The Roadmap of Interest Rate Liberalization in China

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Abstract

This paper examines the roadmap of interest rate liberalization in China, including the current dual-track interest rate system and future benchmark rate. The main contributions of this paper are as follows. First, we thoroughly compare the benchmark interest rate systems around the world, particularly in the United States and Europe, and determine the similarities and differences between the Federal funds rate and London Interbank Offered Rate. This analysis provides the theoretical foundation for China to develop its own benchmark interest rate. Second, we apply a vector autoregression model to test the effectiveness of Chinese market interest rates, Shanghai Interbank Offered Rate, and repo rates against different aspects such as market size, volatility, monetary policy transmission channel, and interest rate term structure. The result shows that SHIBOR affects the market and macro economy and is sensitive to changes in other interest rates and monetary policies. Therefore, SHIBOR has the potential to be the future benchmark interest rate.

摘要

本文主要探討中國的利率市場化進程，即處在金融改革時期的利率雙軌制以及未來市場化條件下基準利率的選擇。本文的主要貢獻在於：首先，深入比較世界各國的基準利率系統，特別是在國際金融市場具有廣泛應用的美國聯邦基金利率和倫敦同業銀行拆借利率，參照不同基準利率系統的共同和差異，為中國基準利率的發展提供了堅實的理論基礎；其次，運用 VAR 模型評估中國目前的部分市場利率，包括上海銀行間同業市場利率（SHIBOR）及債券回購利率（Repo）。我們從市場規模，利率波動性，貨幣政策傳導通道的有效性以及利率的期限結構等多方面進行了實證檢驗，結果表明 SHIBOR 不僅可以影響宏觀經濟和金融市場，對其他利率和貨幣政策也有一定的靈敏度和傳導性，具備成為金融市場基準利率的質素。

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Content

Tables and Figures

CHAPTER 1: Introduction

Economists McKinnon (1973) and Shaw (1973) first presented the theory of financial deepening, which aims to increase the provision of financial services with a wide choice of services that are geared to all levels of society.[1] They indicated that "financial repression" is common in developing countries and suggest that developing countries relax restrictions in the financial sector and reform excessive government intervention to promote economic growth. One of the most important aspects of financial liberalization is interest rate liberalization, which allows interest rates to be set by the market to allocate credit efficiently. The interest rate is the price for money in the market and is the benchmark in the pricing of financial products.

Interest rate liberalization in China has started since 1993 and has gradually developed as the central bank regulates deposit and loan interest rates within a floating band. However, financial institutes other than commercial banks (i.e., shadow banking) price their financial products according to market interest rate, and a dual-track interest rate system has been formed throughout the years.

In a financial market, all interest rates are assessed based on a benchmark interest rate, which is usually the lowest interest rate and

[1]Shaw Edward (1973), Financial Deepening in Economic Development, Oxford University Press
Ronald I. McKinnon (1973), Money and Capital in Economic Development, Brookings Institution Press

fluctuates according to market pressures. Although benchmark interest rates vary from country to country, such interest rates serve as price indicators of capital borrowing and lending in financial markets. People always determine the rate of return of their investments based on the decided benchmark interest rate. Therefore, to develop a complete financial market, choosing an appropriate benchmark interest rate is an inevitable step for the central bank during interest rate liberalization. In the past ten years, the People's Bank of China has considered several market interest rates as the benchmark rate, including the repo rate, rediscount rate, and the Shanghai Interbank Offered Rate (SHIBOR).

1.1 Purpose and Brief Results

The main purpose of this paper is to examine whether SHIBOR or bond repurchase rate can help the Chinese financial market to form a benchmark interest rate that can serve as a standard for financial market prices and a good transmission channel for central bank monetary policies. This problem is important in China because distortions in the financial market affect the money, security, and bond markets, where a controlled interest rate causes credit rationing, shadow banking, and bond market repression, among others. The choice of benchmark interest rate is decided by the central bank and is an important market indicator. The present financial situation in China is unclear because some people believe that an

interbank interest rate similar to LIBOR (i.e., SHIBOR) is the best choice, whereas other people believe that the bond repurchase rate should be used. Nevertheless, the People's Bank of China intends to develop SHIBOR as the future benchmark rate.

To the best of our knowledge, no research has thoroughly compared the different benchmark systems across the world and analyzed the situation in China on the basis of comparisons. Thus, this paper aims to illustrate the roadmap of interest rate liberalization in China and examine which market interest rate can serve as the benchmark interest rate. After analyzing international data, we conduct an empirical analysis from different aspects such as market sizes, relationships among market interest rates, information contents, term structures, and monetary policy transmission channels. Results show that China should adopt a benchmark interest rate system that is similar to LIBOR. SHIBOR has exhibited the characteristics of a benchmark interest rate since 2006 but has also shown instability. China's financial market has changed considerably, and SHIBOR fluctuates with market pressures and policy changes. Thus, we must apply the results to the real economy to provide suggestions for reform.

1.2 Organization of the Paper

This paper is organized as follows: Chapter 2 contains the review of literature on Chinese and international financial reforms. Chapter 3 presents

the research methodology and estimation method. Chapter 4 explains the background of the financial reform and financial market problems of China. Chapter 4 also presents international experiences in choosing benchmark the interest rate, particularly the two most widely used rates: the Federal funds rate and LIBOR, and introduces SHIBOR rate and the repo rate, which are both developing fast in the current financial market. Chapter 5 reveals the empirical results, which examine the relationship among interest rates, transmission channels, and term structures. Chapter 6 concludes, identifies the limitations of the study, presents future research directions, and provides suggestions on the current economic environment.

