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Analysis on Japanese government debt sustainability and Abe economics

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ABSTRACT

After the European debt crisis, the Japanese government debt sustainability and the effect of Abe economic policy are paid close attention. In this paper, an analysis framework on government debt sustainability under the modern credit monetary system is constructed based on the linear differential equation. The conclusion shows a country's government debt is sustainable when the difference of the country's economic growth rate with the sum of inflation rate and the debt interest rate is continuous more than zero. Japan's economic growth is consistently less than the sum of the inflation rate and the debt interest rate since 1988. According to the analysis framework's conclusion, Japan's debt is unsustainable. Abe economic policy against Japan's debt stability, whether debt crisis broke out or not depends on the effect of Abe policy. To ensure the Japanese bonds' stability, Abe policy must promote rapidly economic growth, inflation under control, and there won't be other events to detonate debt crisis.

Key words: debt sustainability; debt crisis; the analysis framework of modern credit system

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INTRODUCTION

After the European debt crisis, Japanese government debt sustainability is heavily concerned, because the proportion of Japan debt is the highest in the developed economies over the world. Since 2010, the Japanese government debt balance accounted for more than 200% of nominal GDP, far higher than the levels of five countries in Europe in the debt crisis (Greece's 148.3%, Italy's 119.2%, Portugal's 120%, Spain's 61.5%, Ireland's 92.2%). However, Japan didn't break out sovereign debt crisis because of high debts [1]. Since Abe government coming to power, Abe launched a series of economic policy "in order to enhance the rate of inflation, to promote economic growth", which is called Abe economics. This caused the domestic and international concern about its policy effect and the outlook of debt, because the foundation of Japan's bond market stability will be weakened by the rise of inflation expectations and treasury bond yields. In this paper, a government debt sustainability analysis framework under a modern credit system is to establish to assess Japanese government debt sustainability and Abe economic policy impact on Japan's debt stability.

THE CURRENT SITUATION JAPANESE GOVERNMENT DEBT

(1) The government debt burden increased year by year

The Japanese government debt absolute size and debt ratios are gradually increase (fig.1). Post-war Japan's rapid economic growth, balancing the fiscal budget, but the oil crisis of the late 1960s has formed a huge impact on Japan's economy of resources dependence and export-led. In order to stimulate economic growth, the Japanese government took massive fiscal stimulus policies, so that the government debt scale expanded unceasingly [2]. With the burst of the Japanese real estate and the stock market bubble in the 1990s, Japan experienced the economic recession of more than 20 years. Japanese government repeatedly implemented fiscal stimulus policy, which resulted in debt scale expansion and debt dependency ratio soaring. The debt balance reached 535 trillion yen in 2000; indebtedness ration reached 105%, far above the security cordon of the European Union 60% and the United States 90%. The international financial crisis in 2008and the Fukushima nuclear accident in 2011 fuelled Japan's fiscal imbalances, and debt hit a record high. By the end of 2012, the Japanese government debt balance reached 997

trillion yen, and accounted for 208% of the nominal GDP of the year.

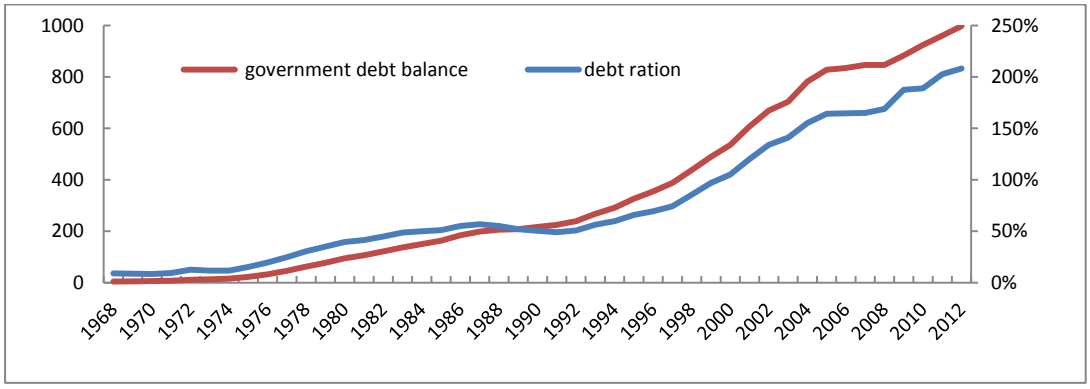

Fig.1, 1968-2012, Japan's debt

Note: the data of this paper is from the Japanese Ministry of Finance and Statistics Bureau website.

