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Government Education Expenditure, Third-party Spillover Effect and Economic Growth in China

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Abstract

This paper investigates the impacts of government education expenditure on economic growth in China taking into account the spatial third-party spillover effects. After the theretical analyse, a spatial panel estimation model based on the augmented Solow model is applied by using province data in China during 2007 and 2013. The results reveal that (1) In a whole, Government education expenditure in China has significantly positive impact on economic growth, but expenditure in different educational level shows different results. Government education expenditure in below high-education is positive related to local economic growth, whereas the effect of education expenditure in high-education is insignificant. (2) Neighboring government education expenditure shows spatial spillover effects on local economic growth, and spatial spillover effects in two education level is different. (3) Other input factors of third-governmet also have spatial effects. Some policies about education and economic development are proposed. Meanwhile this study recommends that corporation relationship among regions is very important.

Keywords: government education expenditure, spillover effects, economic growth, contiguity factors

1. Introduction

The relationship between government expenditure and economic growth are discussed widely, especially the government education expenditure. But the relationship between government expenditure and economic growth has kept a series of controversies in economic literature. Some authors believe there is a positive and significant impact of government expenditure on economic growth (Jiranyakul & Brahmasrene, 2007). Considering five key sectors of government expenditure (security, health, education, transportation, and communication, and agriculture), Bhunia (2012) found government programs on education have impact on economic growth by providing equipment, construction of classrooms and other facilities and services for education. Research by Patron and Vaillant (2012) supported education policy affect the evolution of the ratio of skilled-to-unskilled labor stocks and education is one of the indispensable factors to achieve high and sustainable economic growth. But others believed a negative or complicated correlation between economic growth and public education spending (Laudau, 1983; Tomori & Adebiyi, 2002; Nurudeen & Usman, 2010). Saad and Kalakech (2009) found a short-run negative correlation and a long-run positive relationship between education expenditure and economic growth. Dastidar and Chatterji (2015) examined the empirical relationship between public primary, secondary and tertiary education expenditure and economic growth in India, and found different impact in different education level.

Apparently scholars have devoted significant attention to the function of education expenditure on economic, but studies mentioned above ignored the influence of "location" which is an indispensible factors because spatial dependency exists between various regions. By giving a closer look at the regional composition of the whole national economy and interregional flow of related resources, substantial implications can be given from this information. Spatial econometric analysis can consider this interregional geographic effect. In recent years, some economic studies began to use spatial analysis method to investigate the spatial spillovers of some economic phenomenon, especially agglomeration economies (Boschma, Minondo, & Navarro, 2011; Cortinovis & Oort, 2015). There are also literatures available to presents partial analyses of the spillover effect of government expenditure on economic growth (Olson, 1969). Karjoo and Sameti (2015) used geographic weighted models to examine the impact of government expenditure on economic growth and compared the results with the

traditional regression model. He found adapting location factors as a new independent variable can increase the power of the model. Druckera (2015) focused on the relationship between US higher education and regional economic performance with estimating spatial spillovers and found there is considerable influence across space.

To be more specific, this paper seeks to estimate the impact of government education expenditure on economic growth from a spatial perspective. The contribution that for the universal research may be as follows: Firstly, using spatial econometrics method to examine "neighborhood" and "location" factors. This econometric methodology allows us to estimate not only the coefficients for each independent variable, but also to account for spatial effects among regions. Secondly, not only the government education expenditure as a whole, we also consider the spatial effects of education expenditure in different education level. Finally, besides the spatial effect of education, we also investigate the spatial effect of other independent variables The outcomes have substantial implications for China's regional policy: The rest of this paper proceeds as follows: Section two gives the hypothesis through theoretical analysis, Section three shows the empirical model and its properties. Section four uncovers the findings of the study; and section five contains the conclusion of the paper and recommendations.

2. Theoretical Bases and Hypothesis

Among many factors which affect the economics growth of a country, government is considered to be a important stimulant. This may conclude the government management system, government expenditure, tax, and so on. With fiscal decentralization, which has often been regarded as a means to achieve greater economic efficiency and growth, taxes assigned at the sub-national level have significantly positive correlation with the national growth rate in a long run (Rodriguea-pose & Kroijer, 2009). Meanwhil according to public economic theory, government expenditure has been an effective policy tool to control economic development. Government education expenditure, as a important composition of government expenditure, also has powerful influence on economic growth.

