Advances in Applied Economics and Finance (AAEF)
Vol. 2, No. 3, 2012, ISSN 2167-6348

www.worldsciencepublisher.org

Equilibrium Relationship between Education Spending and Economic Growth

An Empirical Study of China's Yearly Data

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Abstract –The relationship between education spending and economic growth has already caused great concern and long-run debate in academia and many countries. This thesis, using China as the case , conducts an empirical study of the relationship of education spending and economic growth from 1994 to 2011. This article takes root tests and the variable stability study based on the variable long-run equilibrium analysis.It also applies the Granger Causality Test to do empirical studies on the causal relationship between the variables.

Keywords –education spending ; economic growth; cointegration ; causality

1. Introduction

Education spending and economic growth is a topic of divergent views. Generally speaking, in the economically developed countries and regions, the funding for education is more adequate, adequate funding for education spending ensures the rapid development of education in the region. Usually the rapid development of education accumulated a wealth of human resources for the country or region in turn provides a strong impetus for economic development. Economic growth, investment in education funding, education, and development should be a virtuous cycle; otherwise situation will be quite worrying.

This article's data covers from 1994-2011 for research, education spending and economic growth in the long-run equilibrium causality more detailed empirical research. This article is divided into five parts. The next following part is a review of the existing literature on education spending and economic growth from a theoretical perspective, then the third part is an introduction of the model, variables and data, the fourth part is the application above specific empirical analysis and empirical model of the data within the sample interval, the last part gives a brief conclusion.

2. Theory Review

Harrod-Domar's economic growth model of the accumulation of physical capital played as the sole driving force of economic growth. Inferences was made in accordance with this theory but was in contradiction with the people's long-term economic statistics and observations. So Solow proposed an economic growth model, and labor as factors of production to the introduction of the production function. Then, Solow's study in 1957 also found that output growth cannot fully explain the growth of capital and labor, known as "the remaining mystery". In order to explain "the remaining mystery", Solow first proposed technological progress as a factor of production to the introduction of the production function. However, in the Solow model, technological progress is exogenously determined not in the model, which caused the reproach of the people and led to a large number of empirical studies in the 1960s and beyond, growth theory revolves around the interpretation of the "surplus" and the development.

In recent years, a large number of researchers study on the effect of the education and economic growth. Different model structure and the choices of model variables do exit. Data processing method of proxy variables are quite different according to different sources, so they have not come to an absolute result.

(1) A representation of the proxy variables. Usually only education indicators are seen as agents. Some agents are not comprehensive enough .Theoretical and empirical analysis shows that the amount of these factors must be in the same direction.

(2) Problem of endogeneity offset. Education and economic growth may occur because of three reasons. First of all, education demand and supply effects. Second, the development of modern needs because of the educated people. The third is generally believed that the investment in education. Countries with higher education output enjoy more efficiency in the allocation of resources than non-educational. Usually this is considered to be endogeneity offset problems.

(3) Bidirectional causality problem. Usually there is considered to be bidirectional causal relationship between education and the economy, but still we found only the return of the sense of the relationship. It is not yet found Granger causality between education and productivity. Maybe it is because of measurement error and the presence of singular value caused by the lack of representativeness.

3. Model, Variables, and Data

Generally we use Granger Causality Test to determine whether changes in a variable economics are the reasons for the change in another variable. Using Granger causality test must first prove that the random variable is stationary series. A Granger causality test process can be described cointegration between the time series unit root test variables and Granger causality test.

One difficulty in time series analysis is the stationarity of the variables investigated. The majority of overall economic time series have a stochastic trend. These time series are referred be "non-stationary" time series. When the statistical methods are used for stationary time series, it is very easy to judge security errors (Chen Yan, Chen Yongzhi, 2004). The dynamic econometric theory requires macroeconomic empirical analysis, so we must first do some stationary tests on variables otherwise analysis will appear the phenomenon of "spurious regression" (spuriousregression). For those non-zero-order sequence available cointegration test analysis for different time-series variables, only cointegration before there may be a long-term and stable relationship.

