

An Empirical Study of Chinese Treasury Bonds Scale in the Background of European Debt Crisis

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Abstract –This paper examines the relationship between the treasury bonds and economic growth from 1985 to 2009 by means of co-integration and Granger causality test, and the impulse response and variance decomposition are also employed to assess the dynamic effect between treasury bonds and GDP. Our findings show that China's economic growth resulted in the treasury bonds size, which has a strong effect to bond issuance. However the impact of fiscal policy debt issuance just has weak impact on economic growth.

Keywords – VAR; IRF; VDC; Bond Issue Amount; GDP

1. Introduction

In December 2009, the world's three major credit rating agencies cut Greece's sovereign debt rating, which mark the outbreak of the Greek sovereign debt crisis. In July 2010, the international rating agency, Moody's lowered Portugal's sovereign credit rating, and the European debt crisis began to spread to other countries in the euro area. European debt crisis awakes the world to control the scale of national debt. The size of the national debt is not only a practical problem for the financial market and even for national health, but also a major theoretical topic of much academic attention and controversy. The core problem is the unclear relationship that existed between the scale of national debt and the economic growth. Government bond is issued by the State, a powerful mean of national fiscal policy, which was always used for balancing state financial revenue and expenditure, and raising funds for construction, etc. Since 1981, China resumed the issuance of government bonds, and issued a total of nearly 9 trillion to 2009. The relationship between the national debt and economic growth is a hot topic explored by economists. Despite the national debt has existed several hundred years, the use of bonds as a control mean of economic growth dated from the 1930s. Before that, the classical schools of economics Adam Smith and David Ricardo were Western economics mainstream. Keynes (1936) argued that alleviated the social problems of insufficient effective demand based on the introduction of the fiscal deficit to expand the social demand and promote economic development. The relationship between the national debt and economic growth has also contributed considerable research by some Chinese scholars. Liu Cangrong (2009) concentrated on the question of the relationship between the national debt and economic growth. He carried out empirical analysis in-depth and provided a theoretical support to implement expansionary fiscal policy under the insufficient aggregate demand. Liu Hongjie (2008)

used VAR models and Granger causality theory to estimate the economic effects of Chinese fiscal expenditure, the results showed that fiscal spending has little influence to GDP. As a widely used unstructured multi-equation model, VAR is very effective when used for dealing with the dynamic empirical research on economic phenomena. This paper analyzes 1985-2009 Chinese treasury bonds issue size and national GDP data using co-integration analysis and Granger causality test, and explores their co-integration relationship on the basis of causality. Finally, impulse response and variance decomposition are employed to explore the mutual relationship in the investigated variables in which the dynamic impacts are inspected.

2. Theoretical Analysis and Hypothesis

2.1. Macro-control

The macro-control is the government implements policies and measures to regulate the operation of the market economy, market economy supplies, goods demands and services are affected by the Price Law and the free market mechanism. A market economy can not only bring economic growth, but will lead to inflation, recession, economic stagnation and even retrogression followed by the climax as well. However, these cyclical fluctuations have serious impact on the social resources and productivity. Therefore, the macro-control is to focus on the economic operation of the whole the society by means of manual adjustments of supply to reach goal of the planned economy. Macro-control used the methods of development of monetary and fiscal policies in order to reach the economic growth followed by increased employment, stable prices and the international balance of payments targets. Two means of national macro-control are fiscal policy and monetary policy. Firstly, the two policies are intrinsically linked. At the same time, the focus of two policies on control and

adjustment is not exactly the same. Monetary policy may be more focused on the regulation of the economic aggregate, but the fiscal policy may be more emphasized on structural adjustment. Based on the analysis above, we put forward the following hypothesis:

Hypothesis 1: The market has inherent weaknesses and shortcomings: spontaneity, blindness, and lag.

