Public Debt Threshold: Empirical Research in Vietnam

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ABSTRACT

This paper aims to provide empirical evidence of Vietnam's public debt threshold. The data of the annual country's public debt in the 1990 - 2010 period, the threshold model by Hansen (1996, 2000), and the OLS estimation method are employed to test threshold effects and estimate the value of the public debt threshold. The research reveals that Vietnam's public debt threshold is 75.8% of GDP. This finding does not imply that the government should target public debt at this level because it can never know when an unusual shock will happen. Therefore, it is advisable to keep the public debt below this threshold. The detection of the public debt threshold helps the government focus better on control of public debt sustainability.

Keywords: public debt, public debt threshold, economic growth, threshold regression model

1. INTRODUCTION

The global crisis and loosening fiscal policy in many countries have increased public debt rapidly. Public debt crises in some economies have made the global economy stagnant and can cause a new storm of economic recession. Public debt is starting to hit a level that produces a negative impact on economic growth. Many empirical researches have recently been performed on public debt threshold and its effect on economic growth in some parts of the world. In the early 1990s, Vietnam's public debt was very high at an average of 240% of GDP, which was regarded as insolvency. Afterward, thanks to high economic growth and the debt relief by the former Soviet Union in the late 1990s, the government regained control over public debt. However, the global crisis of 2008 accelerated the country's public debt. In the future, due to the restructuring of the economy, public debt is forecast to increase to a much higher level to supply more capital for socioeconomic development. The question arises as to which level Vietnam's public debt should be set at in order to ensure macroeconomic security. No research has so far been conducted on the public debt threshold of Vietnam.

This research contributes to the contemporary theory on the relationship between public debt and economic growth by estimating the threshold with multi-variable functions. A threshold model is very useful for analysis of the non-linear relationship between public debt and economic growth under the OLS estimation method. Using time series of such variables as *economic growth, public debt, economic openness* and *inflation*, the research finds Vietnam's public debt threshold staying within 75.8% at a statistical significance level of 10%. Beyond this threshold, the impact of public debt on economic growth is negative.

The paper is divided into three sections. Section 2 presents the theoretical framework for the research

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model. Section 3 describes empirical analysis and research results. The final section provides conclusion and policy recommendations.

2. ASSESSMENT OF PREVIOUS EMPIRICAL STUDIES AND PRESENTATION OF RESEARCH MODEL

a. Assessment of Empirical Studies:

Debate over the relationship between the size of public debt and economic growth does not often lead to consensus. There are three different views on this subject.

The first is the stimulation view. Public debt may facilitate or determine economic growth, depending on the debt level (Tsangyao Chang, 2010). In a traditional view, when economic growth is low, or the private sector is not motivated for investment, the government should use fiscal or monetary policy to stimulate the economy and accept debt financing. Eisner (1992) argues that if measured correctly, budget deficit and public debt will stimulate labor, consumption, investment and economic growth. Eisner is optimistic about budget deficit and public debt on the condition that the public-debt-to-GDP ratio is maintained at a level that prevents public debt from growing faster than GDP. Kormendi et al. (1983) discovers that the expansion of public debt will boost economic growth. They think that increased government spending will improve the national investment environment and ultimately encourage private investment. Agreeing with this perspective, the IMF (2007) suggests that while potentials of an economy are not fully tapped, an increase in aggregate demand from expanding public spending will promote private investment.

The second view is about crowding-out effect. Rising budget deficit and public debt will lead to falls in economic growth and private investment, and rises in interest rates. In other words, when the economy is achieving growth within or beyond the long-term trend, an increase in public debt may be detrimental to the economy. Huge public debt will create a burden that reduces or delays private investment. In this situation, private investors think that their return on investment will be heavily taxed for public debt repayment. In addition, high public debt will cause adverse effects for macroeconomic stability, discourage capital flow and motivate politicians in power to implement "adventure games", leading to political fluctuation (Malone & Samuel W., 2010). Although this will not decrease gross investment, it will reduce investment efficiency because the uncertainty of the future government's dealing with debt burden may drive investors to short-term and low-risk investment rather than long-term and high-risk investment (Serven & Luis, 1997).