(1) Unit Root Test

The test variable process is called unit root tests. Stationary series are around a mean value fluctuations, and should be moved closer to the trend. Non-stationary processes are not of this nature. Commonly unit root is used as to test DF ,but we cannot guarantee that the residuals in the equation is the white noise (white noise), Dickey and Fuller DF test method expanded form ADF (Augented Dickey-Fuller Test) test, which universal application integration test (Li Zinai, 2000). The basic principle of the test method is n times the differential approach to non-stationary series into a smooth sequence specific method is to estimate a regression equation:

$$\Delta X_t = \alpha_0 + \alpha_1 t + \alpha_2 X_{t-1} + \sum_{i=1}^{k} \beta_{t-i} \Delta X_{t-i} + \mu_t$$

α_0 is a constant term, t the time trend, k number of lags (optimal lag) μt residuals. Test the null hypothesis H_0: $\alpha_2 = 0$; alternative hypothesis H_1: $\alpha_2 \neq 0$. If α_2 the ADF value is greater than the critical value to reject the null hypothesis H_0 and accept H_1 $\{X_t\}$ is I (0), that it is a stationary sequence. Otherwise, there is no unit root, that it is non-stationary series, need further testing until you confirm that it is a sequence of d order one, I (d). Join k lag order residual term μ_t is white noise.

(2) Cointegration Test

Cointegration relationship between the variable sequence is first proposed by Engle and Granger. The basic idea is that the variable sequence is of two or more non-stationary series, but some linear combination may show stability and long-term stable relationship. In other words, cointegration relationship exists between these two variables. The inspection is as following. If the sequence X_{1t} the X_{2t}, ..., the X_{kt} are of order d single whole, there are a vector $\alpha = (\alpha_1, \alpha_2, ..., \alpha_k)$, making in Zt = αXt 'to I (db), which b> 0, Xt '= (X_{1t}, X_{2t}, ..., X_{kt})', that the the sequence X_{1t}, X_{2t} ... X_{kt} (d, b) order cointegration, credited as $X_t \sim\sim$ CI (d, b), α cointegration vector. If two variables are single integer variable, only when their single integration order is the same and only possible cointegration of different integration may go through a linear combination of a low-end single integer variable . The cointegration significance is that it reveals a long-term stable equilibrium relationship exists between variables. Cointegration between economic variables cannot be separated from each other too far. So that explain the reason why it does work. to make them short-term within the deviation from the equilibrium position, in the long term will automatically return to a balanced

(3) Granger Test of Causality

The basic principle of Granger causality test is to do the regression of Y on other variables (including the value of its own past), if the hysteresis value of X is included can significantly improve the prediction of Y, we say that X is Y (Granger) causes; Similarly define Y is the X (Granger) reasons. This is the following:

Unconditional model:

$$Y_t = \alpha + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \sum_{j=1}^{k} \beta_j \Delta X_{t-j} + \mu_t \qquad (1)$$

Conditional model:

$$Y_t = \alpha + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \mu_t \qquad (2)$$

μ_t as white noise sequence, alpha, beta is a coefficient. n is the sample size, m, k is the number of lags of Y_t, X_t variables, so that (1) the residual sum of squares for ESS1; residual sum of squares (2)-ESS0.

The null hypothesis is H_0: $\beta_j = 0$; alternative hypothesis H_1: $\beta_j \neq 0$ (j = 1,2, ..., k). If the null hypothesis is established, then:

$$F = \frac{(ESS_0 - ESS_1)/m}{ESS_1/(n-k-m-1)} \sim F(m, n-k-m-1)$$

The amount of F statistical obeys the first degree of freedom and the second degree of freedom for the n-(k + m +1) F distribution. F-test value is greater than the critical value of the standard F distribution, rejecting the null hypothesis and changing in X, Y reason for the change. Geweke, Kollias and Granger's research show the paradigm and the basis of the following causal analysis model based on vector auto regression (VAR) Granger causality analysis basis.

$$g_t = \sum_{i=1}^{k} \zeta_i^g g_{t-i} + \sum_{i=1}^{k} \zeta_i^m m_{t-i} + \psi_t$$

$$m_t = \sum_{i=1}^{k} \pi_i^g g_{t-i} + \sum_{i=1}^{k} \pi_i^m m_{t-i} + \varepsilon_t$$

We metering the economics software Eviews6.0 to do cointegration test and regression analysis of the economic growth and education funding total investment in these two sets of data from 1994 to 2011. The data are from the China Statistical Yearbook 2011 ", we must first explane the indicators and data on relevant variables.(1) Economic growth, macroeconomics, and GDP reflect the growth of the economy. They also reflect a country's or a region's economic total scale in this article that selection of the 1994 to 2011 a total of 17 years. The GDP data as is explained variable. (2) This paper selects education funding from 1994 to 2011.The data of the total investment of China's education funding formula is as the following explanatory variable: the total investment of the total education budget = education budget + private funding for education + social donation income + career income + other education funding.