2.2. Beneficial National Debt Theory

With the development of the capitalist economy, the market mechanism inherent flaws become increasingly evident, especially in the 1929-1933 crisis has shaken the belief of economists on the intrinsic stability of the market economy mechanism, which called for capitalism countries to abandon the traditional laissez-faire fiscal policy. Government intervention is required in the economy as quickly as possible to get out of the crisis, and to recover from crash and seek for further development. This understanding is reflected in the national debt in theory; most economists changed their attitude of the national debt, turned from that government bonds are harmful to the economy, and then realized that the national debt can be beneficial to the economy. Especially under the further development and refinement of the Keynesian, the debt beneficial theory was finally accepted by most economists and the public.

Specifically, the beneficial national debt on the most fundamental argument is that treasuries for a country's economy is beneficial, it will help to stimulate economic growth, expand employment, and can provide a useful external environment for economic development. The famous British economist, John Maynard Keynes, published a book 《The General Theory of Employment, Interest and Money》 in 1936. He sought to combine economic and social reality, and finally found out a road to save capitalism from the fundamental. To make the economy to keep the level of "full employment" by the government through the complementary role of the financial activities of the expansion of effective demand, the Government should increase spending, cut taxes, budget deficits for fiscal policy. Government uses the method of the issuance of government bonds to finance budget deficits, and then expand fiscal expenditure in the form used to increase the social consumption and investment. This happens to achieve the savings and investment balance, the total social demand and total social supply balance ultimately achieve "full employment" equilibrium level of the state.

After Keynes, some economists inherited and further played this idea. American economist Alvin Hansen thought that the national debt was entirely possible that a kind of "economic welfare" "may provide some guarantees to prevent severe depression". He even believed that in order to make society richer, the easiest way was to issue bonds to satisfy the expenditure.

Beneficial national debt on the second argument is that the bonds will not constitute the burden of the future. Some Western economists believe that the national debt of course, solved the current financial difficulties, but the national debt repayment and interest payments would bring burden to people even the descendants of people. Put forward the following hypothesis:

Hypothesis 2: The capitalist economic recession and a serious cause of unemployment are rooted in the lack of effective demand.

3. Empirical Model Specification

3.1. Main Variables and Definitions

3.1.1. Bond Issue Amount (BIA)

BIA represents the amount of the issuance of treasury bonds, a main variable of treasury bonds issuance scale. Treasury bond is the main form of national debt. The purpose of the central government issued bonds is to make up the national deficit or for a number of costly building projects, as well as some special economic policies and even to raise funds for the war.

3.1.2. Gross Domestic Product (GDP)

GDP refers to in the period of time (a quarter or a year), a production out of the country's or region's economic value of all final goods and services, which is often recognized as the best indicator of the state of the economy. Not only does it reflect a country's economic performance, but also reflect a country's national strength and wealth.

3.1.3. Bond Borrowing Rate (BBR)

BBR is that issuance of treasury bonds accounted for the proportion of GDP, mainly reflects the scale of treasury bonds' impact on the economy and the utilization level of bonds. Usually the Western developed countries' rate is generally 3% to 10%.

3.2. Sample Selection and Data Sources

In order to ensure that the data can be a true reflection of treasury bonds and economic growth, the data in this article referred to the China Statistical Yearbook and China Financial Yearbook. We choose the yearly data of the BIA, GDP, and BBR. There are totally 75 sample data. As shown in table 1. It can be seen from Table 1, BIA accounted for the proportion of GDP, which experienced a rating from 1% to 4.72% of the increase and then reduced to about 2.8% of the process.