The private sector is also facing funding limitations, especially in countries where the domestic public debt accounts for a big share of GDP, the financial markets do not develop, interest rates are rising, and banks tend to invest in low-risk government bonds (Hanson, James A. 2007). Debt volume, followed by increased interest rates, can hinder economic growth and investment because public debt repayment uses a large portion of tax revenues, reducing funds for investment in infrastructure. Hameed, Ashraf and Chaudhary (2008) examine the relationship between external public debt and economic growth in Pakistan with the sample size from 1970 to 2003. Through analysis of the production function, they find that the burden of public debt causes negative effects for the efficiency of economic growth in the short and long terms.

The third view is neutral. In view of the Ricardian school (Barro, 1989), deficit and public debt do not have any impact on economic growth because reduced income and spending in the future will make up for the increased government spending at the present.

From the above-mentioned perspectives, it is necessary to study the non-linear relationship between public debt and economic growth. In fact, many empirical studies have demonstrated the existence of this relationship (Pattillo, 2002). Recent studies focus on determining the public debt threshold. A public debt threshold is a point where any increase in government debt that goes under will have a favorable effect on economic growth, and vice versa.

Andrea F. Presbitero (2010) studied the relationship between total public debt and economic growth in developing countries from 1990 to 2007. The results show that public debt has negative impacts on economic growth if the public debt threshold equals 90% of GDP or higher. This non-linear effect is further explained by the fact that public debt even restricts economic growth in countries with good macroeconomic policies and stable institutions.

Reinhart and Rogoffof (2010) studied the relationship between public debt and economic growth in 44 countries two centuries back. According to the research results, the public debt threshold is 90% in both developed and developing countries. In developed countries where the public debt threshold exceeding 90%, their average economic growth rate is about 2%, lower than that in countries with the public debt threshold of under 30% of GDP.

Based on data from 99 developed and developing countries from 1980 to 2008, Caner et al. (2010) set the public debt threshold at 77% and 64% for developing countries. Tsangyao Chang and Gengnan Chiang (2010) field-tested the threshold regression model to explore the threshold effect of public-debt-to-GDP ratio on per capita GDP in OECD countries. The results show that there exists a threshold value in the public-debt-to-GDP ratio and an asymmetrical reaction of per capita GDP to the public-debt-to-GDP coefficient in OECD countries. The threshold value of this coefficient is 66.636%.

b. Research Model:

Empirical evidence has suggested the existence of public debt threshold but the question arises as to why public debt threshold differs because of effects of national income. Debt may be different in low-income countries because of the poor development of their domestic finance markets; different trade openness (Frankel and Romer 1999); and different institutions (Acemoglu, 2010). Debt levels in many low-income countries can carry different implications for economic growth through inflation. Governments of these countries have resorted to public debt monetization through the sale of government bonds to central banks. As a result, many empirical studies have discovered the relationship between fiscal deficits and inflation in low-income countries, but not in developed countries (Pattillo, Poirson & Ricci, 2002).

Based on studies by Tsangyao Chang (2010) and Caner (2010), the empirical model for Vietnam's public debt threshold is set to consist of the economic growth (GDP) as a dependent variable, the public-debt-to-GDP ratio as independent variable, and control variables including inflation and trade openness. In Vietnam, inflation is the variable representing the uncertainty degree of the economy, and trade openness has been very significant for economic growth policy in the past 20 years. Thus, the research model has the following form:

$Y = f(X, Z, I)$ (1)

where Y stands for GDP, X for public debt, Z for trade openness, and I for inflation. The derivative of equation (1) by Y except for the inflation variable (I) leads to equation (2) as follows:

$dY/Y = (\partial Y/\partial X)dX/Y + (\partial Y/\partial Z)dZ/Y + (\partial Y/\partial I)dI/I$ (2)

where $\partial Y/\partial X$, $\partial Y/\partial Z$, and $\partial Y/\partial I$ are respectively the margin factors of public debt, trade openness, and inflation. With $\partial Y/\partial X = \alpha_1, \partial Y/\partial Z = \alpha_2, \partial Y/\partial I = \alpha_3$, the variables in equation (2) can be explained:

$dY/Y = GDP$ = annual growth rate of GDP;

$dX/Y = X$ = public-debt-to-GDP ratio (%);

$dZ/Y = Z$ = total export and import turnover (% of GDP) – economic openness;

$dI/I = inf$ = annual inflation index.

