

Dear Dr. Xiaolan Fu,

We submit our manuscript entitled “Does Fiscal Decentralization Reduce Public Education Provision in China? A Theoretical Model and Prefectural Panel-Data Research” to Chinese Economic Association Europe and UK Annual Conference 2010.

On the basis of the existing literature, the main contributions and innovations of this paper are: Using all of the prefectural level panel data; using of UNESCO education provision indicators; Comparing education provisions in the different stages of education and in different regions in China. More importantly, it is a whole research of how fiscal regime affects public education provision in China.

We are glad to submit this paper to Journal of Chinese Economic and Business Studies as an individual paper. And as a Ph.D. student from Tsinghua University supervised by Prof. Chong-en Bai, I hope this paper could be involved in the competition for Best Ph.D. Paper Prizes.

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Thank you very much for your attention and consideration.

Sincerely yours,

Weiqing Luo

Does Fiscal Decentralization Reduce Public Education Provision in China? A Theoretical Model and Prefectural Panel-Data Research

Weiying Luo and Shi Chen*

Abstract: While China's 1994 tax-sharing reform raised the financial revenue of central government, it increases the expenditure of local governments. Fiscal decentralization on expenditure may make local governments reduce the provision of public services, such as public education. This paper analyzes the main factors of that phenomenon, and then based on a theoretical model, an empirical test on 1996-2007 prefectural level panel-data verifies that fiscal decentralization does cause decreases of public education provision. Further empirical tests compare public education provision in different education periods and different regions. In the end, from the perspective of public financial system, we try to provide policy proposals on how to improve public education provision according to empirical test results.

JEL: H41, H52, H75

Key words: Fiscal Decentralization; Public Education; Tax-Sharing Reform; Panel Data

1. Introduction

In the three decades of reform and opening up, China's economy has developed very rapidly. There is no doubt that, as the human resources output industry of Chinese economic and social development, China's education is always being highly concerned by central government and society. However, in the three decades, public education expenditure-to-GDP ratio is always below 3.5% (see Figure 1), and it is much less than the world average of 4.6%. In addition, since tax-sharing reform in 1994, public education expenditure-to-total expenditure ratio has also declined. From a practical point of view, in primary and secondary education, local governments avoid responsibilities in education financial security, teaching staff, and school conditions. Shortage of education is harmful to socio-economic sustainable development in China. In May 2010, the State Council pointed out in "State Long-term Education Reform and Development Plan (2010-2020)", that fiscal education expenditure-GDP ratio should be increased to 4% in 2012. Therefore, we need to find out the main factors for education provision shortage in China in fiscal system, and this issue is very critical for China's social-economic sustainable development in the next few decades and even in longer term.

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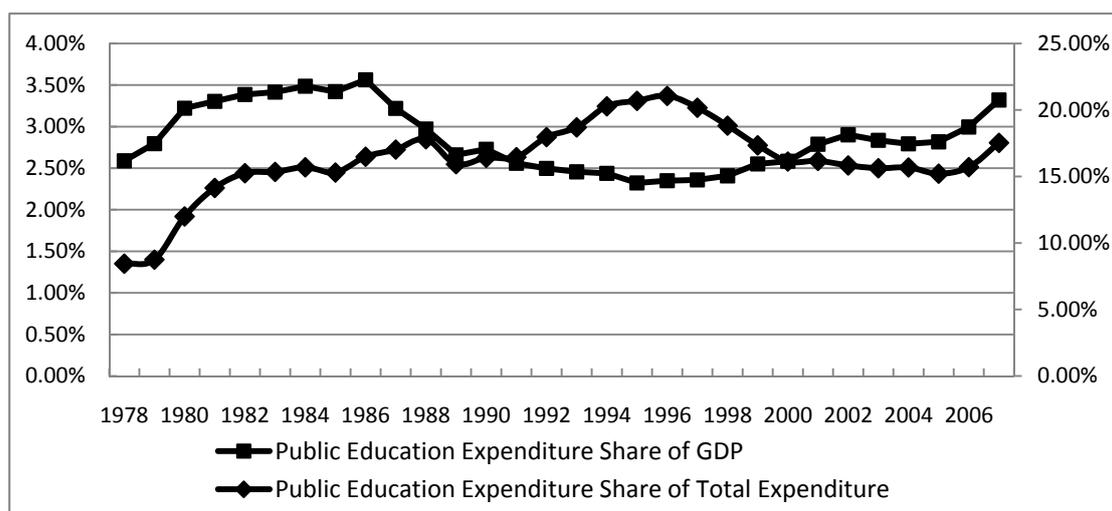


Figure 1 China's Public Education Expenditure-to-GDP Ratio and Total Expenditure (1978-2007)

Many scholars believe that fiscal decentralization is an important reason of the decrease of public education expenditure. The definition of “fiscal decentralization” is that, central government decentralizes some fiscal power to local governments, including revenue and expenditure. When the fiscal power of local governments has reached a certain extent, it can be said that this country is decentralized; or it is called “fiscal centralization”. Theories of fiscal decentralization are developing very fast in the past half century, which we will introduce in the next part. Busemeyer (2008) uses a pooled-data 21 OECD countries analysis, and finds out that fiscal decentralization decreases public education expenditures at national level but increases public education spending at regional level. Qiao et al (2005) apply Tiebout model in China's primary education under the system of fiscal decentralization, based on a provincial panel-data two-step regression model. They find that, fierce competition among local governments reduces the primary education provision of local governments. However, using primary school enrollment rate as measurement of primary education provision and applying Tiebout model which can only be used in United States to China's situation, are the main shortcomings of their research. Lu and Li (2006) develop a linear model which is derived from utility function, through empirical test, they believe that financial decentralization has caused the backwardness of rural compulsory education, and has widened the gap between urban and rural educations. However, its utility function model assumes that there exists a "benevolent" government, which does not meet the current new theory of fiscal decentralization in the field of incentive compatible framework. Moreover, existing studies are based on the data above provincial level, but the problem is that, the provincial data is too broad, and ignore the "Concentrated down" feature of China's education expenditure - the education expenditure of local governments takes a larger proportion. Thus, this paper tries to enrich the theoretical and empirical literature of this issue.