(2)Government debt dependence continuously strengthened

With the continuous extending of Japan's fiscal deficit and high debt repayment rate (the proportion of the cost of repaying debt principal and interest accounting for the general account finance expenditure), Japanese government debt dependence is continuously strengthened [3]. Japan's fiscal deficit has experienced two peaks, in the late 1970 s and after 2010 respectively. In 1979, it soared to 6.89%, and then decreased. In 1991, it is at the bottom, then rising, and consecutive more than 9% during three years since 2010, which is more than 8% of the United States and 6% of the European Union. Since the beginning of this century, the proportion of Japanese bonds accounted for the fiscal revenue has increased to 52.1% in 2009. At the same time, the cost to repay the debt principal and interest has become an important fiscal spending for Japan. The proportion was more than 20% for the first time in 1987. After this, it has remained at about 20%, but to 24.29% in 2012, which became a huge fiscal expenditure slightly less than social security payment. Japanese government almost issues bonds every month. Otherwise, the government does not work.

(3)The special Japanese government debt structure

Japan's debt structure differences from the general developed countries. First, in the debt maturity, medium and long term debt accounted for the main. As-of March 31, 2013, Japan's debt and loan balance of more than one year to 608.83 trillion yen, accounting for 61.39% of the total debt balance, with 10-year (including more than 10 years) outstanding debt to 549.37 trillion yen, accounting for 55.4% of the total debt balance.

Secondly, in the ratio of internal and external debt, internal debt accounted for the main. For a long time, about 95% of Japanese government bonds for domestic investors. Domestic high savings ratio, the investment cautious attitude of financial institutions and enterprises, makes them preference for Japanese government bonds, which become a firm foundation for the Japanese government debt financing.

THE ANALYSIS FRAMEWORK ON GOVERNMENT DEBT SUSTAINABILITY

Under the modern credit monetary system, the analysis on government debt sustainability is actually to study deviation degree of the government debt scale and the real economy [4]. Based on the linear differential equation in this paper, an analysis framework would be built to analyze the long-term sustainability of government debt by inspecting the future change trend of the ratio of government debt balance and GDP. If the future trend of this ratio is to indefinitely increase (i.e. no boundaries), the government debt is unsustainable. If this ratio is at a stable level or to near a stable level (i.e. that has boundary), the government debt is sustainable.

(1) The basic analysis framework

In the short term, the government's deficit policy is the direct factors causing rising government debt scale. In the long run, the government's solvency or financial income derived from the economy continues to grow. Economic growth is the key factors influencing the long-term government debt sustainability [5]. Therefore, first examining the fiscal deficit and economic growth's influence on government debt long-term sustainability, and building the basic analysis framework. Usually, the government's fiscal deficit is meted by increasing debt. Namely, the change amount of the annual government debt total amount just is the budget surplus or deficit. If $B(t)$ is assumed to be the state budget deficit (surplus with "-"), $D(t)$ for government debt balance, there is:

$$\frac{dD(t)}{dt} = B(t) \quad (1)$$

The change amount of the government debt balance is equal to the government's fiscal deficit. According to the equation (1), it can be concluded that the change rate of the ratio of government debt balance with the country's GDP:

$$\frac{\mathrm{dw/dt}}{\mathrm{w}} = \frac{\mathrm{d(D/GDP)/dt}}{\mathrm{D/GDP}} = \frac{\mathrm{dD/dt}}{\mathrm{D}} - \frac{\mathrm{d(GDP)/dt}}{\mathrm{GDP}} \quad (2)$$

Here, $\mathrm{w(t) = D(t)/GDP(t)}$ is the proportion of the government debt balance with GDP. By (2) it can be seen that the change ratio of the proportion of the government debt balance with GDP is equal to the difference between the growth rate of government debt balance and the GDP growth rate. Assuming that the ratio of the state budget deficit and the GDP is m, namely $\mathrm{m(t) = B(t)/GDP(t)}$. So the GDP growth rate is $\mathrm{g(t) = \frac{d(GDP(t))/dt}{GDP(t)}}$. According to (1) and (2), the following formula can be got:

$$\begin{aligned}\frac{\mathrm{dw/dt}}{\mathrm{w}} &= \frac{\mathrm{d(D/GDP)/dt}}{\mathrm{D/GDP}} = \frac{\mathrm{dD/dt}}{\mathrm{D}} - \frac{\mathrm{d(GDP)/dt}}{\mathrm{GDP}} \\ &= \frac{\mathrm{B}}{\mathrm{D}} - \frac{\mathrm{d(GDP)/dt}}{\mathrm{GDP}} = \frac{\mathrm{B/GDP}}{\mathrm{D/GDP}} - \frac{\mathrm{d(GDP)/dt}}{\mathrm{GDP}} \\ &= \frac{\mathrm{m}}{\mathrm{w}} - \mathrm{g} \end{aligned} \quad (3)$$

