

Public Education Spending and GDP in China: Granger Causality Tests Using Toda-Yamamoto Technique

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Abstract - The quantity of national fiscal budget expenditure on education in China has expanded over the past decade. The paper aims to investigate whether GDP may be a significant cause of public education spending. Three series covered the period from 1991-2011. The paper utilized an unconventional Granger causality test in order to deal with the integrated properties of data. Both GDP and CPI Granger caused the share of public education spending to GDP. GDP expansion has contributed significantly to public education spending at least in the short term

Index Terms - Fiscal budget expenditure, education, economic growth, Granger causality, Toda-Yamamoto test

1. Introduction

China holds the second-largest economy in the world. During the period from 2000-2010, China's gross domestic product (GDP) grew at an annual rate of 15%. Meanwhile, the yearly growth rate of national fiscal budget expenditure on education (FBEE) was 21% [1]. Hence, the aggregate amount of public education spending (PES) had grown faster than GDP. However, one significant indicator of public education spending is the percentage of PES to GDP (PES/GDP). The share of PES in GDP was 2.11% in 1991, declined slightly to 2.1% in 2000 and had grown considerably during the period from 2000-2011. It reached 3.36% by 2010. It is noteworthy that the central government was committed to increasing the share of FBEE in GDP to 4% by 2012 [2].

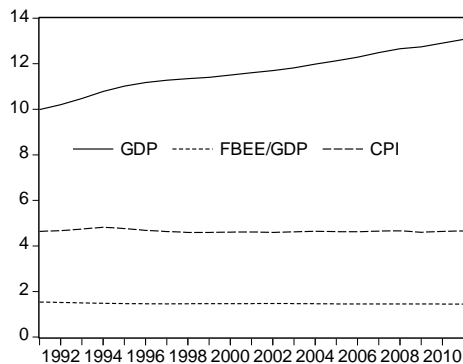


Fig. 1 Logarithmic changes of fiscal budget expenditure on education with GDP and CPI.

Fig. 1 exhibits that the share of FBEE (to GDP) and GDP moved apart. They were negatively correlated (correlation coefficient equaled to -0.83). One reason for this may be that

high inflation reduced the increase in PES to some extent. Literature argues that fiscal decentralization in China leads to the regional disparities and shrinkage of fiscal spending on education [3-4]. Therefore, we argue that during a relatively long period, fast GDP expansion in China might not lead to PES growth in terms of the share of FBEE to GDP. This paper aims to investigate the causal relation from GDP to the share of PES to GDP in China.

2. Methods

If GDP Granger causes PES/GDP, GDP growth may lead to or at least can predict growth in PES/GDP [5]. Conventional Granger causality tests can be conducted within either a vector autoregressive (VAR) setting or an error-correction model (ECM) [6-7].

However, the conventional Granger causality test requires that time-series variables be integrated of order one. Cointegration is crucial for the construction of an ECM. Tests must follow very stringent procedures [8-9]. Time series variables often do not consistently contain a unit root. In such a case, we could test for Granger causality using the 'unconventional' Toda-Yamamoto test [10]. A bivariate Toda-Yamamoto test employs a lag-augmented VAR:

$$y_t = \delta_0 + \delta_1 t + j_1 x_{t-1} + \dots + j_k x_{t-k} + j_{k+1} x_{t-(k+1)} + \dots + j_{k+d} x_{t-(k+d)} + \varepsilon_t \quad (1)$$

Where y_t and x_t contain at most two orders (denoted $d \leq 2$) around a linear trend (t). ε_t denotes the error term. The null hypothesis of non-Granger causality from x to y is:

$$j_1 = j_2 = \dots = j_k = 0 \quad (2)$$

Wald χ^2 -statistics for the hypothesis are calculated.

We tested for unit root using the Augmented Dickey-Fuller (ADF) test [11-12] and the Phillips-Perron (PP) test [13]. We use two unit root tests in order to control for finite sample.

3. Data

The study employed yearly time series data. They are nationwide fiscal budget expenditure on education (FBEE), GDP (GDP) and average CPI (CPI) [1]. FBEE represents total public education spending (PES). Data covered the period from 1991-2011. Tests utilized the logarithmic values of data. Table I describes the statistical properties from the data.

TABLE I Statistical Description for the Original Data

	Mean	Median	Max	Mini	Jarque-Bera (p-value)
GDP (RMB100 million)	11.6	11.6	13.1	10.0	0.62 (0.73)
FBEE (RMB10 thousand)	17.1	17.1	18.9	15.3	1.03 (0.60)
FBEE/GDP	1.47	1.46	1.54	1.45	16.6 (0.00)
CPI (preceding year=100)	4.65	4.64	4.82	4.59	10.8 (0.00)

Notes: Data were transformed into natural logarithms.

4. Empirical Results

Table II shows that both ADF and PP tests detected at least two unit roots for the three variables of interest at the 5% confidence level. Hence, we could not examine causal

relations using conventional Granger causality test techniques. Instead, we conducted the Toda-Yamamoto tests (Table III). Table III shows that both GDP and CPI Granger caused FBEE/GDP.

TABLE II Unit Root Tests

	ADF		PP	
	Level (lags)	F.D. (lags)	Level (lags)	F.D. (lags)
Log (GDP)	-2.56(0)	-1.55(0)	-2.49(2)	-1.62(2)
Log (FBEE/GDP)	-3.20(0)	-2.90(0)	-3.11(1)	-2.85(1)
Log (CPI)	-1.86(0)	-1.86(0)	-2.12(1)	-2.60(8)

Notes: F.D. denotes the first difference. Log denotes natural logarithms. Test equations included both the trend and intercept. For ADF regression, lag was selected using modified AIC. For PP regression, lag was chosen utilizing the Newey-West method [14].

TABLE III Toda-Yamamoto Granger Causality Tests

H_0	Wald- χ^2	$k+d$	F	Adj. R^2	AIC	ARCH	Jarque-Bera
GDP does not Granger cause FBEE/GDP	63.7 (0.00)	6	544	0.99	-7.27	10 (0.04)	0.10 (0.95)
CPI does not Granger cause FBEE/GDP	186 (0.00)	6	1628	0.99	-8.37	9.39 (0.05)	0.01 (0.99)

Notes: Data were in natural logarithms. Tests chose the lag length k by reducing AIC to the extent possible. We set k at two to five using general-to-specific techniques [15]. The data contained the maximal order of integration d at two based on the results in Table II. Hence, VAR($k+2$) system was estimated. However, we estimated the $\chi^2(k)$ -statistic to test for H_0 . ARCH is the LM statistic for no ARCH. The figures in parentheses are p-values.

5. Concluding Remarks

With high inflation, the increase in the share of PES to GDP is more meaningful than the increase in total PES. The central government was committed to increasing the proportion of fiscal budget expenditure on education in GDP. If GDP expands quickly and CPI maintains a high level during an extended period, PES may not keep up with GDP while allowing for inflation.

Tests suggested that GDP Granger caused the share of PES to GDP. Hence, in the short term, a significant growth of the share of PES ensues GDP expansion. Fiscal decentralization rarely exerts an adverse effect on public education spending. This finding is inconsistent with several past studies. The contribution of fast GDP expansion to education is significant at least in the short term.

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