Therefore, this paper analyses the main reasons of education provision shortage from the perspective of public financial system, and builds a theoretical model to model that practical problem, and then after empirical tests, makes policy proposals based on empirical test results. On the basis of the existing literature, the main contributions and innovations of this paper are: Using all of the prefectural level panel data to make this research more detailed; using of UNESCO uniform education provision indicators; Comparing education provisions in the different stages of

education (primary and secondary) and in different regions (East, Middle, West and Northeast).

This paper is organized as follows: Section 2 briefly analyses the main factors of how fiscal decentralization reduces public education provision. Section 3 builds a theoretical model of intergovernmental fiscal relationship. Section 4 discusses the empirical analytical background and indicators of education provision and fiscal decentralization. Sections 5 present the empirical analysis results, and Section 6 concludes and provides policy proposals.

2. How Fiscal Decentralization Affects Public Education Provision: Main Factors

2.1 Decentralized Public Finance System and Education Finance System

Since the 80s of the 20th century, federal index, which is the degree of decentralization, has increased steadily in most developed, developing and transition countries. In fiscal expenditure, China is one of the most decentralized countries in the world, and local governments should bear more than 70% of the expenditure responsibility in recent years. However, this number is only about 15% in developing countries, and about 26% in transition countries, even in OECD countries it is only about 32%. Therefore, Wang (1997) believes that China is over decentralized.

What make things worse, the major responsibilities fall on local governments in China, in many areas, in which the central government should take the major responsibility. For example, Wong and Deepak (2003) point out that our education expenditure system is over decentralized. 90% of China's education expenditure is taken by local governments, and 70% happens in the governments below prefectural level, which is different from the international common mode of education expenditure decentralization, and proportion of local government expenditure is higher. Central government accounts for a relatively higher proportion of education expenditure in major unitary countries, while local governments take a lower proportion, which is 35.3% in average (see Table 1). They believe that this may lead to distortion in government expenditure structure.

Table 1 Education Expenditure Distribution among All Levels of Governments, in Major Countries

Federal Countries	Share of Education Expenditure			Unitary Countries	Share of Education Expenditure	
	Central	State	Local		Central	Local
Australia	8.5	91.3	0.2	France	75.3	24.7
Canada	4.8	34.5	60.7	United Kingdom	12.7	87.3
Germany	1.0	73.8	25.2	Denmark	46.8	53.2
Switzerland	6.2	57.5	36.3	Kenya	94.0	6.0
United States	4.2	24.5	71.3	Thailand	94.8	5.2
Unweighted Average	4.9	56.3	38.7	Unweighted Average	64.7	35.3

The first-generation theory of fiscal decentralization¹ believes that, market failure occurs in public goods provision, which is usually called "tragedy of the commons²". So the government should enter these areas, and correct these market failures through appropriate policies. As public

1 The first-generation theory of fiscal decentralization comes from AMS public economics theory which contains research of Paul A. Samuelson, Richard A. Musgrave and Kenneth J. Arrow in the 50s of 20th century. In addition, Tiebout (1956) also creates an effective theory, however, the basic assumptions of his theory is too strong that this theory cannot be used in other countries.

2 Tragedy of the commons: Because property rights of public goods are difficult to define (high transaction costs of defining their property rights), they are usually over-used or encroached.

goods, if education is provided by the market, the equilibrium value will be less than the social optimum. What's more, the first-generation theory of fiscal decentralization believes that the beneficiaries of education are all of the citizens in the region³, and the local governments could understand local conditions better than central government. Therefore, providing local public goods by local governments will make local citizens "better-off" than providing local public goods uniformly by the central government. However, the second-generation theory of fiscal decentralization believes that incentive mechanisms must be designed to ensure that local government has sufficient incentives to provide efficient public goods (Oates, 2005; Qian and Weingast, 1997).

The greatest difference between the second-generation and first-generation theories of fiscal decentralization is that, the second-generation theory holds the thinking that governments are not pure "Guardians of Public Interests", they concern about their own private interests, and behavior distortion may occur if there is no restriction. Therefore, an efficient government structure should fulfill the incentive compatibility between local governments and local citizens' welfare (Luo, 2010). But without appropriate incentive system constraints, citizens can not enjoy the benefits of fiscal decentralization, but are "worse-off" because of distorted behaviors of local governments.

2.2 Features of Education: Local and National Public Goods

In a society of high population mobility, education is not only a local public good, but also a national public good. China is currently in the period of rapid urbanization, and a large number of populations are mobile. According to public goods theory, national public goods should be provided by central government, while local public goods should be provided by local governments. And, the more elementary the education is, the more positive externalities it has, in other words, the more elementary the education is, the stronger the national public goods nature it has. Calabrese et al (2009) finds that, fiscal decentralization causes lower efficiency of public services, and they consider the positive externalities of public services as the main reason.

This paper tries to compare secondary education with primary education⁴. Relative to primary education, secondary education is paid more attention by local governments. The reason is, first of all, as the analysis above, secondary education has weaker positive externality⁵ than primary education, as the probability of local job enrollment of secondary school graduates is larger than primary school graduates; Secondly, the rate of college entrance examination is still highly valued by the local education sector.

2.3 Yard-stick Competition among Local Government Officials

In our current economic situation, to promote economic development, local governments can invest directly in infrastructure⁶ or in the provision of public services. However, since the 80s of the 20th century, in the evaluation criteria of the yard-stick competition among local government officials, the most important "fixed target" is economic growth, especially GDP growth rate, while

3 Of course, this argument deserves further discussion. Education is not only a local public good, but also a national public good.

4 Higher education is mainly funded by central finance, while primary and secondary educations are mainly funded by local government. Therefore, we do not compare higher education with primary and secondary educations in this paper.

5 Positive externalities: some actions have spillover effects on public environmental interests or other citizens, but others do not need to pay, then positive externalities are generated.