Namely: $\frac{\mathrm{dw/dt}}{\mathrm{w}} = \frac{\mathrm{m}}{\mathrm{w}} - \mathrm{g}$, which can be concluded the equation as $\frac{\mathrm{dw}}{\mathrm{dt}} = \mathrm{m} - \mathrm{gw}$. According to the nature of the first order linear differential equation, the differential equation (3) has a unique steady state of $\bar{\mathrm{w}} = \mathrm{m/g}$, and the general solution of the equation is:

$$w(t) = \bar{w} + C_1 e^{-gt} \text{ , i.e., } w(t) = \frac{m}{g} + C_1 e^{-gt} \quad (4)$$

The $\mathrm{C_1}$ is constant, $\mathrm{C_1 = w(0) - \frac{m}{g}}$, and $\mathrm{w(0) = D(0)/GDP(0)}$, namely this is the ratio of government debt balance and GDP in the initial period ($\mathrm{t = 0}$).

The general solution of above differential equation (4) is a dynamic equation that w will vary over time t. If the continuous economic growth rate of the debtor is greater than 0, the ratio of balance of government debt to GDP is convergent (border), and the government debt is sustainable. If the economic growth rate is less than 0, and the ratio of balance of the debtor government debt to GDP will tend to infinity (i.e., no boundaries), which makes the government debt scale appears uncontrollable situation, thus unsustainable.

The following conclusion can be got: under the basic analysis framework, the fiscal deficit is the direct factors influencing the scale of government debt in the short term, and the key factors of government debt long-term sustainability is the economic growth rate.

(2)The extension analysis framework considering debt interest rate

The basic analysis framework shows that as long as the debtor doesn't appear continued economic recession, the balance of government debt to GDP would be convergence, which will maintain the sustainability of government debt. But the debtor government's borrowing is to pay the interest; this will increase the total amount of government debt. Therefore, we need to consider this variable of debt interest rates, further expanding the basic analysis framework. The change amount of government debt balance consists of two parts: (1) the state budget deficit increase debt balance; (2) the payment of debt interestDi, here i for debt interest rates, and so are:

$$\frac{dD}{dt} = B + Di \quad (5)$$

If we plug the formula (5) into the equation (2), there will be

$$\frac{dw/dt}{w} = \frac{d(D/GDP)/dt}{D/GDP} = \frac{dD/dt}{D} - \frac{d(GDP)/dt}{GDP} = \frac{B}{D} + i - \frac{d(GDP)/dt}{GDP}$$

$$= \frac{B/\mathrm{GDP}}{D/GDP} + i - \frac{d(GDP)/dt}{GDP} = \frac{m}{w} + i - g \quad (6)$$

Namely: $$\frac{dw/dt}{w} = \frac{m}{w} + i - g \quad (7)$$

According to the nature of the first order linear differential equation, the differential equation (7) has a unique steady state of $\bar{w} = m/(g - i)$, and the general solution of the equation is:

$$w = \bar{w} + C_2 e^{-gt}, \qquad \text{namely: } w = \frac{m}{g-i} + C_2 e^{-(g-i)t} \quad (8)$$

The C_2 is constant, $C_2 = w(0) - \frac{m}{g-i}$, and $w(0) = D(0)/GDP(0)$, namely this is the ratio of government debt balance and GDP in the initial period ($t = 0$).

The formula (8) is a dynamic equation that w will vary over time t, where the economic growth rate g and the debt interest rate i are both considered. If the difference between the debtor's economic growth rate and the debt interest rate is greater than zero, the ratio of the balance of government debt to GDP is convergence (border), and government debt is sustainable; If the difference between the debtor continuous economic growth rate and the debt interest rate is less than zero, then the ratio of the country's balance of government debt to GDP will tend to infinity (i.e., no boundaries), which shows debt appears uncontrollable situation, and unsustainable.

The following conclusion can be got: under the extension analysis framework, the key factors of government debt long-term sustainability are the economic growth rate and debt interest rate.