The main implications and mechanism of government education expenditure on economic growth are analyzed in the following. Firstly, this instrument of government control promotes economic growth in the sense that public education investment, such as the investment to education equipment, contributes to capital accumulation. Capital input is the essential factor to improve economic growth. Secondly, government education expenditure play a central role in human capital accumulation by funding varies of education, then raise the productivity of labor and increase the growth of national output. Education is the basis of human capital accumulation (Odit, Dookhan & Fauzel, 2010) and human capital has taken on a vital role in the endogenous economic growth models (Barro, 1991; Robert & Lucas, 1988; Ciccone & Papaionnou, 2009). Labor force with different education level may show different productivity. Public education expenditure affects the evolution of labor stocks from unskilled to skilled (Rossana & Marcel, 2012). Thirdly, public education expenditures might crowd out some physical capital and private human capital investment that enhance economic growth (Blankenau & Simpson, 2004; Greiner, 2008).

As we know, fiscal education expenditure per capital in China had increased from 509.13 yuan to 1535.59 yuan during the period of 2007-2013. The ratio of education expenditure per capital to GDP per capital in 2013 also increased over one percent on the basis of 2.50% in 2007. With the rapid progress in government education expenditure in China, we have the first proposition based on the three channels mentioned above.

Proposition 1: Government education expenditures in China should have complicated influences on economic growth. This impact may vary in different educational level.

Though the channels through which the education expenditure influences the economy are relatively well established, there are some differences when considering the "neighborhood" and "location" factors. According to the fiscal decentralization system, local government has the right and responsibility to develop local education and economy. The local government will make their education and economic decision based on many complicated factors such as economic, education and revenue. Given the spatial theory, one important factor which should be included is the influence of neighborhood region, because most spatial data exist spatial correlation (Anselin, 1988).

Firstly, the education expenditure of neighborhood government may affect education expenditure decision of the local government, and results in the change of local economic growth (Zhu, Zong, & Chen, 2013). There is competitive and cooperative relationship among government education expenditure (Li & Yin, 2012). Secondly, due to the flow of labors and students, the local government can share the benefit of neighborhood government education expenditure. On the one hand, with the optimization of education environment in neighborhood region, the agglomeration of education resources in this area will increase. The local economy will benefit from more

education resources inflowing to local and neighborhood region. On the other hand, the education resources flowing from neighborhood region to local region will enhance the local economic growth. Thirdly, the economic growth in neighborhood region, which partial comes from the education expenditure, will influence the local economic growth. This economic correlation among regions has been certified (Pan, 2012). When we refer to the driving force of regional economic growth, we shouldn't ignore the spatial influence of "neighborhood". So we have the second proposition.

Proposition 2: Expenditures on different educational level and economic input resources of the third government in China have spillover effect on local economic growth.

3. Empirical Models and Properties

On the basis of human capital theory which postulates that human capital is the vital factors of economic growth and government management theory, government have play an important role in the cultivation of human capital. The augmented Solow model, which was came up with by Mankiw, Romer, & Weil (1992), is used in this paper. Oluwatobi and Ogunrinola (2011) used this model to analyze the relationship between human capital development and economic growth. The basic assumption of this model is the fact of non-homogeneity of labor force. That means possessing different levels of education may result different productivity.

The augmented Solow model is specified as:

$$Y = AK^{\theta}(hL)^{\rho} \tag{1}$$

Where Y=Output level; K=Stock of physical capital; hL=Real labor force which is the function of h and L, while h=Education level and L=Nominal Labor input level; A=Total Factor Productivity level; θ=Elasticity of capital input with respect to output; ρ=Elasticity of real labor input with respect to output.