4. Empirical Analysis of estimated results

(1) Root test results

The time sequence of the variables in this article may have non-stationarity if each variable's first unit root pass the stationarity test. If non-stable, we will use cointegration tests to analyze the relationship between the variables. Finally, the causal analysis of the relationship is just between the variables. In order to eliminate the effect of price factors, we take the natural logarithm of the original sample data, respectively LnGDP, and LnMDF. Stochastic trend and deterministic trends are due to the vulnerability of macroeconomic data. The two sets of time series data has strong time trend, which does not meet the stability requirements of the time series. In order to prevent spurious regression phenomenon caused by unstable data unit root test is necessary. Also it can be seen in the table of test results obtained from the ADF unit root test method (Table 1) nonstationary time series LnGDP, LnMDF were stable after a first-order differential, and the same to order one sequence, meet cointegration test prerequisite.

Dicker-Fuller standards exit in order to ensure the validity of the model, the first application of unit root tests (ADF) test the stability of the economic growth rate (gt) and the education burden of time-series data (mt). The test results are shown in Table 1.

Table 1 Rate of EconomicGrowth and Spending on Education ADF test

Variable	t_μ	t_τ
gt	-2.3927[0]	-2.3298[0]
mt	-4.4135**[0]	-2.5529[2]
∆ gt	-4.2655***[1]	-4.1462**[2]
∆ mt	-3.7178**[0]	-3.7488***[1]

Note: ① t_μ, t_τ contains a constant term respectively and linear time trend.

② *, **, ***, respectively are at 90%, 95%, 99% confidence level on the significant resistance.

③within the digital representation of the lag order, the number of lags in the text is based on the AIC criterion and consider the overall inspection of determination.

Judging from the results, unstable time series from 1994 to 2011 are different, but the first-order difference stationary for 1 order one I (1).It does not consider the time trend mt significantly and order one I (0)consider the time trend was not significant. The first-order differential smooth, for 1 order one I(1)

(2) Cointegration analysis

From 1994 to 2011, if we consider the time trend outcomings, the education spending and economic growth indicators are at I (1) process, so it can be used in cointegration analysis. Johansen cointegration law test can also be used here to analyze relationship between education spending and economic growth. Due to the use of a two-variable system, the null hypothesis of no co-integration relationship H0: r = 0, H1: r = 1, reject the null hypothesis that cointegrated. The choice of the lag order is as following. The test results are shown in Table 2.

Table 2 *Johansen cointegration test results*

Eigenvalue	Likelihood ratio	5% Threshold	1% Threshold
0.690117	30.25729	15.41	20.04
0.399145	9.169216	3.76	6.65

The test results show that in the case of education spending and economic growth, the null hypothesis H0: r = 0.The statistical magnitude is greater than the 5%

significance level threshold, so we can accept the alternative hypothesis .H1: r = 1, while in H0:r ≤ 1 under the statistical value is less than the 5% significance level threshold, so we can accept the null hypothesis H0: r ≤ 1.A cointegration relationship between education spending and economic growth does exit. This means that there is a long-run equilibrium between spending on education and economic growth from 1994 to 2011 in China.

(3) Causal analysis results

Cointegration test is based on the relationship between education spending and economic growth in 1994-2011 Granger causality test, the test results are shown in Table 3.

Table 3 Education spending and economic growth causality test

Causality assumes	F	p-value	Conclusion
If mt is not the reason of gt	1.17215	0.33832	accept
If gt is not the reason of mt	8.22242	0.00435***	deny

Note: statistic P-value test is the probability value. If the P-value of less than 0.05, it indicates causality in a 5% significant level established, and if the P value of less than 0.1, it indicates that the causal relationship in the 10% significance level established under the contrary, so the causal relationship is not established.

From the test results, the impact of education spending on economic growth is not obvious, but the impact of the economic growth in education spending is significant. Only one-way causal relationship between education spending and economic growth, and there is no way to receive each other's feedback.

5. Conclusion

This thesis is based on causal analysis method to conduct an empirical study of the data within the sample interval from 1994 to 2011. First we conducted a smooth data analysis and then root test shows that the first-order differential time-trend of economic growth and the burden of education in the 1994 to 2011 range with smoothness. Cointegration found that from 1994 to 2011, There is a long-run equilibrium between China's education spending and economic growth. The causality analysis finds out that only one-way causal relationship between education spending and economic growth and there does not exist ways to receive feedback each other. The result is that economic growth is the Granger cause of education spending, and education spending is not Granger cause of economic growth. The results show that education spending is not a strong economic growth in the exogenous variables.

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Vitae

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