(3)The comprehensive analysis framework considering the inflation rate

Above analysis framework, the impact of the economic growth and debt interest rates on government debt sustainability were taken into account and, but this does not take about inflation caused by government issuing too much money of in the era of credit money. However, the inflation can lead to increase in the nominal GDP, so that the ratio of balance of government debt to GDP may decline in order to the effect of diluting the debt in the short term. But nominal GDP can't reflect the real level of economic growth and the sustainability of government debt, because economic growth is the only real source of the government debt capital. Sustained inflation would undermine investor confidence in the government debt investment, which will increase the government's funding costs, financing difficulty, and the risk of debt default [6]. Therefore, inflation factor should be taken into the analysis framework to analyze government debt sustainability with the proportion of government debt balances to real GDP. Assuming the price index for P, then the proportion of government debt balances to real GDP is $\acute{w} = D/(GDP/P)$, the proportion of the national fiscal deficit to the real GDP is $\acute{m} = B/(GDP/P)$. Combined with formula (5), the following equation can be obtained:

$$\frac{d\acute{w}/dt}{\acute{w}} = \frac{d(D/(GDP/P))/dt}{D/(GDP/P)} = \frac{dD/dt}{D} - \frac{d(GDP/P)/dt}{GDP/P} = \frac{B}{D} + i - \frac{d(GDP/P)/dt}{GDP/P}$$

$$= \frac{B/(GDP/P)}{D/(GDP/P)} + i - \frac{d(GDP/P)/dt}{GDP/P} = \frac{\acute{m}}{\acute{w}} + i - \left(\frac{d(GDP)}{GDP} - \frac{d(P)}{P}\right)$$

$$= \frac{\acute{m}}{\acute{w}} + i - (g - \pi) \quad (9)$$

Namely: $$\frac{d\acute{w}/dt}{\acute{w}} = \frac{\acute{m}}{\acute{w}} + i - (g - \pi) \quad (10)$$

The π is the inflation rate, i for debt interest rates, g for GDP growth. According to the nature of the first order linear differential equation, the general solution of differential equation (10) can be obtained, as follows:

$$\acute{w} = \frac{\acute{m}}{g-\pi-i} + C_3 e^{-(g-\pi-i)t} \quad (11)$$

The C_3 is constant, $C_3 = \acute{w}(0) - \frac{\acute{m}}{g-\pi-i}$, and $\acute{w}(0) = D(0)/(GDP(0)/P)$, namely this is the ratio of government debt balance and real GDP in the initial period ($t = 0$).

The formula (11) is a dynamic equation considering the economic growth rate g, the inflation rate π and debt interest rates i, where the ratio of government debt balance D to real GDP $\acute{w}$ will vary over time t. If the difference between the economic growth rate and the sum of inflation rate plus debt interest rate is greater than zero, the dynamic path of the ratio of the balance of government debt and real GDP is convergence (border), and government debt is intrinsic sustainability; If a country's continuous economic growth is less than the sum of the inflation rate and debt interest rate, the proportion of government debt balance to real GDP has divergent dynamic path (i.e., no boundary), and the country's government debt is unsustainable.

The following conclusion can be got: in the comprehensive analysis framework, the fiscal deficit is the direct factors influencing the scale of government debt in the short term, the key factors of government debt long-term sustainability include the economic growth rate, debt interest rate and inflation rate.

SPECIFIC ANALYSIS ON JAPANESE GOVERNMENT DEBT SUSTAINABILITY

Since the Japanese Banking Law was enacted in 1942, the bank of Japan officially performed the functions of modern central bank, and the modern credit monetary system was formally established in Japan. According to the comprehensive analysis framework above, under the credit monetary system the long-term sustainability of government debt depends on the economic growth rate, inflation rate, debt interest rates three key factors, and the fiscal deficit rate (the deficit/GDP) impacting debt scale in the short term. Here, nominal GDP growth is used instead of economic growth, the CPI instead of the inflation rate, the yield on the 10-year Treasury instead of government debt interest rates (because of the debt of 10 years or more by more than 50% in Japan's debt period structure). According to the principle of data availability, the relevant data since 1987 was selected.

By comparing Japan's nominal GDP growth rate in 1987-2012 with the sum of inflation rate and the 10-year Treasury yield (fig.2), this shows that over the past 25 years (in addition to three years, 1988, 2011 and 2012), Japan's nominal GDP growth rate has be being further lower than the sum of inflation rate and the 10-year Treasury yields. In three groups of different time span of 1987 ~ 2012, 1987 ~ 2012, 2009 ~ 2012, the average of nominal GDP growth rate, inflation rate and the 10-year yields were calculated separately (table 1). The three sets data displays that the nominal GDP growth rate averages are all less than the sum of the average of inflation rate and the 10-year Treasury yields' average. And Japan is gradually aggravating recession, deflation has become even more so, debt interest coming down.

