However, it is too biased to only conclude the diagnosis of epidemic to governments' spending since there are other factors also have the effects on it. Therefore, we implement such variables into the model to make our model more comprehensive. However, since we only wish to use such controlled variables to get the more comprehensive result for the coefficient of the major variable--government spending, whether the eventual results for controlled variables are statistically significant or not is not in our consideration.

2.2 Variable Selection

2.2.1 Dependent Variable

The dependent variable we chose in this paper is the rate of infectious disease diagnosis. This rate is based on the amount of people that are surely of being infected by these diseases per million of people. This rate could directly reflect the extent of infectious diseases' effects in that region. The

reason we have chosen the dependent variable as rate instead of the quantity is our consideration about the distinct population in different regions. Only rate of people could indicate the average effects, which could eliminate the bias brought by different population base.

2.2.2 Independent Variable

For the independent variable selection, we hypothesized that governments' fiscal spending would make significant contributions to the explanation of our dependent variable. As government sponsored regional healthcare institutions, these institutions would be able to provide more advanced treatment methods and also be able to make free diagnosis for residents to avoid the spread of infectious diseases.

2.2.3 Controlled Variable

We have selected five variables as our controlled variables, which are spending in secondary industries, number of road per people, urban rate of that region, the porportion of people in school, and the net value of export and import. These values are not what we expect to be related to the dependent variable, but they are difference in different regions. Therefore, if we want to use data from different regions as the sample, we have to consider the disparencies regions have, which the controlled variable we selected aimed for.

2.2.4 Data Source

This paper selected the panel data of 30 distinct provinces and municipalities in China from 2007 to 2022 as the sample to operate the empirical analysis. Therefore, the sample size is enough to generate a convincing conclusion. All data are from the EPS data base.

Table 1. Descriptive statistics analysis

	obs	mean	standard deviation	minimum value	maximum value
lnfinvalue	480	8.163	0.770	5.488	9.827
lnsec	480	3.757	0.241	2.760	4.119
lnrdppl	480	2.672	0.381	1.396	3.332
lnurbanrate	480	4.026	0.231	3.341	4.495
lninschool	480	5.239	0.323	4.198	6.078
lnMX	480	-3.649	0.975	-6.814	-1.409

3. Empirical Analysis

3.1 Main Regression

In the regression, we initially operate the basic regression, which only discussed the relationship between independent variable and dependent variable. As the table shows, the coefficient for the dependent variable is -0.238 with the 1% significance, which indicates that, without other extra conditions, the independent variable is significant enough to explain the variation of dependent variable. Therefore, it is convincing for us to conclude that, for the one unit increase of the medical spending, the rate of infectious disease diagnosis will goes down for 0.238 units, which fit our hypothesis of the inverse relationship.

However, the analysis is incomplete and the results might be biased if we ignore the controlled variables. Also, as the table (add the denotion of which table) shows, the coefficient for the dependent variable is -0.165 with 1% of significance as well. These five controlled variables has statistics meaning either. considering the five coefficient respectively, only the coefficient of the secondary industry spending has the significance of 1 percent, which could show that structure of industries in fact have some effects on the rate of infectious diseases diagnosis. Nevertheless, other controlled variables are either with the significance of 5 percent and 10 percent or even not significant, which provides us inconvincing evidence to conclude that these factors really affects the rate of

diagnosis. In general, after considering the effects of five controlled variables, the independent variable still display its statistically significant correlation with the dependent variable. Therefore, there is convincing evidence for us to conclude that the change of public healthcare fiscal spending would cause the inverse change of rate of diagnosis.

Table 2. Influence of public healthcare spending on rate of infectious diseases diagnosis: Main Regression

(Notes: *p < 0.10, **p < 0.05, ***p < 0.01; t statistics in parentheses)

	lnmedical (independent)	lnmedical (with dependent variables)
lnfinvalue	-0.238*** (-15.65)	-0.169*** (-4.56)
lnsec		-0.463*** (5.33)
lnrdppl		-0.193** (-2.13)
lnurbrate		0.427* (1.83)
lninschool		-0.060 (-0.55)
lnMX		0.046 (1.50)
Cons	7.368*** (59.19)	4.341*** (6.42)
R2	0.3531	0.4190
Obs	480	480