6 In this paper, infrastructure is "hardware infrastructure" which can attract outside capital, and do not include education, health and other public services.

public services are lower ranked as the "soft target", such as education, health care, etc. In the constraints of the fiscal capacity, local government officials must make choice between infrastructure investment and public services provision. In this selection process, local officials usually choose to maximize "political achievements", rather than maximize the local public interest. As long as the investment is beneficial to maximize their "political achievements", the officials will strive to provide. In general, investment in infrastructure can contribute directly in GDP, and can attract outside capital and promote local economic development, thus, infrastructure investment will become the first choice for local officials (Ding and Deng, 2008). That's an important reason for amazing and rapid economic growth in recent years, and, however, low efficiency in most of public goods, like education, healthcare and environment (Zhou, 2007).

2.4 Preliminary Summary

In decentralized fiscal expenditure system and decentralized education expenditure system, local governments have more power to determine education expenditures. However, education is not entirely a local public good, but has characteristic of national public good and positive externalities. Therefore, under fiscal decentralization and blind pursuit of local officials for "political achievements", "vacancy" and "offside" behaviors of the local governments will occur, such as over-investment in competitive areas, like infrastructure, but under-investment of basic public services. Ultimately, these factors will result in inadequate supply of local public services, for example, in education area.

3. Theoretical Model

3.1 Model Setting

Qian and Roland (1998) and Cai and Treisman (2003) both construct theoretical models of China's central – local governments, and analysis the difference in local government expenditure structures, under fiscal centralization and decentralization⁷. However, their models mainly focus on infrastructure investment, so we discuss the relationship between fiscal decentralization and public services by modifying the game theory model in this paper. Suppose the utility function of local government i is:

$$U_i = (1 - t)F(A_i, K_i, I_i) + \lambda v(z_i) \quad (1)$$

I_i denotes infrastructure investment of local government i , while z_i denotes public services investment of local government i . I_i and z_i both come from tax revenue $tF(A_i, K_i, I_i)$ of local government i . t denotes tax rate, and t is uniform in China. A_i denotes the effect of endowment on output, A_i is larger in region with better endowment.

K_i denotes all capital in region i , include domestic and foreign capital). Because of mobility of capital, $K_i(I_i, I_{-i})$ is affected by infrastructure investment of local government I_i and other local governments I_{-i} . $\frac{\partial K_i}{\partial I_i} > 0$, $\frac{\partial K_i}{\partial I_{-i}} < 0$, $\frac{\partial^2 K_i}{\partial I_i^2} < 0$.

⁷ Seabright (1996) constructs a mathematical model and discusses how European democratic local government elections limit the abuse of financial power, but the basic assumptions of the model only apply to European countries.

$v(z_i)$ denotes utility function of public services for citizens, $\frac{\partial v(z_i)}{\partial z_i} > 0$, $\frac{\partial^2 v(z_i)}{\partial z_i^2} < 0$.

λ denotes local government preference for public services relative to the economic development. We can see λ as importance of public services indicators relative to economic development indicators in China's officials' performance appraisal system.

In the following, we discuss a simplified model with a central government and two local governments.

3.2 Fiscal Decentralization

Under fiscal decentralization, local government 1 chooses I_1^D and z_1^D to maximize its utility function:

$$\max U_1 = (1-t)F(A_1, K_1^D, I_1^D) + \lambda v(z_1^D) \quad (2)$$

$$s.t. I_1^D + z_1^D = tF(A_1, K_1^D, I_1^D) \quad (3)$$

Local government 2 chooses I_2^D and z_2^D to maximize its utility function:

$$\max U_2 = (1-t)F(A_2, K_2^D, I_2^D) + \lambda v(z_2^D) \quad (4)$$

$$s.t. I_2^D + z_2^D = tF(A_2, K_2^D, I_2^D) \quad (5)$$

To get optimal solution, from first order conditions we can get:

$$(1-t) \left[\frac{\partial F(A_1, K_1^D, I_1^D)}{\partial I_1^D} + \frac{\partial F(A_1, K_1^D, I_1^D)}{\partial K_1^D} \frac{\partial K_1^D}{\partial I_1^D} \right] + \lambda t \frac{\partial v(z_1^D)}{\partial z_1^D} \frac{\partial z_1^D}{\partial I_1^D} = 0 \quad (6)$$

$$(1-t) \left[\frac{\partial F(A_2, K_2^D, I_2^D)}{\partial I_2^D} + \frac{\partial F(A_2, K_2^D, I_2^D)}{\partial K_2^D} \frac{\partial K_2^D}{\partial I_2^D} \right] + \lambda t \frac{\partial v(z_2^D)}{\partial z_2^D} \frac{\partial z_2^D}{\partial I_2^D} = 0 \quad (7)$$

Because $\frac{\partial F(A_1, K_1^D, I_1^D)}{\partial I_1^D} > 0$, $\frac{\partial F(A_1, K_1^D, I_1^D)}{\partial K_1^D} \frac{\partial K_1^D}{\partial I_1^D} > 0$, and $\frac{\partial v(z_1^D)}{\partial z_1^D} > 0$, therefore, $\frac{\partial z_1^D}{\partial I_1^D} < 0$. In the same way, $\frac{\partial z_2^D}{\partial I_2^D} < 0$.

3.3 Fiscal Centralization

Under fiscal centralization, central government chooses I_1^C , z_1^C , I_2^C and z_2^C to maximize the utilities of all local governments.

$$\max U = U_1 + U_2 = (1-t) \left[F(A_1, K_1^C, I_1^C) + F(A_2, K_2^C, I_2^C) \right] + \lambda \left[v(z_1^C) + v(z_2^C) \right] \quad (8)$$

$$s.t. I_1^C + z_1^C = tF(A_1, K_1^C, I_1^C) \text{ and } I_2^C + z_2^C = tF(A_2, K_2^C, I_2^C) \quad (9)$$

To get optimal solution, from first order conditions we can get:

$$(1-t) \left[\frac{\partial F(A_1, K_1^C, I_1^C)}{\partial I_1^C} + \frac{\partial F(A_1, K_1^C, I_1^C)}{\partial K_1^C} \frac{\partial K_1^C}{\partial I_1^C} + \frac{\partial F(A_2, K_2^C, I_2^C)}{\partial K_2^C} \frac{\partial K_2^C}{\partial I_1^C} \right] + \lambda \left[\frac{\partial v(z_1^C)}{\partial z_1^C} \frac{\partial z_1^C}{\partial I_1^C} + t \frac{\partial v(z_2^C)}{\partial z_2^C} \frac{\partial F(A_2, K_2^C, I_2^C)}{\partial K_2^C} \frac{\partial K_2^C}{\partial I_1^C} \right] = 0 \quad (10)$$