Table 1. Chinese BBR from 1985 to 2009
(Unit:CNY one hundred million)

Year	BIA	GDP	BBR
1985	89.85	9016.04	1.00%

1986	138.25	10275.18	1.35%
1987	223.55	12058.62	1.85%
1988	270.78	15042.82	1.80%
1989	407.97	16992.32	2.40%
1990	375.45	18667.82	2.01%
1991	461.4	21781.5	2.12%
1992	669.68	26923.48	2.49%
1993	739.22	35333.92	2.09%
1994	1175.25	48197.86	2.44%
1995	1549.76	60793.73	2.55%
1996	1967.28	71176.59	2.76%
1997	2476.82	78973.03	3.14%
1998	3310.93	84402.28	3.92%
1999	3715.03	89677.05	4.14%
2000	4180.10	99214.55	4.21%
2001	4604.00	109655.17	4.20%
2002	5679.00	120332.69	4.72%
2003	6153.53	135822.76	4.53%
2004	6879.34	159878.34	4.30%
2005	6922.87	184937.37	3.74%
2006	8833.30	216314.43	4.08%
2007	7637.00	265810.31	2.87%
2008	8558.20	314045.43	2.73%
2009	10054.5	340506.87	2.95%

Sources: The China Statistical Yearbook and China Financial Yearbook

4. Empirical Analysis

4.1. Vector Auto-regression (VAR)

Vector auto-regression model referred to as the VAR model is a commonly used econometric model raised by Christopher, 1980. VAR model does regression process with all the current variables in the model to all variables' lagged variable. The VAR model is used to estimate the dynamic relationship of the joint endogenous variables, rather than with any prior constraints. It is the promotion of the AR model, and this model has been widely used.

Vector auto-regression (VAR) model is based on the statistical nature of the data. Each endogenous variable in the system is as a function of lag values of all endogenous variables in the system to construct the model, and then the univariate auto-regressive model is extended to vector auto-regression model by multivariate time series variables. VAR model is one of the easiest operation models to handle multiple analyses and forecast the multi-related economic indicators. Under certain conditions, the multi-MA and ARMA models can also be converted into the VAR model. VAR model in recent years has attracted more and more economic workers attention.

4.2. VAR Stability Test and Co-integration Analysis

Firstly, carry out VAR stability test of the model. If the reciprocal values of all roots are all in the unit circle, the VAR model is stable. In the BIA and GDP's VAR model (Figure 1), the characteristic roots of reciprocal values maps reveal that the value are greater than 1, it is a non-stationary system.

Inverse Roots of AR Characteristic Polynomial

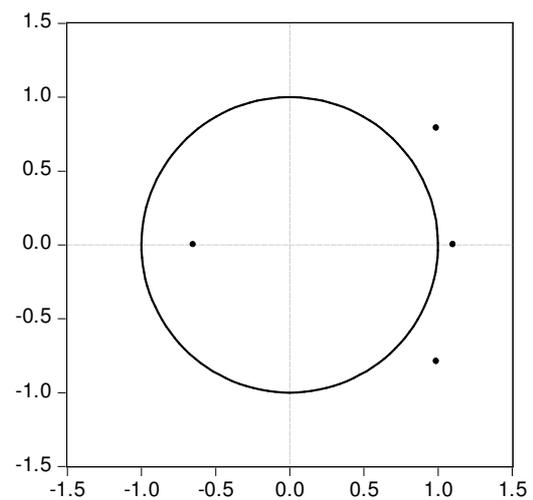


Figure 1. BIA and GDP's VAR stability model

Non-stable VAR model cannot do the impulse response function and variance decomposition analysis. Therefore, we must do the variable co-integration analysis at first, to determine the possibility of long-term relationship of the variables. If a group of non-stationary time series exist a smooth linear combination, therefore, the combination does not have a stochastic trend, and that's mean this sequence is the co-product and this linear combination is called the co-integration equation, said as a long-term equilibrium relationship. This article employed the Johanson co-integration test, the trace statistics volume in the 5% significance level is greater than the critical value, so we can refuse the 5% significance level hypothesis, and that is, between the BIA and the GDP, there are two co-integration equations. After co-integration test, there is a long-term equilibrium relationship between the BIA and GDP.

