

## Analysis of Co-Movement of the Chinese and US Treasury Yields: Empirical Evidence from T-Bond Markets During 2002-2015

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### Abstract

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The volatility of Treasury yields has an important influence on financial asset pricing, the effectiveness of monetary policy, and financial market stability for a country. Based on the sample data of Treasury yields in the Chinese and US markets during 2002-2015, this paper conducts comparison study on the co-movement of the Chinese and US Treasury yields and their influence factors. The study found that in 2002-2008, there is a low correlation between the Chinese and US Treasury yields; after the 2008 global financial crisis, the co-movement between them is obviously improved, and the US Treasury yield has a positive effect on that of China; after 2012, the interest rates of China and the United States have entered a new stage of reciprocal causation. The result explains the reason for the divergence of the US Treasury yield from the Dollar index since the speculation of Fed rate hike began to rise in 2013. The weak global economy and the ease monetary policy of other major economies make the US Treasury yield run in a low level.

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**Keywords:** global financial crisis, rate hike cycle, Chinese and US Treasury yields, co-movement

### 1. Introduction

The Treasury market is an important part of a country's financial markets, which has a very important influence on financial asset pricing, the effectiveness of monetary policy, and financial market stability. In 2007, the US subprime mortgage crisis broke out, and evolved into an international financial crisis. The crisis resulted in greater fluctuations of the US Treasury yield, and many countries witnessed dramatic volatility in their Treasury market. Under the background of financial globalization, as the opening up of the financial market advanced comprehensively, the correlation between Treasury markets of China and other countries is growing, and the impact effect of Treasury yields fluctuations in foreign financial markets on China's Treasury yield appeared gradually. In 2013, the speculation that the Fed exits its QE policy began to ferment, the Dollar index goes strong gradually, there saw dramatic volatility in the international financial markets, and the Chinese and US Treasury yields were influenced significantly. Currently, the United States and China are the world's largest and second economy respectively. It is very necessary to study in-depth the relevance between the Chinese and US Treasury yields, and inspect how Treasury yield of one country reacts to the yield fluctuations in the other country, which will help promote the healthy and stable development of China's Treasury market. This paper mainly investigates the relationship between 10-year Treasury yields of China and the United States in the period of 2002-2015.

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The choice of this sample period is mainly according to the actual circumstances of the Chinese economy and the development of its bond market. First of all, China officially joined the WTO at the end of 2001, the Chinese economy is rapidly integrated into the world economy, and the financial market is gradually opened up. WTO entry started a new stage of the economic development for China, which makes China's financial market and the international financial market connected more closely. Second, in 2003, the People's Bank of China (PBOC), China's central bank, announced the general idea of China's reform of interest rate liberalization. The process of interest rate liberalization has made steady progress since then, making Treasury yields gradually play the function of price signal of money market funds. Under the backgrounds of gradual liberalization of China's capital market and the reform of renminbi exchange rate, the dynamic relationship between the Treasury yield curves of China and the US is increasingly becoming closer. Third, from the point of the development of the bond market itself, before 2002, the depth and active degree of China's bond market is also very limited, and the degree of bond interest rate marketization is very low; whereas since 2002, China has witnessed an increasingly rich variety of Treasury bonds with an increasing scale. The paper, based on the data of Treasury markets in China and the United States during the period of January 2002 - December 2015, analyzes the co-movement characteristics between Treasury yields of the two countries on the condition of financial openness from the perspective of empirical study.