To further the relevance of this study, we modify the model. Firstly, we assume the education level is decided by government education expenditure. Private education investment system is excluded in our study due to the fact that most school especially high-education school are funded by government in China. Secondly, besides the whole government education expenditure (*Edu*), we also consider two different education levels----below high-education (*Bel*) and high-education (*Hig*). The purpose is to differentiate the impact of different education level expenditure on economic growth. Thirdly, we transform this model into a log-linear form. Econometrically, the model is specified as follows:

$$LnY_{it} = \alpha_0 + \alpha_1 LnK_{it} + \alpha_2 LnL_{it} + \alpha_3 LnX_{it} + \lambda_i + \delta_t + \mu_{it} \tag{2}$$

Based on the available data and research purpose of our study, output level (Y_{it}) is represented by real Gross Domestic Product (*GDP*) in region i at time t. Stock of physical capital (K) is measured by the Gross Fixed Capital, which is acquired by Perpetual Inventory Method (*PIM*) as Zhang, Wu & Zhang (2004). Nominal labor input (L) is measured by the worker number at the end of the year. Independent variable X represents government education expenditure scale. According the expenditure structure in China, We get the whole government education expenditure (*Edu*) by fiscal education expenditure per capital multiplying the total population in each province. In general, fiscal education expenditure includes operating expenses for education, capital construction for education and educational surcharge. Due to the availability of classification data, expenditure on different education level is measured by operation expenses in high-education (*Hig*) and below high-education (*Bel*). This will help us to analyze the different influence of classfied education expenditure on economic growth in some extent. Additionally, to acquire stable estimators of above empirical model, we use the education expenditure growth rate as an alternative index to education expenditure scale. u=random disturbance term, and $u \sim iid(0, \sigma^2)$ .The model contains time fix effect δ_t and province fix effect λ_i, in an attempt to control the impact of time and province factors, which aren't included in this empirical model.

In the model above, the spatial effect is ignored. Generally, many neighboring governments exists interaction, so we further estimate the effect of neighboring government education expenditure and economic input resources on local economic growth from a spatial perspective. In order to account for geographical proximity, a spatial structure regression model has to be imposed.

$$LnY_{it} = \alpha_0 + \alpha_1 LnK_{it} + \alpha_2 LnL_{it} + \alpha_3 LnX_{it} + \alpha_4 WLnX_{-i,t} + \lambda_i + \delta_t + \pi_{it} \tag{3}$$

Where $\pi_{it} = vw\pi_{-i,t} + u_{it}$, $|v| \leq 1$. The spatial lag term $WLnX_{-i,t}$, which are obtained by spatial weight matrix multiples independent variables of other regions except the local region, captures the spatial effect of input factors in other government on local economic growth. With respect to proposition 2, spatial coefficients represent the direction and volume of the spatial effects of independent variables. The spatial weight matrix W in panel data spatial model is a $NT \times NT$ matrix and N=31, T=7 in this paper. All elements of W equal zero except

that are on the diagonal line. These elements on the diagonal line are notated by W_n (31×31), with their elements demonstrating the spatial connection pattern of two regions in geography. If two regions are not geographical neighbors, the value of W_{ij} will be zero, otherwise will be one.

In order to test above hypothesis, we use mainly secondary cross-provincial data in China which is obtained from the province and national Bureau of Statistics in China and the national education funds execution statistics bulletin. Considering the fiscal expenditure revolution occurred in China in 2007, this study covers a period of 2007 to 2013. We adjust nominal data to real data by using GDP index (Gao & Mao, 2011). General OLS estimation has some shortcomings when the spatial factors are included, namely that it produces an inefficient estimator. To solve this problem, we use maximum likelihood estimation method (MLE) to estimate spatial panel data model (Elhorst, 2003). Stata 10.0 is used as the necessary software.

4. Model Estimation and Discussion

We start with providing our traditional economic growth model results where education expenditure is represented by expenditure scale in the former two columns and expenditure growth rate in other columns. Our results show that education expenditure in China as a whole increases economic growth in traditional economic growth model even controlling region input characteristics of labor and capital. As seen from column (1) and column (3) of Table 1, the estimated coefficient of education expenditure as a whole is positive and statistically significant at the 5% level. This empirical result means local government in China has played an important role in developing local education and economic growth. The education expenditure speeds up economic growth because the positive impacts of education expenditure offset the negative effects that have been mentioned in theoretical analysis section. In addition, a region improving its education policy is likely to improve other economic policies as well. As a result, the joint impact of all those policies will further increase economic growth.