After adjustment, equation (2) can be rewritten as:

$GDP_t = \alpha_1 X_t + \alpha_2 Z_t + \alpha_3 \inf_t$ (3)

Equation (3) is a traditional linear model for economic growth. It can be changed into the two-regime threshold autoregressive model by Hansen (1996, 2000). It can be expressed as follows:

$Y_t = \beta_{1,0} + \beta_{1,1}X_t + \beta_{1,2}W_t + \varepsilon_t$; if $X_t \leq \lambda$ (4)

$Y_t = \beta_{2,0} + \beta_{2,1}X_t + \beta_{2,2}W_t + \varepsilon_t$; if $X_t > \lambda$ (5)

where Y is a dependent variable reflecting economic growth (GDP); X is a threshold variable added as an independent variable that reflects the scale of public debt and splits the sample into two groups; W are control variables (Z and *Inf*); λ is an unknown threshold value; and β is a correlation coefficient. Based on Caner (2010), equations (4) and (5) can be presented as follows:

$Y_i = \beta_{1,0}1_{(X_i \leq \lambda)} + \beta_{2,0}1_{(X_i > \lambda)} + \beta_{1,1}X_i1_{(X_i \leq \lambda)} + \beta_{1,2}1_{(X_i > \lambda)} + \beta_{2,1}W_i1_{(X_i \leq \lambda)} + \beta_{2,2}W_i1_{(X_i > \lambda)} + \varepsilon_i$ (6)

where 1 reflects an index function that takes the value of 1 if the event occurs, and zero otherwise. To estimate the threshold λ, equation (6) is estimated to find the least sums of square errors (ε). Chan (1993) suggests that estimating least squares of threshold is very suitable for estimating the threshold. It is important to establish a minimum set of the observations above and below the threshold value. The grid search method is applied to find the threshold value.

The sum of square errors is described as $S_1(\lambda) = \hat{\varepsilon_1}(\lambda)^{'}\hat{\varepsilon_1}(\lambda)$. The selected optimal threshold value is based on the least squares estimator with $\hat{\varepsilon} = \arg\min S_1(\lambda)$. Once the threshold value is determined, the hypothesis H_0 (suggesting no threshold effect) must be checked. If $H_{0:}$ $\beta_{1i} = \beta_{2i}$ (i =0,1,2,3,4…), the model has no threshold effect and vice versa.

3. EMPIRICAL ANALYSIS AND RESEARCH RESULTS:

a. Data Collection:

In the model, the author collects annual data about economic growth (GDP%), public-debt-to-GDP ratio (X%), trade-openness-to-GDP ratio (Z%) and inflation (Inf%). Public debt data mainly come from the IMF. Data of the remaining variables are taken from the ADB. The 2011 data in particular are based on publications by Vietnam's GSO at the year's end. Table (1) describes estimated variables in the model over time.

Table 1: Research Data (%)

	GDP%	X%	Z%	INF%
1990	5.09	450.64	54.1	67.1
1991	5.81	350.74	54.3	67.5
1992	8.69	229.3	50.8	17.5
1993	8.08	174.6	49.4	5.2
1994	8.83	153.5	57.1	14.4
1995	9.53	111.1	61.4	12.7
1996	9.34	94.4	70.1	4.5
1997	8.15	76.1	73.1	3.6
1998	5.76	79.3	72.4	9.19
1999	4.76	75.8	77.1	0.1
2000	6.79	41.7	91.5	-0.6
2001	6.89	39.9	90.5	0.8
2002	7.08	40.8	98.3	4
2003	7.34	44.3	108.4	3
2004	7.79	43.4	121.5	9.4
2005	8.44	42.2	127.2	8.4
2006	8.23	39.5	135.3	6.7
2007	8.46	38	151.3	12.6
2008	6.31	43.9	151.7	25
2009	5.32	49	126.1	6.88
2010	6.7	56.6	152.55	11.75
2011	5.8	58.7	170	18.58

The Vietnamese Law on Public Debt Management 2009 defines public debt as composed of government debt, government-guaranteed debt and local authority debt. Hence, ODA loans, the issuing of government bonds (at home and abroad) and urban project bonds, or foreign loans guaranteed by the government are all considered as public debt. Time series data show that the highest public debt level of Vietnam between 1990 and 2010 was 450% of GDP (1990) and the lowest was 38% (2007). The

average public debt of the whole period was 102% of GDP and the average growth rate was 7.2% a year.