Then we get:

$$(1-t) \left[\frac{\partial F(A_1, K_1^C, I_1^C)}{\partial I_1^C} + \frac{\partial F(A_1, K_1^C, I_1^C)}{\partial K_1^C} \frac{\partial K_1^C}{\partial I_1^C} \right] + \lambda \frac{\partial v(z_1^C)}{\partial z_1^C} \frac{\partial z_1^C}{\partial I_1^C} + \left[(1-t) + \lambda t \frac{\partial v(z_2^C)}{\partial z_2^C} \right] \frac{\partial F(A_2, K_2^C, I_2^C)}{\partial K_2^C} \frac{\partial K_2^C}{\partial I_1^C} = 0 \quad (11)$$

3.4 Comparisons under fiscal decentralization and fiscal centralization

Under fiscal decentralization, we get (6).

Under fiscal centralization, we get (11).

Because $[(1-t) + \lambda t \frac{\partial v(z_2^C)}{\partial z_2^C}] > 0$, $\frac{\partial F(A_2, K_2^C, I_2^C)}{\partial K_2^C} > 0$, $\frac{\partial K_2^C}{\partial I_1^C} < 0$

Therefore:

$$\left[(1-t) + \lambda t \frac{\partial v(z_2^C)}{\partial z_2^C} \right] \frac{\partial F(A_2, K_2^C, I_2^C)}{\partial K_2^C} \frac{\partial K_2^C}{\partial I_1^C} < 0 \quad (12)$$

From (6) (11) and (12) we get:

$$(1-t) \left[\frac{\partial F(A_1, K_1^C, I_1^C)}{\partial I_1^C} + \frac{\partial F(A_1, K_1^C, I_1^C)}{\partial K_1^C} \frac{\partial K_1^C}{\partial I_1^C} \right] + \lambda \frac{\partial v(z_1^C)}{\partial z_1^C} \frac{\partial z_1^C}{\partial I_1^C} > (1-t) \left[\frac{\partial F(A_1, K_1^D, I_1^D)}{\partial I_1^D} + \frac{\partial F(A_1, K_1^D, I_1^D)}{\partial K_1^D} \frac{\partial K_1^D}{\partial I_1^D} \right] + \lambda t \frac{\partial v(z_1^D)}{\partial z_1^D} \frac{\partial z_1^D}{\partial I_1^D} \quad (13)$$

Suppose:

$$G(I_i) = (1-t) \left[\frac{\partial F(A_1, K_1^D, I_1^D)}{\partial I_1^D} + \frac{\partial F(A_1, K_1^D, I_1^D)}{\partial K_1^D} \frac{\partial K_1^D}{\partial I_1^D} \right] + \lambda t \frac{\partial v(z_1^D)}{\partial z_1^D} \frac{\partial z_1^D}{\partial I_1^D} \quad (14)$$

We can prove that $G(I_i)$ is a decreasing function of I_i .

From (13) and (14), we get $G(I_1^D) < G(I_1^C)$, then we get $I_1^D > I_1^C$.

And we know that $z_i = tF(A_i, K_i, I_i) - I_i$, and we get prove that z_i is a decreasing function of I_i .

Thus, we get $z_1^D < z_1^C$. In the same way, we can get $z_2^D < z_2^C$.

3.5 Conclusions of Theoretical Model

In the above, we prove that under fiscal decentralization, local governments tend to provide lower public expenditure on education and other public services than which is provided by central government under fiscal centralization. The main reason is, in current yard-stick competition

government official promotion mechanism, local officials tends to allocate more fiscal expenditure on infrastructure to attract outside capital, to promote local economic development, and thereby reduce other expenditures like public services.

That is concluded from a simplified model with one central government and two local governments. Actually, we can get the same conclusion from extended models with two or more local governments and two or more government levels. In other words, this conclusion is applicable to province government and prefecture government.

In the following, through prefectural panel data based empirical test, we try to verify that financial decentralization causes decrease in public education provision, which is an important part of public service provision.

4. Data and Empirical Test

4.1 Dependent Variables

Since this paper focuses on government behavior, and education provision is directly related to government behavior. The direct reflection of the investment in education by local governments is the increase of education provision. In this paper, we use the indicators used uniformly in "World Education Report" and "Education Statistical Yearbook" published by UNESCO (United Nations Educational, Scientific and Cultural Organization) as indicators of public education provision.

UNESCO uses two groups of indicators of education provision:

- (1) The first group is financial indicators, the two most important financial indicators are public education expenditure-to-GDP ratio and public education expenditure-to-total government expenditure ratio.
- (2) The second group is human resource indicators, the most important indicator of human resource is student-teacher ratio, which is, the number of students / full-time teachers.

Qiao et al (2005) use primary student enrollment rate to measure primary education provision, but it is not an appropriate measurement; in addition, only using the student-teacher ratio to measure education provision is incomplete in China's situation. Thus, we use public education spending as share of total expenditure, and public education expenditure-to-GDP ratio, and student-teacher ratio, to measure public education provision comprehensively. Among them, the student-teacher ratio is to be used in the comparison of different stages of education.

First of all, we make international comparisons, the absolute value of our public education expenditure has been raised from 8.68 million yuan in 1993 to 86.91 million yuan in 2007, and it was a 10 times increase. Public education expenditure as share of GDP dropped from the highest point of 3.49% in 1984 to the lowest point of 2.32% in 1995, and then slowly rose to 3.16% in 2007. As we can see from Table 1, 3.16% is closed to the level of low-income countries, even lower than 3.5% the average of Latin America and the Caribbean.