But expenditure in different educational level in China shows different results. As noted by Su (2004), that levels in a hierarchical educational systems implies imperfect substitutes, which means similar budget in different level have different effects on efficiency. In the following columns, we investigate government education expenditure from two levels to examine the significance of our result. We conclude government education expenditure in below high-education (*Bel*) is positive related to local economic growth, whereas the effect of education expenditure in high-education (*Hig*) is insignificant. According to the *T*-statistic, the growth of the government education expenditure in below high-education is the significant variable that influences the local economic growth. Fundamental education can improve cultural qualities and knowledge background of local people in a whole. These qualities are essential factors for economic growth. Most population of this region will benefit from education development. But only a few people have the opportunity to go to college. After graduating from university, many of them will flow to developed region to gain better career and more opportunities. Regions spending money on high-education can't gain the corresponding returns. Our results are robust to consider different index representing the education expenditure. Using education expenditure growth rate or education expenditure scale has shown similar effects.

Table 1. Traditional economic growth effect of education expenditure

	Scale		*Growth rate*	
	(1)	(2)	(3)	(4)
LnEdu	2.142**(0.961)		0.023**(0.011)	
LnBel		1.289**(0.647)		0.015**(0.007)
LnHig		2.073(1.884)		0.029(0.036)
LnK	4.214*(2.294)	4.071*(2.239)	0.782*(0.420)	0.917*(0.502)
LnL	3.021**(1.438)	3.108**(1.480)	0.641**(0.305)	0.619**(0.311)
Log L	89.346	90.521	94.829	100.498
LR chi^2	228.163***	329.184**	267.152***	395.115**

Note. Before ( ) are estimated parameters of independents. Stationary standard errors with heteroscedasticity adjusted are in ( ). ***, **, *denote 1%, 5% and 10% significance levels respectively.

We enrich our empirical analysis and provide further results from spatial perspective with its consideration of the contiguity factor. We attempt to discover the effect of education expenditure in neighboring government on the local economic growth and whether this inter-region effect changes the impact of local education expenditure on local economic growth. The first step to examine contiguity factor, which has been done in column (1) and column (2) of Table 2, is to merely estimate the parameter of neighboring government education expenditure. Afterwards we add other input factors of neighboring government into empirical model to investigate more complicated contiguity effects. Many economic studies use this technique to increase the reliability and power of prediction.

According to Table 2, with estimated results of basic input elements of labor and capital in accordance with previous analysis, the parameter of local education expenditure decrease but continue to be significant. This could be the result of including neighboring government education expenditure as new independent variables in the empirical model. This significance confirms that local education expenditure in China is a vital factor to local economic growth. Furthermore, from the perspective of each spatial lag coefficient of education expenditure variable, it reveals that the local economic growth in China is influenced by education expenditure of its neighboring government, as mentioned in theoretical section. The more the neighboring governments spend on education, the higher the local economic growth may achieve. Though education expenditure isn't the only reason for economic growth, education expenditure of local government and neighboring government have joint influence on local economic growth after controlling other input factors. Bilateral coordination may have the merits of raising economic growth rate of both regions. Meanwhile, we examine the effect of contiguous education factor on local economic growth from different education level. Estimated parameters in column (2) of Table 2 show some interesting changes. Local economic growth benefits more from high-education of neighboring government than below high-education. The spatial effect of high-education expenditure is more significant than below high-education. The most direct reason may be the easier mobility and the higher productivity of high-education workers. But we should avoid the excessive utilitarian struggle of attracting high-education workers, because bilateral coordination may have the merits of raising public education expenditure above the suboptimal non-cooperative levels (Egger, Falkinger & Grossmann, 2012).

What can not be ignored is the interregion effect of other input factors besides education expenditure. Empirical studies need to take this issue into consideration while investigating interregion effect between education expenditure and economic growth in province. Without controlling the interregion effect of other input factors, the impact of neighboring government education expenditure on local economy may be amplified. These coefficient estimations are presented in Column (3) and column (4) of Table 2. Parameters of *WLnK* and *WLnL* show that local economic growth is affected by input factors not only of its own but also of contiguous government. Hence, the hypothesized relationship between input factors of neighboring government and local economic growth shows up in this empirical research. The input factors of neighboring government have positive and significant impaction on local economic growth.