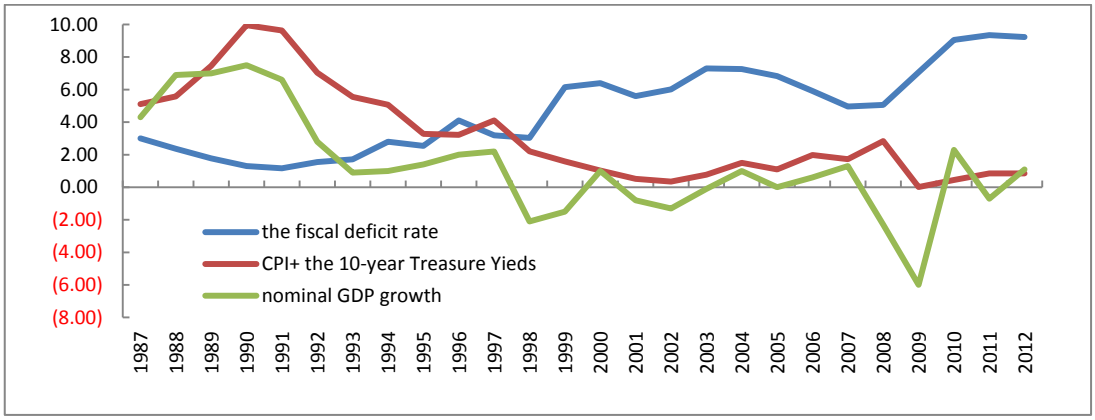

Fig. 2 Japanese economic growth rate, the sum of the rate of inflation and debt interest rate, the ratio of fiscal deficit and the GDP during 1987-2012

Table 1 GDP growth rate, inflation rate and debt interest rate of Japan different time span (%)

Time span	Nominal GDP growth rate(g)	nflation rate(π)	-year Treasury yield(i)	g -(π+ i)
1987-2012	1.35	0.45	2.77	-1.87
2000-2012	-0.30	-0.27	1.35	-1.37
2009-2012	-0.83	-0.59	1.13	-1.37

In addition, the rate of fiscal deficit has be also expanding since 1991 (fig.1), especially in the recent three years, which has been as high as 9% above. Not strictly did the Japanese government abide fiscal discipline, and widening budget deficits in the short term expanded directly Japan debt scale.

According to comprehensive analysis framework's conclusion, the dynamic path of the ratio of government debt balance to real GDP is divergent (i.e. no boundaries) because Japan continued economic growth rate of nearly 25 years is less than the sum of the inflation rate and debt interest rate. So the Japanese government debt sustainability is difficult to guarantee.

However, Japanese has not taken place the sovereign debt crisis as the European debt crisis yet, which thanks to its special debt support system. Namely, higher domestic savings, long-term trade surplus, lower debt interest rates and the support from domestic investors [7]. But this does not mean that the crisis will not happen in future. Abe economic policies' effect and influence is very important to the stability of the debt.

THE INFLUENCE OF ABE ECONOMICS FOR JAPANESE DEBT

Abe economics refers to a series of economic policies, including three main aspects, the quantitative easing (QE) monetary policy, the fiscal stimulus policies of a total of $226.76 billion government investment and the yen depreciation policy [8]. The following is to separately analyze the specific influence of each policy for Japan's debt sustainability.

(1) The QE policy's influence for Japanese debt sustainability

Abe quantitative easing monetary policy is that the Bank of Japan buys Treasury bonds and other assets to provide liquidity for the market in order to achieve the inflation target of 2%. If assuming that the first goal can be to achieve, how will the national debt market react? When the inflation rate is negative, bonds become the best choice for investors. However, when the rate of inflation is positive, asset prices will raise, which will produce "Tobin Effect". Thus the investment interest of people goes to risk assets, and then treasure yields will rise [9]. Since the end of 2012, as the Japanese stock market rose sharply and the inflation rate's month data is from negative to positive, the yield on 10-year Treasury is also from the nadir of 0.442% on April 4th up to 0.905% on May 28th. In more than a month, the yields rose more than doubled. This has an adverse effect on Japan's debt sustainability. In the future how to develop, the key is to see the balance between economic growth and inflation. Only can rapid economic growth, controlled inflation expectations reduce the possibility of debt crisis. If inflation in the future is serious, this will push bond yields to continually rise. If the economic growth is not as good as expected, it could cause investors to sell their Treasury bonds. So this can become a tipping point of debt crisis.