Table 2 Public Education Expenditure-to-GDP Ratio in Some Countries in the World, in the Year of 2007, Grouped by Income and Region

Country, Grouped by Income	Public Education Expenditure-to-GDP Ratio	Country, Grouped by Region	Public Education Expenditure-to-GDP Ratio
Middle-Income	4.5%	Europe and Middle East	4.1%

Lower Middle Income	3.2%	Europe	5.2%
Upper Middle Income	4.5%	Latin America & Caribbean	3.5%
High Income	5.1%	Sub-Saharan Africa	4.1%
World Average	4.6%	World Average	4.6%

Source: World Development Indicator 2009

Then we look into the situation of different regions in China (see Figure 2), and we can see that public education expenditure-to-total expenditure ratio is higher in eastern region, then central region, and northeast and western regions are the lowest; public education expenditure-to-GDP ratio is higher in western region, then central and northeast regions, and eastern region is the lowest (see Figure 3).

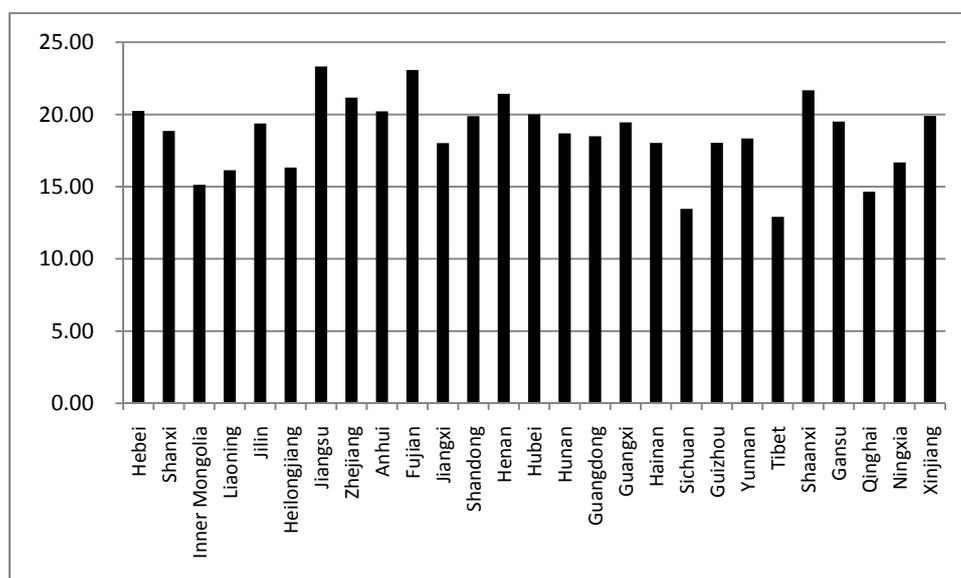


Figure 2 Public Education Expenditure-to-Total Expenditure Ratio 1996-2007, Annual Average, Excluding Four Municipalities

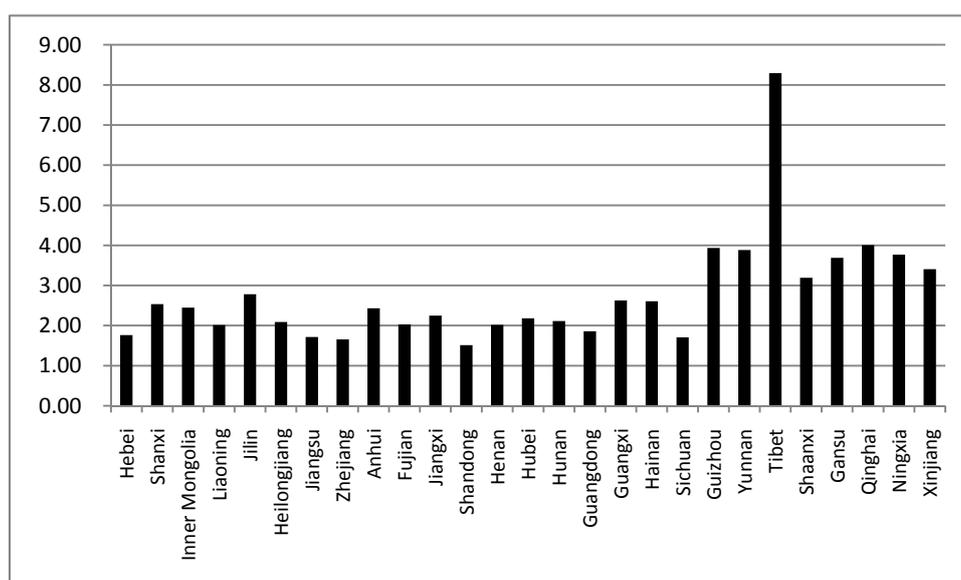


Figure 3 Public Education Expenditure-to-GDP Ratio 1996-2007, Annual Average, Excluding Four

Municipalities

Analysis of variance (ANOVA) results also show that the description of statistical conclusion above is not false (see Table 3). Comparisons of different indicators show different comparison results, which is probably due to higher GDP in eastern region and lower GDP in western region. Therefore, we need to use indicators as a group, and detailed analysis to get conclusions.

Table 3 Comparison of Public Education Provision in Different Regions in China, Analysis of Variance

Region	Observations	Public Education Expenditure-to-Total Expenditure Ratio		Public Education Expenditure-to-GDP Ratio		Student / Teacher Ratio in General Primary Schools		Student / Teacher Ratio in General Secondary Schools	
		Average	Rank	Average	Rank	Average	Rank	Average	Rank
East	84	20.60	1	1.88	4	21.68	2	18.33	3
Central	72	19.54	2	2.25	2	21.55	2	18.38	3
West	132	17.25	3	3.72	1	21.81	2	17.15	2
Northeast	36	17.28	3	2.30	2	15.72	1	15.67	1

4.2 Independent Variables

In this paper, we construct fiscal decentralization (indicated as *FD*) as: prefectural expenditure per person/consolidated expenditure per person, to measure the degree of fiscal power of this prefectural jurisdiction government. The formula of *FD* is:

$$FD_{ijt} = \frac{\frac{PRX_{ijt}}{P_{ijt}}}{\frac{PRX_{ijt}}{P_{ijt}} + \frac{PX_{it} - \sum_j^m PRX_{ijt}}{P_{it}} + \frac{CX_t}{P_t}} \quad (15)$$

In this formula, *i* denotes province *i*, *j* denotes city (region) *j* in province *i*, *t* denotes year *t*. FD_{ijt} denotes fiscal authorities of city (region) *j* in province *i* in year *t*, PRX_{ijt} denotes fiscal expenditure of city (region) *j* in province *i* in year *t*, P_{ijt} denotes population of city (region) *j* in province *i* in year *t*. Therefore, PRX_{ijt}/P_{ijt} denotes fiscal expenditure per person of city (region) *j* in province *i* in year *t*. PX_{it} denotes fiscal expenditure of province *i* in year *t*, P_{it} denotes population of province *i* in year *t*, CX_t denotes central fiscal expenditure in year *t*, P_t is population in year *t*. Therefore, PX_{it}/P_{it} denotes fiscal expenditure per person of province *i* in year *t*, CX_t/P_t denotes fiscal expenditure per person in year *t*.⁸ $0 < FD < 1$, the closer to 1 *FD* is, the more fiscal authorities of this city (region) has.