Our results are also robust in different regressions, as well as employing education expenditure growth rate or education expenditure scale to represent the education expenditure. The corresponding results are displayed in column (5) to column (8).

Table 2. Spillover of education expenditure on economic growth

	Scale				*Growth rate*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LnEdu	2.063**		1.905**		0.019*		0.016**	
	(0.984)		(0.909)		(0.010)		(0.007)	
LnBel		1.892**		1.627**		0.012*		0.011*
		(0.951)		(0.729)		(0.007)		(0.006)
LnHig		1.919		1.872**		0.018		0.016**
		(0.476)		(0.872)		(0.016)		(0.007)
LnK	3.112**	3.278*	2.626*	2.522*	0.652*	0.627**	0.534*	0.592*
	(1.449)	(1.801)	(1.419)	(1.392)	(0.355)	(0.292)	(0.292)	(0.325)
LnL	2.451**	2.167*	1.941**	1.830*	0.431**	0.309*	0.261**	0.238*
	(1.099)	(1.180)	(0.904)	(1.007)	(0.217)	(0.169)	(0.124)	(0.131)
WLnEdu	0.078*		0.045*		0.071*		0.040*	
	(0.042)		(0.025)		(0.039)		(0.022)	
W LnBel		0.010		0.009		0.003*		0.001
		(0.013)		(0.011)		(0.002)		(0.001)
WLnHig		0.017*		0.011*		0.004*		0.003*
		(0.009)		(0.006)		(0.002)		(0.002)
WLnK			0.017*	0.015*			0.003*	0.002*
			(0.009)	(0.008)			(0.002)	(0.0011)
WLnL			0.012**	0.009**			0.001**	0.001**
			(0.005)	(0.004)			(0.004)	(0.0004)
Log L	66.43	70.82	52.19	60.28	51.03	55.28	44.73	41.32
LR chi2	72.32***	58.58***	66.81**	49.72**	44.47***	30.35***	44.98**	33.16**

Note. The same as the above table.

5. Conclusion and Recommendation

We use one of the new and competent ways to investigate the relationship of education expenditure and economic growth with considering contiguity factor. This article aims to analyze whether government education expenditure efficiently promotes economic growth in local region and adjacent region, whether other input factors in adjacent area influence economic growth in local area. By applying this spatial method to augmented Solow model with province data in China during 2007-2013, the results presented in different model by using different index indicate that geographic weighted regression is appropriate. Neighboring government education expenditure has a significant and positive effect on local economic growth. The other input factors such as labor and capital also have spatial effects. But the spatial effect of education expenditure in different education level isn't the same. Our results are robust when selecting alternative index in different regressions. From the analysis of this paper, the following implications can be summarized.

Firstly, we should increase the government education input in each province. Although not all education expenditure allocated in different sector seems to enhance economic growth, but as a whole there are significant evidence to support human capital theory. Local governments should be made to supplement national education funding, as this will go along way boosting the achievements in economic growth.

Secondly, cooperation relationship among provinces is as important as competition relationship. Our empirical results show the existence of space effects which has sufficient implication for policymakers in local government. The increase of neighboring government education expenditure leads to enhancing economic growth scale not only in neighboring area but also in local area. Furthermore, local economy can be stimulated by the spillover effect of neighboring area economic development. Then, every area benefits from the blooming of education

expenditure and economic development in adjacent area. Every government should seek opportunity of common development in the conflict and friction.

Thirdly, local government should make other economic policies with education policy according the institutional structure, labor market characteristics and openness policies, and so on. We should emphasize the network external effect. On the one hand, optimal condition for education budget allocation is very import to improve the efficiency of high-education. On the other hand, reducing the economic gap among province and making incentive policy for intellectuals contributes to prevent high quantity labor force outflow. Such policies will create incentives for high-education people to participate activities enhancing economic growth in local area rather than rent-seeking activities.

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