(2) The fiscal stimulus policy's impact on Japanese debt sustainability

Abe proactive fiscal stimulus policy is essentially to increase government investment by selling bonds to drive economic growth [10]. Japan troubled in debt should have cut government spending, reducing the fiscal deficit, increasing investors' confidence, such as the European Union do. On the contrary, the Japanese government continues to increase fiscal deficits and spending. So Japanese government debt burden will become heavier, and lowering its credit rating. This further increases also the cost of financing, and against the stability of the debt. The policy's impact on Japan's debt is to mainly see its economic growth effect in the short term. If in the short time the policy has immediate effect to promote economy growth, this will be good for debt stability. Otherwise, it will undermine the confidence of investors, and increase the likelihood of debt crisis.

(3) The yen depreciation policy's impact on Japanese debt sustainability

Mr. Abe's yen depreciation policy's original intention is to improve the international competitiveness of export enterprise products by yen depreciation, which would increase exports to drive the development of Japan economy. But the yen depreciation policy also has two sides effect, good for export enterprises, adverse to the importers. Because Japan is a resource dependent country, a lot of raw materials and semi-finished products relying on imports, the yen depreciation would increase the cost of imports, which partly offsets the benefits for exports. On May 22, 2013 Japan Ministry of Finance announced trade statistics of April. The data shows the initial value of trade deficit of 879.9 billion yen, the largest deficit at the same period since 1979, the trade surplus as the foundation of Japan's debt financing will be shaken. In Japan the export enterprises are big business, and import enterprises are small and medium-sized enterprises which bear 80% of employment in Japan. The increase of the imports cost caused by the yen depreciation will increase the living cost of the Japanese people. Inflation is inevitable, most of the Japanese people working in the small and medium-sized enterprises increased cost of living while wage no increasing, which would result in reducing consumer demand, hindering economic growth, further pushing up inflation. Therefore, the yen depreciation policy will go against Japan debt stability.

CONCLUSION

Japan's debt scale has been up to an unprecedented height, the highest in the world. Its economic growth rate is less than the sum of the rate of inflation and the yield on 10-year Treasury notes for a long time. According to the conclusion of the government debt sustainability analysis framework under the modern credit monetary system based on the linear differential equation, this shows that Japanese debt is unsustainable, and its prospects is grim. Abe, Japan's prime minister, put out a series of economic policies called "Abe economics". The policies will push up Japanese debt scale, enhancing the rate of inflation and national debt interest rates, increasing the cost of financing, which is adverse to the stability of Japan's debt. Whether Japan debt crisis will happen depends on Abe economics' effect. To ensure Japan's debt market is stable, no debt crisis, the only way is Abe economic policy to work positively. There will be a substantial economic growth, even more than desired, the inflation expectations in the controllable range. In the meantime, there will be not the emergent events hitting the debt crisis, such as dramatic exodus of foreign capital, foreign institutions shorting the Japanese stock market, or the world economy recession than expected, or man-made or natural disaster like Fukushima nuclear accident, etc. Otherwise, the outbreak of Japan sovereign debt crisis is inevitable.

REFERENCES

[1] Wang Hui. *Journal of Financial Research*, **2010**(5), pp.75-77.
[2] Du Qiong. *Journal of Macroeconomic Management*. **2011** (9), pp.71-72.
[3] Xiong Lu. *Journal of Financial Development Review.* **2011** (4), pp. 83-87.
[4] Alfred Grenier, Uwe Koller and Wili Semmler. Debt Sustainability in the European Monetary Union: Theory and Empirical Evidence for Selected Countries. Oxford Economic Paper, **2007**, 59(2), pp.194-218.
[5] Yang Dongliang. *Modern Japanese Economy*. **2013** (1), pp.10 -18.
[6] Henning Bohn. *Journal of Money, Credit and Banking*, **1995**, 27(1), pp. 257-271.
[7] Henning Bohn. *Quarterly Journal of Economics*, **1998**, 113(3), pp.949-63.
[8] Christina. Abe economics: Japanese last-minute onslaught. *The 21st century*, **2013**-01-16.
[9] Tobin, J.. *Econometrica*, **1965** (33), pp. 671-684.
[10] Zhang Cheng. *The international herald*, **2013**-05-10.