4.3. Granger Causality Test

Through co-integration test, there does exist a long-term relationship between BIA and economic growth, but does not indicate a causal relationship

between the two. Granger causality test used in this article can reflect the causality. Table 2 showed that GDP's impact strength to BIA is greater than BIA to GDP's influence. We concluded that economic growth is the reason of treasure bond issuance size.

Table 2. BIA and GDP's Granger causality test

Null Hypothesis	F-statistics	Significance Probability	Conclusion
BIA does not Granger Cause GDP	1.6878	0.2331	Accept
GDP does not Granger Cause BIA	3.63825	0.0446	Refuse

4.4. Impulse Response Function and Variance Decomposition

Vector auto-regression model (VAR) is a widely used unstructured multi-equation model, mainly used for the dynamic empirical study of economic phenomena. To build the model used to predict the interrelated time series and analysis the random perturbations of the dynamic impact of the variable system, it explains a variety of economic shocks on the journey of economic variables. In this model, select the issuance of treasury bonds scale (BIA) and economic growth (GDP) as the basic variable. Constitute a p-order VAR model using BIA and GDP:

$$y_t = \phi_1 y_{t-1} + \dots + \phi_p y_{t-p} + Hx_t + \varepsilon_t \tag{1}$$

Among them, y_t for the k-dimensional column vector, x_t for the d-dimensional column vector, ε_t is a k-dimensional disturbance column vector. Lag p, you can use the principle of the AIC, SC and R2. Using AIC and SC to determine the lag period is to minimize the AIC

and SC, while using R2 to determine the lag is to maximize R2. By this principle the lag of the optimal lag can be determined.

4.4.1. Impulse Response Function

Impulse response Function depicts the impact the temperament and future value of endogenous variables by increasing the impact of one standard deviation in the error term. Chomsky decomposition is used after error orthogonal, y_{t-p} producing a unit shock to y_{jt} with other variables and early variables unchanged in period t, as:

$$\frac{\partial y_{t-p}}{\partial u_{jt}} = \frac{\partial y_{t-p}}{\partial \varepsilon_{jt}} \frac{\partial \varepsilon_{jt}}{\partial u_{jt}} = \Theta_q P_j \tag{2}$$

Among them, Θ_q is the cumulative response function, P_j is the Cholesky decomposition of the P matrix elements in column j.

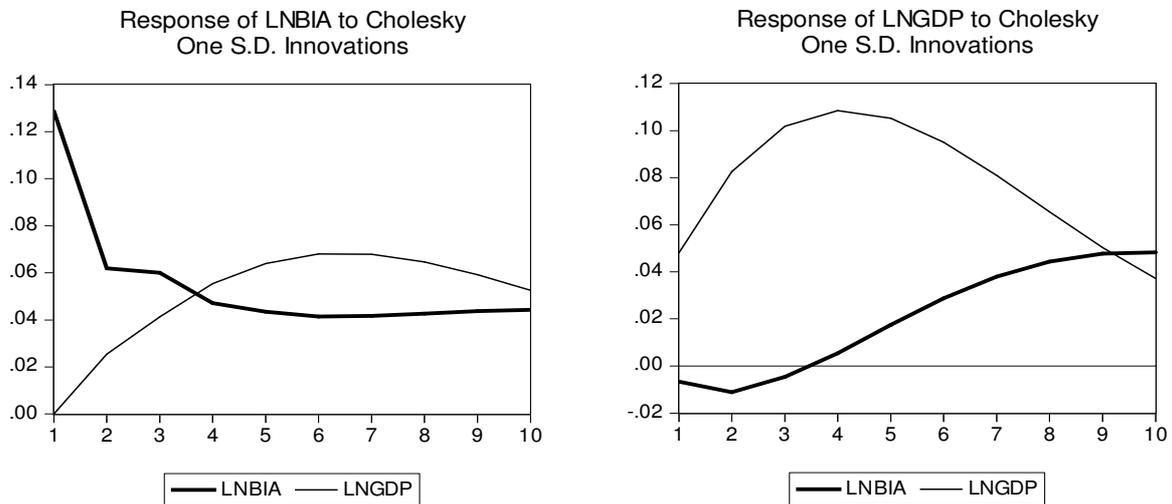


Figure 2. LN BIA and LN GDP's Impulse response

Figure 2 is the logarithmic BIA and logarithmic GDP's one standard deviation impulse responses. Can be seen the response function of the volatility of treasury bonds for development and economic growth on both sides will have an impact, which shows the dynamic relationship existed between. On the number of logarithm BIA and the logarithm GDP, they both impact themselves stronger, on the other side of the effect is relatively weaker.