The economic sense of this indicator is that: PRX_{ijt}/P_{ijt} denotes the fiscal expenditure city (region) *j* in province *i* spend on one person in year *t*, $\sum_j^m PRX_{ijt}$ denotes summer of fiscal expenditures of all *m* cities (regions) in province *i* in year *t*, $\frac{(PX_{it} - \sum_j^m PRX_{ijt})}{P_{it}}$ is provincial

⁸ The assumption here is that fiscal expenditure is spent equally on each citizen under jurisdiction at all levels of governments.

government fiscal expenditure spend on one person in province i in year t , therefore, $\frac{PRX_{ijt}}{P_{ijt}} + \frac{(PX_{it} - \sum_j^m PRX_{ijt})}{P_{it}} + \frac{CX_i}{P_i}$ denotes the fiscal expenditure spent on one person of the whole country in year t .

Thus, FD_{ijt} denotes the share of fiscal expenditure spent on this person of the whole prefecture in the fiscal expenditure spent on this same person of the whole country in year t . By using this indicator, we can get rid of population effect in fiscal expenditure and effect of grant transfers from central government to local governments, and fully denotes the share of local government fiscal power. Many scholars have used this indicator (Ying, 2004; Qiao et al, 2005).

There are also other indicators to measure fiscal decentralization in existing literature, such as Zhang and Zou (1998) use the provincial government budget expenditure per person (in-budget and off-budget) over the government's total expenditure per person, the difference is that they use integrated indicators; Lin and Liu (2000) use marginal sharing rate of provincial government in budget revenue of the province to measure fiscal decentralization, however, this indicator only reflects allocation share in incremental fiscal revenue, but cannot measure the overall level of decentralization.

Other control variables are: (1) per capita GDP, economic development affect education provision. We take natural logarithm of per capita GDP to reflect economic development, denoted by $\ln GDPPC$; (2) public expenditure-to-GDP ratio in prefectural level, denoted by X_GDP ; (3) province dummy variables, to control features of each province, there are a total of 26 province dummy variables⁹; (4) capital dummy variable, if the prefecture is capital city, it is 1, otherwise 0.

4.3 Empirical Test Model

This paper uses panel data regression model in empirical test, and tests whether fiscal decentralization (FD) reduces public education provision. In empirical test, individuals of panel data are prefectures in the whole country, time series is year. Panel data regression model can overcome multi-collinearity, and provide more information, more freedom degree and higher estimate efficiency. Statistical software is STATA 11.

The panel data regression model is:

$$Y_{ijt} = \alpha_0 + \alpha_1 FD_{ijt} + \alpha_2 \ln GDPPC_{ijt} + \alpha_3 X_GDP_{ijt} + \alpha_4 DC_{ijt} + \beta D_{it} + \mu_{ij} + \nu_t + \omega_{ijt} \quad (16)$$

In this model, α_1 is the marginal effect of fiscal decentralization on education provision. $\beta = [\beta_1, \beta_2 \dots \beta_{26}]$, $D_{it} = [D_{1it}, D_{2it} \dots D_{26it}]^T$.

(1) Basic model or pooled data regression model, with the same intercept and the same slope, the same model without individual effects in the cross section changes, no structural changes, can be regarded as a simple model of cross-sectional data accumulation.

(2) Variable intercept model, with the same slope, but intercepts are not the same, model in different cross section of individual effects, and there is no structural change. Individual effects are divided into Fixed Effects and Random Effects.

(3) Variable coefficient model, except for individual effects, there is still cross-section changes in the economic structures, and thus structural parameters of different cross-section units are different.

⁹ After excluding four municipalities, there are 27 provinces, therefore, 26 dummy variables are needed.

By using covariance analysis (F statistic) to identify the model, we find that the model should be variable intercept model, which means "there is no significant difference in marginal effect of fiscal decentralization on education provision among regions, but education provision varies among regions." In addition, Hausman test reveals that the model should be random effects model.

4.4 Descriptions of Data

The panel data we use in this paper is all cities and regions from 1996 to 2007 (excluding four municipalities: Beijing, Tianjin, Shanghai and Chongqing¹⁰, and Taiwan, Hongkong and Macau), 3979 observations in all¹¹.

Data sources are: China Data Online¹², Fiscal Data Statistics of All Prefectures (1996-2007), Cities and Counties in China (1996-2007), China Statistical Yearbook for Regional Economy (1996-2007), and Statistical Yearbooks of all provinces (1996-2007).

The description statistics of all variables are in Table 4.

Table 4 Descriptive Statistics of All Variables (Province Dummy Variables Omitted)

Variables		Observations	Average	Std. Err.	Min	Max
Dependent Variables	Public Education Expenditure-to-Total Expenditure Ratio	3978	20.0544	5.4209	2.0152	41.7126
	Public Education Expenditure-to-GDP Ratio	3978	2.4032	1.9294	0.1223	17.6481
	Student / Teacher Ratio in General Primary Schools	3780	20.7936	5.3352	3.0385	48.3546
	Student / Teacher Ratio in General Secondary Schools	3780	17.3592	3.4099	3.5389	33.8764
Independent Variables	Fiscal Decentralization	3979	0.5068	0.1275	0.2097	0.9795
	Natural Logarithm of GDP per Capita	3979	8.9393	0.7677	6.7530	11.4968
	Fiscal Expenditure as Share of GDP	3979	12.3157	10.1178	1.3841	94.7462

In the panel data model, to avoid false regression, we need to analyze stability of data series, that is, unit root test. Unit root test in STATA is Fisher test. Fisher test is contributed by Im, Pesaran and Shin (2003), and it is a combination of multiple unit root tests. The null hypothesis H_0 is that unit root exists. Fisher test rejects null hypothesis at 5% significance level, so all data series are stationary (see Table 5).