In the early 1990s, Vietnam was a big debtor with the total debt of 1990 equivalent to 450% of GDP, indicating its solvency crisis. However, thanks to rapid economic growth from the second half of the 1990s, constantly rising GDP, and debt reduction and debt write-off by some sponsors, especially Russia with debts left over from the former Soviet Union, Vietnam's total debt decreased continuously. Public debt fell from an average of 244% in the 1990 – 1995 period to 73% in 1996-2000, which caused the economic growth rate to fall from 7.6% to 6.9%.

After the financial crisis in 1997, the government implemented economic stimulus policies to stimulate domestic demand and increase public investment for economic restructuring by increasing the budget deficit and public debt. As a result, the economy recovered during the 2000 – 2005 period at a growth rate of 7.5%, higher than the previous period. A high economic growth allowed the government to keep public debt at a low level of 42% of GDP on average. Afterwards, the crisis of 2008 raised the budget deficit to 7.7% of GDP (2009), a record high within the past 20 years. This led to a leap in public debt from 38% in 2007 to 58.7% of GDP in 2011. In the whole 2006 – 2011 period, the average public debt was about 47.6%, higher than the previous period. In the context of rising public debt, economic growth tended downward, averaging 6.8% (Table 2).

Table 2: Public Debt and Economic Growth in 1990 – 2011

Period	Public debt	Economic growth
1990-1995	244.98	7.6
1995-2000	73.46	6.9
2001-2005	42.12	7.5
2006-2011	47.6	6.8
Average of 1990 – 2011	102	7.2

Overall, the preliminary survey of the 1990 – 2011 data shows nonlinear signs between public debt and economic growth. However, an empirical study must be conducted to confirm this.

b. Data Check:

Before performing the tests, the author checks the stationarity of time series data because the OLS testing method does not apply to non-stationary one. This also helps eliminate false correlations. The results show that the time series of *GDP, X* and *inf* are stationary at 10%, 1% and 5% respectively by ADF statistical standards. The Z series in particular stops at first-order difference with a statistical significance of 1%. Therefore, the time series data of *GDP, X, dZ* and *inf* will be used to perform the regression model (Table 3). Examining the correlation between two variables *GDP* and *X* with a scatter plot (Figure 1), the author finds that these variables have a very weak relationship (with a correlation coefficient of 0.19). The data expresses random distribution. With such data, a non-linear model is appropriate for the threshold estimation. Before estimating the model, the Granger causality test is applied between public debt and economic growth. Table (4) signifies that public debt has an impact on

economic growth at a statistically significant level of 10% but not vice versa. This result helps confirm the correctness over the selection of independent and dependent variables in the model.

Table 3: Testing of Variable Stationarity

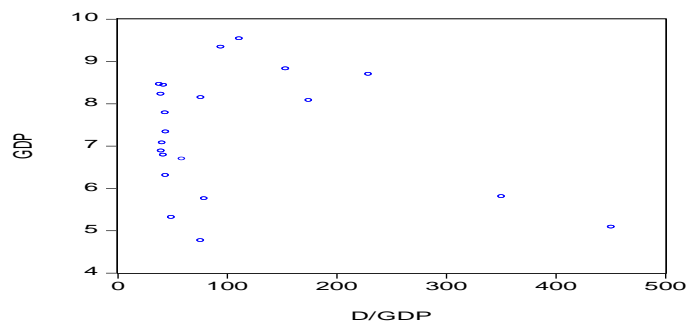| Variable	t-Statistic (Augmented Dickey-Fuller test statistic)	Prob
GDP	- 2.7	0.07
X	- 12	0.00
DZ	- 4.9	0.001
Inf	- 3.6	0.012

Figure 1: Dispersion of GDP and Public Debt

Table 4: The Granger Causality Test of Public Debt (X) and Economic Growth (GDP)

Null Hypothesis:	Obs	F-Statistic	Prob.
X does not Granger Cause GDP	20	2.75983	0.0954
GDP does not Granger Cause X		2.53568	0.1126

d. Empirical Results:

Equation (6) is estimated using the OLS method as proposed by Chan (1993). The variable 'threshold λ' is created in the range varying from 38% (the lowest level of public debt recorded in 2007) to 108% (average). To achieve research objectives, the estimation starts from the threshold of 38% and then increases gradually by 1%. During the process, the RSS parameter is calculated. The threshold will have the smallest RSS and a statistically significant p-value (Yasir Ali Mubarik, 2005).