## **2. Fed's Rate Hike and Variation of the Chinese and US Treasury Yields**

### **2.1 Literature Review**

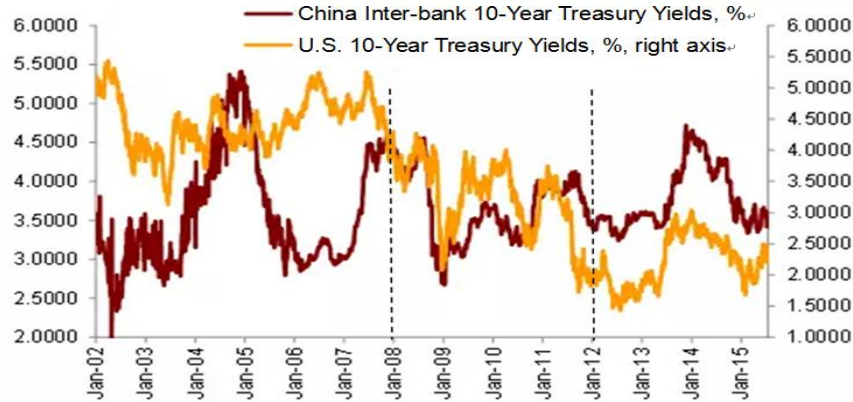
On the co-movement of Treasury yields, Chinese scholars have conducted in-depth research. FENG Tao and LIU Wei (2013) established a VAR-GRACH model, examined the spillover effects between Treasury yields of China, the European Union and the United States during January 2009 - January 2013, and found that there exists obvious bidirectional volatility spillover effect between the three yields in the environment of the international financial market turmoil. SHI Ziguo (2014) analyzed the data of one-year and 10-year Treasury yields in the Chinese and US Treasury markets during 2002-2012. The research shows that in the short-term Treasury market, before the outbreak of the financial crisis in 2008, the fluctuation of the US Treasury yields has on the whole a positive influence on the Chinese Treasury yields, while the fluctuations of the Chinese Treasury yields has a relatively weak negative impact on the US Treasury yields; After 2008, the volatility spillover effect of the Chinese Treasury yields is obviously increased, and there is positive correlation between Treasury yields of the two countries; However in the long-term Treasury markets, there exists no significant correlation between the Chinese and US Treasury yields. DING Chunhui (2014) analyzed the Treasury yields of China and the United States from 2002 to 2013, and found that China's Treasury yields can affect the yield curve of the US, while after the financial crisis the yields of the two countries can affect each other. SHI Ziguo and LIU Yue (2015) carried on comparative study on Treasury yields of China and the United States during 2002-2014. The results show that the Chinese and US Treasury yields have different reaction to the change of the Dollar index, they showed a certain degree of convergence when the Dollar is on the rise, however showed a certain degree of deviation when the Dollar is on the fall. XIE Yaxuan et al. (2015) found that the correlation between the Chinese and US Treasury yields is significantly improved after the 2008 global financial crisis, and that factors such as corporate financing, substitutability of bonds, intervention of central banks and psychological expectations could be the specific transmission mechanism.

### **2.2 Analysis of the Movement of the Chinese and US Treasury Yields during 2002-2015**

From the past experiences of over a decade, the co-movement between the Chinese and US Treasury yields is increasing. The moving trend of 10-year Treasury yields of China and the United States during 2002-2015 is shown in Figure 1. It can be seen that the correlation between the Chinese and US Treasury yields during 2002-2008 is quite low, and that the moving trends of them are obviously different. During the period, China's 10-year Treasury yield goes down first, then up and falls again with the highest close to 5.5% and the lowest less than 2.5%. Particularly, there emerges an obvious inverted V-shaped moving trend during 2004-2005, when the Chinese bond market experienced a switch from bull to bear. However, during the same period, the US 10-year Treasury yield fluctuates much less than the Chinese yield with no clear moving direction. After the 2008 global financial crisis, the linkage between interest rates of China and the United States increased. Especially, the correlation between the Chinese and US treasury yields has improved significantly after 2012.

Since 2005, China has carried out a series of financial reforms such as current account convertibility, RMB exchange rate system reform and so forth, and China's capital market has begun to integrate into the global market gradually. Therefore, the influence of international capital flows on China's asset prices gradually increased. On the other hand, since the financial crisis, the economic cycles of China and the United States runs relatively consistent, and the global coordination in macroeconomic policy is improving. As a result, the convergence of economy and policy cycle is also an important factor which makes the long-term Treasury yields of China and the United States go alike.