4.4.2. Variance Decomposition

Variance decomposition further evaluates of the importance of different structural shocks through the analysis of the impact of each structure impulse contribution to the endogenous variables.

Sims 1980, based on the VMA(∞) summarized variance decomposition method to quantitatively grasp the impact of relationships between variables. The idea is as follows:

$$y_{it} = \sum_{j=1}^k \left(\theta_{ij}^{(0)} \varepsilon_{jt} + \theta_{ij}^{(1)} \varepsilon_{jt-1} + \theta_{ij}^{(2)} \varepsilon_{jt-2} + \theta_{ij}^{(3)} \varepsilon_{jt-3} + \dots \right),$$

$$i = 1, 2, \dots, k; t$$

$$= 1, 2, \dots, T \quad (3)$$

Know the content in the various brackets is the *j*th disturbance- ε_j , which is the impact from the infinite past to the present point. of comprehensive. The variance of y_i can be decomposed into *k* irrelevant, to determine

the disturbance variances' contribution to y_i , define the following scale:

$$RVC_{j \rightarrow i}(s) = \frac{\sum_{q=0}^{s-1} (\theta_{ij}^{(q)})^2 \sigma_{jj}}{\sum_{j=1}^k \left\{ \sum_{q=0}^{s-1} (\theta_{ij}^{(q)})^2 \sigma_{jj} \right\}}, \quad i, j =$$

$$1, 2, \dots, k \quad (4)$$

That is relative variance contribution rate, on the basis of the variable *j* variance impact contribution to y_i variance to observe the variable *j*.