3.2 Heterogeneity Analysis

Within the sample and observations we have for the regression analysis, there is still some differences. We have separated the sample into three groups since we have observed that there are mainly three regions: west, east, and middle. We have hypothesized that there are differences between the effects of medical spending on the rate of diagnosis. In China, cities in the east are the wealthiest, and then cities in the middle, and the least are cities in the west regions. One possible explanation and motivation for our hypothesis is that, east cities in China are along the ocean. As they are along the coast, they become the centers for maritime trade and facilitate fast faculties

exchange, which stimulates the local economy and boosts the increasing population density. After grouping all 30 cities into 3 groups, we do the regression analysis with the consideration of controlled variables for each group separately. For cities in the west regions of China, the coefficient for the independent variable is -0.109 with the p-value larger than 0.1. Therefore, based on the statistics, we concluded that the effects of change in medical spending in west regions on the change of rate of diagnosis is not significant enough to be convincing. For cities in the middle of China, the regression analysis shows the coefficient of independent variable as -0.182 with the p-value smaller than 0.1. For cities in the east regions of China, the coefficient of independent variable is -0.224 with the p-value lower than 0.01, which shows strong significance. By comparing three resutls in three general regions respectively, we could recognize that the significance of the coefficient is in an ascending order from west regions to east regions. This recognition is also consistent with our initial hypothesis. Since the economy in eastern regions are better than others, the average income is correspondingly higher. As residents are wealthier, survival would not be a extremely severe challenge and people tend to pay more attention on living standard. Therefore, more money and efforts would be paid to persist their own health. In addition, better finance and fiscal ability would allow for better development in healthcare and medicine. Hence, what therapies patients in eastern areas have enjoyed, comparing with treatments in other regions, is much more advanced, which provides substantial support for preventing and rehabilitating the infectious diseases.

Table 3. Influence of public healthcare spending on rate of infectious disease diagnosis in different regions: Heterogeneity Analysis

(Notes: *p < 0.10, **p < 0.05, ***p < 0.01; t statistics in parentheses)

	East	Middle	West
lnfinvalue	-0.224*** (-3.62)	-0.182* (-1.95)	-0.109 (-1.57)
lnsec	0.473** (3.17)	0.535*** (3.84)	0.088 (0.56)
lnrdppl	-0.228* (-1.87)	0.602*** (2.64)	-0.009 (-0.07)
lnurbrate	0.402 (1.09)	1.561*** (3.36)	-0.795** (-2.01)
lninschool	0.389** (2.00)	-1.554*** (-6.56)	0.181 (1.23)
lnMX	-0.016 (-0.22)	0.007 (0.10)	0.070** (2.01)
cons	2.181 (1.63)	5.530*** (3.37)	8.643*** (7.01)
R2	0.4576	0.5657	0.5202
Obs	176	128	176

4. Conclusion

4.1 Test Results

Based on the results of the empirical analysis, the low p-value provide convincing evidence that two variables are with a strong linear relationship. The result of this research is strictly consistent with a research of data in Bangladash, where a higher government healthcare budget and more healthcare resources, such as doctors, apparently lower the diagnosis, and even death rate of local Diphtheria[5]. Therefore, we concludes that 1 unit increase of the government's fiscal spending will decrease the rate of diagnosis of infectious disease by 0.165 percent. Consistently, there is convincing evidence that west, middle, and east regions of China have a difference value of coefficient respectively, which could be explained by different level of income and different extent of development.

4.2 Inspiration

In current society, infectious diseases are the most common reasons people get illed, which even not severely harmful but still make large destruction to the society and people's health. Therefore, effective control of the spread of infectious diseases is urgent and crucial. Within the management of infectious diseases diagnosis, government's direct administration and intervention still play a central role. Therefore, the result of this paper would be inspirational for the policies makers and may assist their policy making. Since the coefficient illustrates the relationship between governments' fiscal spending and the rate of diagnosis, it would be a potential reference to governments when they anticipate to control the rate of infectious diseases diagnosis. Since this paper has provided a convincing solution, in real scenario, when government wants to reduce the infectious diseases in their region, one possible approach would be increasing their spending on public healthcare.

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