**Figure 1.** The movement curves of China and US Treasury yields during 2002-2015



**2.3 Fed's Rate Hike and Treasury Yield of the United States**

Early May 2013, the expectations of QE quit began to appear in the international financial markets, and at the end of May, Mr. Bernanke officially talked about the problem of QE quit for the first time. Influenced by the quit expectations, the Dollar index started to bottom out. On December 16, 2015, the Federal Reserve announced to increase the federal fund rate by 25 bp, and the Dollar index has risen from 80 points to 100 points. Before then, it is generally believed that the US Treasury yields would go stronger as the Dollar index bounced after Fed's rate hike. However, the US Treasury yield has not got enough momentum to go upward since the fermentation of Fed's QE quit expectation in 2013. The Dollar index went significantly stronger in 2014; however the US Treasury yield still showed no sign of going upward sharply. When the Dollar index had broke the peak point since the last round of rate hike, the 10-year Treasury yield hasn't broken through the highest rate since 2014 (see Figure 2). As seen in Figure 2, there appears a relationship of moving in the same direction between the Dollar index and the US Treasury yield during 2004-2013. While as the United States entered into rate hike cycle in 2014, the Dollar index climbs upward obviously, but the Treasury yield goes in a downward trend.

**Figure 2.** The movement curves of US Treasury yield and the Dollar index since 2004



What causes the emergence of such an apparent divergence? Due to the correlation between the Treasury markets of China and the United States, the divergence will certainly affect the expectation of the Chinese Treasury yield. Therefore, it is necessary to make in-depth analysis on the correlation between the Treasury yields of the two countries and their influence factors, so as to guide Treasury bond investment in the Chinese market.

### 3, Empirical Analysis on the Co-movement between the Long-term Treasury Yields of China and the United States during 2008-2015

To examine the correlation between the fluctuations of the Chinese and the US Treasury yields, we choose 10-year Treasury yield of China Interbank Bond Market and 10-year Treasury yield of the United States as test variables. The Chinese Treasury yield is noted as time series YCN, and the US yield as time series YUS. The test is based on data samples of the Chinese and US Treasury markets during the period from January 2008 to December 2015. The empirical data are from the Wind EDB database. According to the above analysis of the moving trend of the Chinese and US Treasury yields, we select two sub sample intervals and make the empirical testing and analysis. One sub interval is January 2008 - December 2015 and the other January 2012 - December 2015.

#### 3.1 Empirical Analysis of the Correlation between the Chinese and US Treasury Yields since 2008

##### 3.1.1 Stationarity Test

Usually, a time series has the problem of nonstationarity, leading to spurious regression. Whether two variable sequences are both stationary or integrated process is the basis to use different methods to analyze the relations between the variables. In the following, we use the ‘‘Augmented Dickey-Fuller’’ (ADF) test to conduct stationarity test on YCN and YUS. The test results are shown in Table 1. The results show that at 5% significance level, both YCN and YUS are integrated process.

**Table 1. The results of ADF unit root test on the Chinese and US Treasury yields**

Time series	ADF test statistic	Critical value at 1% level	Critical value at 5% level	Critical value at 10% level
YCN	-1.667 656	-3.444 655	-2.863 028	-2.567 771
YUS	-1.198 831	-3.434 606	-2.866 626	-2.569 508

##### 3.1.2 Cointegration Test

For variable series with the same integrated orders, whether there is a long-run and stable relationship between them is the precondition for the analysis of the relationship between the variables. In the following, we use the Johansen (1988) method based on Vectors Autocorrelations (VAR) to examine whether there is a long-run equilibrium relationship between the long-term Treasury yields of the two countries. The results are shown in Table 2. It can be seen in Table 2 that in the two sub sample intervals and at 5% significance level, the trace statistic exceeds the critical value, so the null hypothesis of no cointegration vectors is rejected. Therefore, there is at least one cointegration relationship between the Chinese and US Treasury yields, that is, there is a long-run and stable relationship between the two yields. On this basis, we can conduct the causality test on the two variables.

**Table 2. The results of Johansen cointegration test on the Chinese and US Treasury yields**

No. of CE(s)	Eigenvalue	Trace statistic	Critical value at 5% level	P-values
None	0.028 940	21.617 482	18.287 745	0.016 810
At least one	0.014 280	3.370 057	9.841 466	0.052 628

##### 3.1.3 The Granger Causality Test

To test whether there is a causal relationship between the Chinese and US Treasury yields, we conduct the Granger causality test on the two variables. The results are shown in Table 3. It can be seen from Table 3 that at 10% significance level, the null hypothesis that YUS is not the Granger cause of YCN is rejected, so YUS is the cause of YCN, that is, in the linkage of Sino-US rates, the US Treasury yield is the cause, and the Chinese yield is the effect. On the other hand, the null hypothesis that YCN is not the Granger cause of YUS is not rejected at 10% level. Therefore, there is a long-run equilibrium relationship between the 10-year Treasury yields of China and the United States, however in the equilibrium relations, the US Treasury yield is the independent variable.