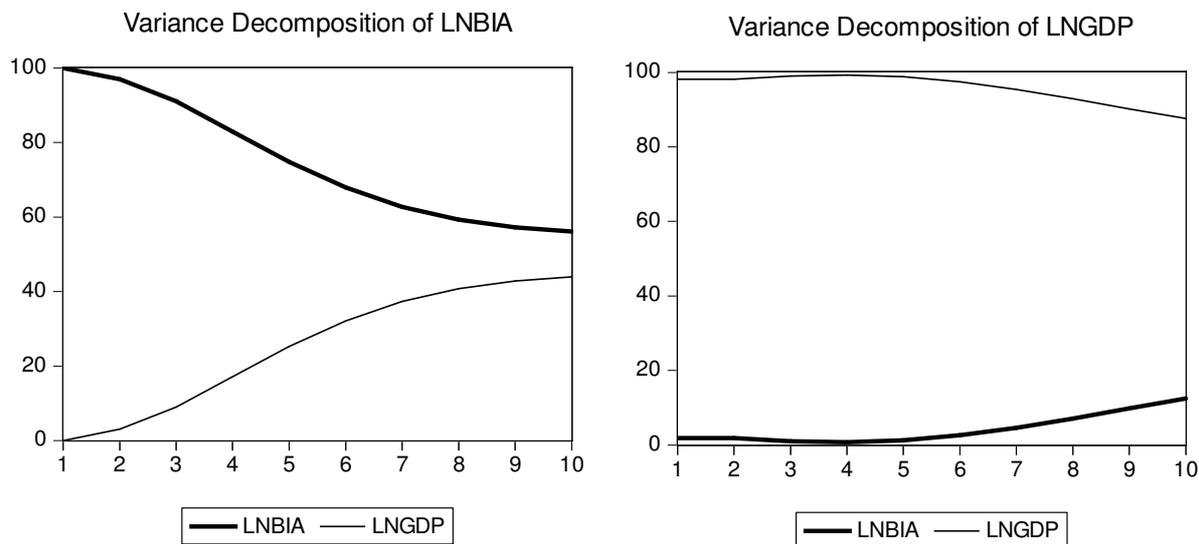


Figure 3. LNBIA and LNGDP's variance decomposition

Through variance decomposition model, we can clearly observe the contribution rate to BIA and GDP. The contributors are BIA, GDP and other external disturbances. From Figure 3, we can see that the changes of BIA is determined mainly by its own factors in the forecast period from 1-10. But with the increasing number of installments, the contribution rate of BIA is declining, while the contribution of GDP is raising and the contribution of the tenth is nearly half. Thus it indicates that the level of economic growth in China has a tremendous impact on the bond issue size, and the effect of an increasing trend over time. Within the forecast period from 1-10, changes in economic growth are basically explained by their own reasons. With the increase of the number of installments, the economic growth of its own contribution rate has declined, however the decline is not obvious. It can be seen from Figure 4 that the changes in the economic growth led start to finish for its own contribution.

5. Conclusions and Policy Suggestions

The following conclusions can be drawn from the empirical analysis: Economic growth can effectively adjust the scale of the issuance of treasury bonds with long duration; the role of fiscal policy to the issuance of treasury bonds exists long delay, the effect on economic growth is not obvious, and weakening macroeconomic regulation and control of the fiscal policy of the issuance of treasury bonds to play the role. It takes a long time for

fiscal policy to influence the issuance of treasury bonds effectively. Its impact on economic growth is not obvious and weakened the effect that fiscal policy plays on treasury bonds in the macro level. For the problems exist in the issuance of treasury bonds regarding fiscal policy, this paper proposes the following policy recommendations.

5.1. Specification Issuance of Treasury Bonds

The purpose of issuing treasury bonds of the central government is often for making up the national deficit, for a number of costly building projects, or some special economic policies and also for raised funds for the war. Increased issuance of treasury bonds for economic development has played a positive role. Treasury bonds are different from the savings, the mechanism is that the national debt can play the role to balance between investment and savings, can make up for the investment gap. Treasury bonds are employed as fiscal policies require administrative intervention, rather than a simple stored procedure. Economic growth, fiscal deficit, government solvency, bond subscription, etc. can have an impact on treasury bonds for development. During the procedures of issuance of treasury bonds, treasury bonds size is the primary issue. The dynamic economic growth, fiscal deficit, government solvency, government bonds subscription and other factors should be considered, dynamically decided each year treasury bonds issuance amount. Combine the long-run equilibrium relationship

of treasury bonds size and economic growth, to enhance the positive role of the issuance of treasury bonds for economic growth.

5.2. Optimize the Structure of the Issuance of Treasury Bonds

On the basis of clearly defining treasury bonds, the issuance of treasury bonds needs to be achieved by optimizing the structure. First of all, the object should be changed from mainly for residents to primarily for financial institutions. The issuance of treasury bonds plays a special function on bridging the investment gap. While issuing to residents for long-term restrains the function, and keeps the interest rates of government bonds below the benchmark rate. Change the distribution object and standardize Chinese bond market. Secondly, we must change the status that both the issuing bank and saving bank develop the same bond products. With the change of object issued, distribution methods and species must be standardized. Short-term government bonds should be mainly issued to financial institutions, while new kind of long-term bonds should be developed to individual residents. Finally, financial sector should establish its own government bonds issuing institution instead of maintaining the current status that authorizing banks to issue bonds to residents. Regulate sales and purchasing market, reduce intermediates and minimize financial costs. The specification of Chinese bond market issuance and the optimization of the structure of issuance of treasury bonds will play an important role in China's economic growth.

Our proposed method can be applied to other academic fields [13-20].

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