Table 5 Unit Root Test Results

Variables		χ^2 Statistic	P-Value
Dependent	Public Education Expenditure-to-Total	1639.31	0.0000

10 Municipalities are special, so regression results can be more objective by excluding municipalities.

11 As in these 12 years, China's prefecture-level administrative divisions have changed, from 324 in 1996, to 334 in 2007; and there are some name changes. These changes have been considered, therefore, it is an unbalanced panel data model. In regression, because of some data defect, there will be some reduction of the amount of observations.

12 "China Data Online" is provided by China Data Center, University of Michigan.

Variables	Expenditure Ratio Public Education Expenditure-to-GDP Ratio	1045.25	0.0000
	Student / Teacher Ratio in General Primary Schools	1259.14	0.0000
	Student / Teacher Ratio in General Secondary Schools	752.96	0.0122
Independent Variables	Fiscal Decentralization	745.09	0.0209
	Natural Logarithm of GDP per Capita	739.83	0.0276
	Fiscal Expenditure as Share of GDP	990.94	0.0000

Granger causality test results show that (see Table 6) the causality setting of this model is not false, at 10% significance level.

Table 6 Results of Granger Causality Test

Null Hypothesis H_0	Observations	F Statistic	P-Value
Fiscal Decentralization does not Granger cause Public Education Expenditure-to-Total Expenditure Ratio (Lag 1)	3643	49.31	0.0000
Public Education Expenditure-to-Total Expenditure Ratio does not Granger cause Fiscal Decentralization (Lag 1)	3643	0.02	0.8761
Fiscal Decentralization does not Granger cause Public Education Expenditure-to-GDP Ratio (Lag 1)	3643	123.18	0.0000
Public Education Expenditure-to-GDP Ratio does not Granger cause Fiscal Decentralization (Lag 1)	3643	2.13	0.1380
Fiscal Decentralization does not Granger cause Student / Teacher Ratio in General Primary Schools (Lag 1)	3419	165.70	0.0000
Student / Teacher Ratio in General Primary Schools does not Granger cause Fiscal Decentralization (Lag 1)	3419	1.72	0.1901
Fiscal Decentralization does not Granger cause Student / Teacher Ratio in General Secondary Schools (Lag 1)	3403	95.55	0.0000
Student / Teacher Ratio in General Secondary Schools does not Granger cause Fiscal Decentralization (Lag 1)	3403	1.38	0.2551

5. Empirical Test Results and Analysis

The empirical test results are in Table 7 and Table 8 (province dummy variables regression results omitted; F test indicates the panel data model is significant; t test statistics corresponding to coefficients are in the parentheses):

Table 7 Empirical Test Results 1 (Province Dummy Variables Omitted)

Independent Variables		Dependent Variables	
Name	Abbreviation	Public Education Expenditure-to-Total Expenditure Ratio	Public Education Expenditure-to-GDP Ratio

Fiscal Decentralization	FD	-7.48*** (-5.31)	-0.79*** (-4.71)
Natural Logarithm of GDP per Capita	lnGDPPC	-2.24*** (-12.02)	-0.07*** (-3.29)
Total Expenditure as Share of GDP	X_GDP	-0.10*** (-6.50)	0.16*** (84.08)
Capital Dummy Variable	DC	-3.06*** (-4.58)	-0.45*** (-4.24)
Constant	_cons	47.74*** (28.88)	2.48*** (4.32)
R ²		0.61	0.89
Observations		3978	3978

***Significant at 1% Significant Level; **Significant at 5% Significant Level; *Significant at 10% Significant Level

Table 8 Empirical Test Results 2 (Province Dummy Variables Omitted)

Independent Variables		Dependent Variables	
Name	Abbreviation	Student / Teacher Ratio in General Primary Schools	Student / Teacher Ratio in General Secondary Schools
Fiscal Decentralization	FD	4.22*** (4.70)	-17.70*** (-28.21)
Natural Logarithm of GDP per Capita	lnGDPPC	-3.71*** (-32.07)	0.94*** (11.38)
Total Expenditure as Share of GDP	X_GDP	-0.10*** (-8.65)	0.09*** (11.47)
Capital Dummy Variable	DC	1.06* (1.84)	0.70** (2.05)
Constant	_cons	48.07*** (42.04)	12.89*** (16.75)
R ²		0.62	0.69
Observations		3780	3780

***Significant at 1% Significant Level; **Significant at 5% Significant Level; *Significant at 10% Significant Level

As we can see from Table 7, fiscal decentralization significantly reduces public education expenditure-to-total expenditure ratio and GDP. If the degree of fiscal decentralization increases 1 percent, public education expenditure-to-total expenditure ratio decreases 0.075 percent, and public education expenditure-to-GDP ratio decreases 0.008 percent. This empirical result is consistent with the analysis and conclusions of theoretical model above: fiscal decentralization significantly reduces public education provision. The greater fiscal expenditure authorities local governments have, the more local government officials are inclined to allocate fiscal expenditure to areas like infrastructure but not education and other public services. Therefore, the expenditure allocated to education definitely decreases.

As we can see from Table 8, fiscal decentralization significantly increases student / teacher ratio in general primary schools, but decrease student / teacher ratio in general secondary schools¹³. Through comparison, fiscal decentralization promotes provision of secondary education, and that is opposite to the results of primary education. It is possibly because that, as the analysis above, compared with secondary education, primary education has more positive externalities, which means that the probability of local employment of primary school graduates is bigger than that of secondary school graduates. Therefore, the incentive to provide for primary education by local government is weaker than providing secondary education.

In control variables, GDP per capita significantly decreases education provision at 1% significance level, which indicates that, although economic development could enhance education, but to accelerate economic development, local government over-invest in infrastructure, while under-invest in education. Public expenditure-to-GDP ratio is another important control variable, but we do not make detailed analysis here. Capital dummy variable significantly reduces education provision, which indicates that "education in capital city is better" is not correct.