The Chinese yield is the dependent variable, and the interest rates of the Chinese market move with the variation of the rates in the US market.

**Table 3. The results of Granger causality test on the Chinese and US Treasury yields**

The null hypothesis	F-statistic	Prob.	Observations
YUS is not the Granger cause of YCN	2.076 96	0.082 60	reject
YCN is not the Granger cause of YUS	0.809 83	0.519 20	accept

### 3.2 Empirical Analysis of the Correlation between the Chinese and US Treasury Yields since 2012

The above qualitative analysis on the co-movement of the interest rates of the two countries shows that the correlation between the Chinese and US Treasury yields has obviously been improved since 2012. In order to explore the new mechanism in the correlation between the Chinese and US Treasury yields after the Dollar entered into rate hike cycle, we conduct causality test on the Treasury yields of China and the United States after 2012. The time range of the data is selected from May 2012 to December 2015, and the results are shown in Table 4. Table 4 shows that the 10-year Treasury yields of the two countries are the Granger cause of each other, suggesting that since China's exchange rate reform in 2012, the interest rate co-movement of China and the United States is no longer a one-way process from the United States to China, but the interest rate variations in the Chinese market can produce corresponding impacts on the interest rates in the US market. In other words, the co-movement of interest rates of the two countries has been developed to the stage of reciprocal causation. At this stage, the downtrend of the Chinese Treasury yield will exert downward pressure on the US Treasury yield through a certain mechanism.

**Table 4. Results of Granger causality test on the Chinese and US Treasury yields after 2012**

The null hypothesis	F-statistic	Prob	Observations
YUS is not the Granger cause of YCN	4.410 85	0.012 70	reject
YCN is not the Granger cause of YUS	4.526 30	0.011 40	reject

## 4. Analysis of the Mechanism of the Co-movement of the Chinese and US Treasury Yields

### 4.1 Analysis of the Causes of the Strengthening of the Co-movement of Chinese and US Treasury Yields since 2008

Since 2008, the linkage between the Chinese and US interest rates has been enhanced unceasingly, the main background of which is a series of financial reforms in China and the convergence of China-US economic and policy cycles. The Chinese and US Treasury yields, through the transmission mechanism of the interest rate channel and asset price channel, can affect international trade, social financing costs, bond supply and demand, and psychological expectations, thus realize co-movement and mutual influence.

#### 4.1.1 *China's Financial Opening up and Financial Reforms*

After the WTO entry at the end of 2001, China fulfilled its commitments, and accelerated the pace of financial opening up and reforms. The capital account has been liberated step by step, the policy measures of QFII (2002), QDII (2007), RQFII (2011) have been issued, China's capital market has begun to gradually integrate into the global market, and thus the connection between the Chinese and international financial markets has been gradually improved. On July 21, 2005, China carried out the reform of RMB exchange rate system, and announced the start of implementation of a managed floating exchange rate system based on market supply and demand and adjusted according to a basket of currencies. The RMB has gradually formed a more flexible mechanism of exchange rate. On April 16, 2012, PBOC announced to widen the interval of the daily floating rate range of the yuan against the dollar, and the floating range rose from 5‰ to 1% in China's inter-bank spot foreign exchange market. On July 14, 2015, PBOC relaxed a great deal the quota restrictions and investment scope for financial institutions such as foreign central banks, international financial organizations and sovereign wealth funds in the inter-bank market, and changed the audit system to records.

#### 4.1.2 *The Convergence of the Economic Cycle*

The economic globalization has promoted the integration of product and element markets of the world and the unity of the global market, and constantly raised the economic dependency among different countries. The 2008 global financial crisis severely clashed the economy of them.