Table 5 reveals that in the linear regression model, the relationship between public debt and economic growth is not statistically significant at 10%. In the threshold model, public debt has a positive impact on economic growth at a statistical significance level of 1%. Public debt is determined at a threshold of 75.8%. Beyond the threshold, the effect of public debt on economic growth is negative. The beta coefficients (β) in the threshold regression model have different values. This suggests that hypothesis H_0 is rejected, meaning that there are threshold effects. Table 6 shows that the threshold effects in the model are statistically significant at 10%.

Table 5: Estimation of Public Debt Threshold Model (Dependent variable: GDP)

Variable	Linear regression		Threshold (λ)<=75.8		Threshold (λ)>75.8	
	Coefficient	P value	Coefficient	P value	Coefficient	P value
C	6.857976	0.0000	8.201051	0.0000	6.880463	0.0000
X	0.010107	0.1048	0.037642	0.0087	-0.014168	0.0191
DZ	0.040924	0.1913	0.041896	0.1429	0.191697	0.0447
INF	-0.056631	0.0891	0.008661	0.8458	-0.088020	0.0222
	R^2=0.2; RSS =29		R^2=0.39; RSS= 22		R^2=0.44; RSS =20	

Table 6: Effect of Threshold Variables (Dependent variable: GDP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.026250	0.385657	20.81188	0.0000
X	-0.086122	0.029555	-2.913967	0.0101
Threshold (λ)	2.737220	1.526103	1.793601	0.0918
DZ	0.040223	0.025670	1.566933	0.1367
INF	-0.010031	0.042550	-0.235745	0.8166
R-squared	0.492461			

4. CONCLUSION AND POLICY RECOMMENDATIONS

This paper focuses on studying the non-linear relationship between public debt and economic growth in Vietnam by estimating the threshold model. The threshold model by Hansen (2000) is applied to do the estimation of the threshold value of public debt in Vietnam. With annual data of the variables *GDP, X, Z* and *inf* during the 1990 – 2011 period, the estimation results signifies that Vietnam's public debt threshold is determined to be 75.8% at a statistical significance level of 10%. Beyond this threshold, the impact of public debt on economic growth is negative. This idea is relatively consistent with researches conducted by Reinhart and Rogoffof (2010), Caner et al. (2010), and Tsangyao Gengnan Chang & Chiang (2010) in which the public debt threshold is proposed to stand at 64% - 77% for developing countries.

Detecting a public debt threshold does not imply that the government should target public debt at this level. In contrast, because the government can never know when an unusual shock will happen to public debt, it is wise to keep public debt below this threshold. In other words, the detection of a public debt threshold helps the government focus on better control of debt sustainability.

In recent years, Vietnam's public debt increased rapidly due to the government's failure to control budget deficit. This violates a basic principle for the management of sustainable public debt, which is the current debt should be financed by budget surpluses in the future. This is the main reason why Fitch

downgraded the long-term credit rating of Vietnam from BB- to B+ in late July 2010. With rising demand for more investment, Vietnam's public debt will certainly continue to grow in the future. High GDP growth rate is necessary to increase budget income and achieve a budget surplus. However, Vietnam's GDP growth mainly comes from increases in investment volume instead of efficiency, as evidenced by ICOR constantly growing to 7-8 in 2010. The economy is showing signs of slowing growth and investment cannot increase endlessly. It is time for the government to strengthen institutional reforms and build better public debt strategies by clearly defining safety levels, financing structure and public debt repayment. It should also promote programs for public investment restructuring and economic restructuring to enhance the absorption of public debt for economic growth (Acemoglu et al., 2010).

Policy recommendations from the research results are important to planning of public debt policy. However, due to the limitation of the research data as well as the characteristics of the economy in transition, it is necessary to do more research in the future to clearly identify the nature of basic relationships when better data becomes available■

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