Next, we divide China into four regions for further research: eastern, central, western and northeast regions. Table 9 shows marginal effect of fiscal decentralization on education provision in prefecture-level in different regions (control variables omitted because of limited space).

Table 9 Empirical Test Results in Different Regions

Region	Dependent Variables			
	Public Education Expenditure-to-Total Expenditure Ratio	Public Education Expenditure-to-GDP Ratio	Student / Teacher Ratio in General Primary Schools	Student / Teacher Ratio in General Secondary Schools
Eastern	-5.74*** (-3.17)	-0.54*** (-2.70)	13.78*** (7.87)	-9.73*** (-9.98)
Central	-0.11 (-0.06)	-0.54*** (-2.95)	2.75 (1.59)	-22.96*** (-20.75)
Western	-10.07*** (-3.29)	-1.44*** (-4.01)	-1.65 (-0.98)	-20.48*** (-17.31)
Northeast	-6.37** (-2.29)	-0.66* (-1.89)	5.98*** (4.40)	-12.49*** (-7.94)

***Significant at 1% Significant Level; **Significant at 5% Significant Level; *Significant at 10% Significant Level

As we can see from Table 9, in four regions, fiscal decentralization reduces education provision by varying degrees. The marginal effect of fiscal decentralization on education provision is the highest in western region, if the degree of decentralization increases 1 percent, public education expenditure-to-total expenditure ratio decreases 0.1 percent, and public education expenditure-to-GDP ratio decreases 0.014 percent; student / teacher ratio in general primary schools does not significantly change, and student / teacher ratio in general secondary schools decreases 0.23. Eastern and northeast regions are in the middle. In eastern region, if the degree of

¹³ As we know, the lower student / teacher ratio is, the more education provision is.

decentralization increases 1 percent, public education expenditure-to-total expenditure ratio decreases 0.064 percent, and public education expenditure-to-GDP ratio decreases 0.006 percent; student / teacher ratio in general primary schools increases 0.14, and student / teacher ratio in general secondary schools decreases 0.1. In northeast region, if the degree of decentralization increases 1 percent, public education expenditure-to-total expenditure ratio decreases 0.057 percent, and public education expenditure-to-GDP ratio decreases 0.005 percent; student / teacher ratio in general primary schools increases 0.06, and student / teacher ratio in general secondary schools decreases 0.13. The marginal effect of fiscal decentralization on education provision is the lowest in central region.

The possible reason is that, although the economic growth is not slow in western region in recent years, however, previous economic foundation is too weak in western region, so if western prefectures have more fiscal power, the fund is still over-invested in infrastructure to attract outside capital to enhance economic development. Thus, public education and other public services are neglected. The eastern and northeast regions are the most economically developed areas in China, also need to pay attention to economic development as political mandate. In current yard-stick competition system, the local officials could relatively neglect public education. In addition, different economic and fiscal policies of central government to different regions are another important reason.

6. Conclusions and Policy Proposals

Education can improve the overall quality of population, and more importantly, it has long-term positive effects on the entire country, both on the economy and society. In China, the education expenditure-to-GDP ratio is low, what makes things worse, the decentralized fiscal system decreases education expenditure.

This paper discusses how the decentralized tax-sharing system affects public education provision, and find out that fiscal decentralization decreases the public education provision, by building intergovernmental game theory model and prefecture-level 1996-2007 panel data empirical test to verify that this phenomenon exists in China.

The degree of fiscal decentralization of local governments significantly decreases public education provision. China is currently in a period of rapid urbanization, and large migration is happening, so education is not an entire local public good, but is also a national public good. In addition, decentralizing most of the education responsibility to local governments is inconsistent with most countries of the world. If local governments have greater autonomy in fiscal expenditure, it will reduce investment in education because of the positive externalities of education provision. For example, the implementation of "Two Exemptions and One Subsidy" policy¹⁴ itself is a good policy to improve compulsory education, but because matching fiscal burden of local governments might bring pressure on local finances and reduce incentive of local governments to implement policies. Therefore, it is necessary to retrieve some education responsibilities to the central government.

14 "Two Exemptions and One Subsidy" policy refers a school-funding policy, which supports students from poor families in rural compulsory education by Chinese government since 2001. Mainly for students from poor families, "free of fees, free textbooks, and gradual subsidies for school accommodation". Central government is responsible for providing free textbooks, while local governments are responsible for fees and school accommodation subsidies.

In comparison of primary and secondary education, we get surprising conclusions. The effect of fiscal decentralization on secondary education is opposite to that on primary education. With increasing of the expenditure power of local governments, education resources are relatively more allocated to secondary education, but primary education has been neglected, which is because of more positive externalities of primary education.

While fiscal decentralization increases enthusiasm and autonomy of local governments, it also brings negative effects on public services. In fact, except for education area, the under-investment in public service is also observed in other areas of local public services, such as healthcare and environment (Luo, 2010), which are also very important to people's life.

At present, the key issue of fiscal decentralization system is to make a clear division of responsibilities between central and local governments. Because the foundation of expenditure responsibility division is the clear division of tax revenue, and the tax revenue should match the responsibility at all levels of governments. If the transfer from central government to local governments is unreasonable, that may encourage local governments to reduce local taxes but increase expenditure. Division of expenditure responsibilities should be clarified by, and should include which public good should be provided by each level of government. The public goods and services benefited by the whole national population should be provided exclusively by central government; local government should provide public goods and services benefited by local residents; in public projects with "externalities", central government should be involved, for example, education projects, especially primary educations.

From public finance system, to improve the population welfare, central government should increase the revenue of local governments, and alleviate some expenditure burden, to re-balance between decentralization and centralization, and relieve the vertical fiscal imbalance; or subsidize public goods input of local governments through direct transfer payments, especially for western region. What's more, local government officials' performance assessment system needs to be adjusted to prevent fierce yard-stick competition, by reducing the relative importance of GDP growth rate to public services. If all of those policy proposals above can be finished, the problem of shortage of public education and other public services will be resolved essentially.

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