The moving trends of GDP growth rates and industrial outputs of China and the United States reveal that the economic cycles of the two countries roughly have gone in the same direction since 2008. During the crisis period, the Chinese and US economy slowed down simultaneously. Then, under the stimulus of "4-trillion investment plan" in China and the quantitative easing policy in the United States, their economy gradually stabilized and went up. The inflation level also has an important influence on bond yields. Since the crisis, the CPI growth trends in China and the United States moved more consistently. During the first two rounds of QE period, the US inflation level rose dramatically, while China's inflation rate went up all the way before monetary policy was tightened in 2011.

#### **4.1.3 The Convergence of Policy Cycle**

During the 2008 financial crisis, the international community strengthened coordination in their macroscopic policies under the common impacts. The crisis made all countries form a new consensus in terms of policy coordination in macroeconomic regulation and control. When they adjust their interest rates, it is necessary for them to strengthen coordination with other countries in order to avoid further negative impact on the global economy resulted from policy conflicts. During the crisis, central banks around the world eased their monetary policy so as to save their economy and financial system from collapse. The Fed reduced the federal funds rate to an unprecedented low level of 0-0.25%, and then launched several rounds of quantitative easing policy. The European Central Bank, the People's Bank of China, the Brazilian Central Bank and others reduced their benchmark interest rate level to different degrees. When the European sovereign debt crisis was intensifying at the end of 2011, the six global major central banks made joint efforts to rescue the market. The Federal Reserve announced to join hands with central banks of the European Union, Japan, Canada, Britain and Switzerland, and strengthen cooperation in terms of liquidity with the purpose to alleviate the impact of the debt crisis on the global financial markets. The convergence of the economic and policy cycles of China and the United States drives the co-movement of their Treasury yields.

#### **4.2 Changes of the Linkage Mechanism of the Chinese and US Treasury Yields since 2012**

Since the 2008 crisis, the US economy continued its robust recovery under the strong stimulation of three rounds of QE policy. The speculation of Fed rate hike began to emerge in 2013, and the Fed's monetary policy will go back to normal. However, the rate hike speculation resulted in sharp fluctuations in global financial markets, the European Union and Japan suffered a serious impact on their economy, and the European Central Bank and the Bank of Japan pushed out an ultra-loose monetary policy. At the same time, China was also affected by Fed's rate hike policy. Since 2014, the Chinese economy continued going downward. From November 2014 on, PBOC started its rate cut operation, and cut its interest rates for several times. It can be seen that since the Fed ceased its QE operation, the economic and policy cycles of the United States and China have already begun to disperse. However, the correlation between the Chinese and US 10-year Treasury yields has been further strengthened instead since 2013. On the other hand, there is an obvious divergence between the US Treasury yield and the Dollar index. The Treasury yield did not rise with the dollar index, but fell with the falling Chinese Treasury yield. This indicates that the Chinese Treasury yield has had obvious effects on the US Treasury yield, and that the linkage mechanism between the yields has changed.

The above empirical results show that the Chinese and US Treasury rates have entered into a phase of reciprocal causation after 2012. This conclusion may provide explanation for the weak going up of the long-term US Treasury yields since 2014. Under the background of long-term stagnation of the global economy, the impact degree of international factors on the US Treasury bond yields remarkably rises higher, and the weak global economy and the easing monetary policies of other major economies pose a larger constraint to the upward running of the US Treasury yields. In recent years, China has made remarkable progress in financial opening and RMB internationalization, China's financial market will be further integrated into the global financial markets, and its domestic interbank bond market is opened up earlier than other markets, which means that the global linkage degree of China's bond yields will likely be even higher.

The opening measures match the higher internationalization degree of the RMB, which will attract more foreign investors to participate in the transactions of the interbank market. The globalization of the dealer subjects means that the globalization factor has increased its position among other factors in the determination of market interest rates, and the embodiment of China's market interest rates in the change of global liquidity will also improve accordingly.

In October 2016, the renminbi is officially included in the currency basket of SDR, which means that the proportion of the renminbi assets in future global foreign reserves will rise further. More international investors will go to participate in the Chinese bond market, which is an important downward momentum for China's bond yields. Currently, China's economic growth is in slowdown, inflation is in a low level, the monetary policy will remain ease, and there is still rate cut space. These factors will support China's bond yields running at low level. Therefore, the US Treasury yield will also run at low level under the conditions that the Treasury yields of China and the United States affect each other and the correlation between them is enhanced.

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