CHAPTER 2: Literature Review

Chai (1981) and Bryd (1983) examine the financial system and financial reform in China in the early 1980s, which marks significant changes and transitions in the role of banks and financial systems. They analyze all occurrences and potential changes in circulating capital, credit financing, interest rate, and so on. Twenty years later, DaCosta and Foo (2002) illustrate the progress and inadequacy of the financial reform and conclude that financial systems remain vulnerable to crisis and potential dangers with the entrance of foreign banks even though many fundamental changes have been implemented in the reform.

Chinese scholars have analyzed the continuing financial reform from different perspectives. Zhang (1995) concludes that the financial reform is remarkable but not profound because the most distinct change is the scale of the financial market rather than the system and structure. Dai (2000) provides a new angle that the informal financial sector, including saving collectors and private moneylenders, who are not legally registered at the national level, is vital to the success of the financial reform in China. His view matches that of Lin (2003), who states that China needs to develop rural financial institutions, given the different economic and geographic conditions of China compared with other countries. Wu (2002) indicates that the banking reform will be the most important part of it because banks have

an irreplaceable place in the Chinese financial system.

The view that interest rates should be considered policy targets has been suggested since the late 1970s. Engle and Granger (1987) verify the co-integration relationship between different interest rates. Pesaran and Shin (1998) introduce the generalized impulse response analysis in the fractionally integrated vector auto-regressive (VAR) model and analyze the interaction between variables with a VAR error correction model. By following similar methods, interest rate transmission has been perceived as empirically successful. One remarkable piece of evidence is the discovery that the Federal funds rate effectively reflects information of the future movements of real macroeconomic variables (Bernanke, Blinder 1992). The Federal funds rate is sensitive to the money supply, which is an apparent indicator of monetary policy, and this transmission channel works through both bank loan channels and bank deposit channels. The change in the Federal funds rate is then categorized into anticipated and unanticipated components (Kuttner 2001). The changes in bond rates and bill yields are mainly caused by unanticipated movements. Anderson, Granger, and Hall (1992) argue that the co-integration relationships exist between the different yields to maturity of US Treasury bills and co-integrating vectors are defined by the spreads between yields when the Federal Reserve targets short-term interest rates. Dickey, Jansen, and Thornton (1991) show that co-integrating relationships can be found among M1, M2, nominal income,

and nominal interest rates, and these co-integrations affect the transmission of monetary policies to the macro economy. Atesoglu (2003) examines the relationship between the prime rate and Federal funds rate and shows that these two rates have a two-way causality. In addition to research on the Federal funds rate, Heffernan (1997) use an error correction model to capture the dynamic response of the British interest rate to the central bank base rate change. He suggests that the imperfect competition in the retail banking market causes the adjustment differences of the loan and deposit rates to the changes in LIBOR, thus further influencing the speed of money transmission.

When the interest rate market is not fully liberalized in a developing country (e.g., the current dual-track interest rate system in China), interest rate determination and transmission usually differs for different periods. For example, Edwards and Khan (1986) outline a theoretical framework that shows how the interest rate is determined when controls are removed on the financial sector and concludes that the interest rate is linked to the openness of the financial system. Cottarelli and Kourelis (1994) employ evidence from multiple countries and provide a measure to relate the lending rate stickiness of banks to the structure of the financial system. Obstacles to bank competition, constraints on international capital movement, and absence of negotiable short-term financial instruments (e.g., T-bills) cause interest rate to stick to monetary policies. Qin and Lu (1996) compare the

process of interest rate liberalization in several developing countries including Argentina, Chile, Indonesia, and so on, and suggest that the People's Bank of China should loosen restrictions on deposit and loan rates first. Rosen (2002) argues that bank interest rates (i.e., the price that a bank faces in the market) sometimes respond to market interest rates (i.e., the cost that a bank faces in the market). The response tends to be large when the price–cost margin is large. However, Cho (1986) states that the elimination of interest rate ceilings and government credit allocation, which is the general policy adopted by developing countries in financial liberalization, is insufficient in increasing the efficiency of the market without a well-developed equity market. Sa (1996) employs empirical evidence from seven developing countries to prove the danger of high interest rates in financial reform under an unstable macroeconomic environment with high inflation, unbalanced exchange rates, and insufficient policies. The People's Bank of China has been implementing both quantitative and price-based monetary policies. However, the transmission mechanism has experienced many problems. For example, the expanding monetary supply generated by the proactive monetary policy of the People's Bank of China in 1998 to 2002 has only "leaked" into the 'black hole" of bank deposits and equity market speculators rather than into investments and the real economy (Pei and Xiong, 2003). Shao (2007) suggests that the dual-track interest rate system causes inefficiency in the transmission between interest rates and corporate

investments. Residents are also not sensitive to changes in the interest rate because of the deposit ceiling. Most people deposit money for future security expenditures such as education or medical expenses rather than investing their money in financial products based on market interest rates. Guo (2009) employs the co-integrated model and provides empirical analysis to prove the inefficient transmission of interest rates to either exchange rates or macroeconomic indicators.

Wang (2001) and Yi (2009) illustrate the interest rate liberalization in the financial market of China since 1993. They both categorize the gradual process of interest rate liberalization into three stages: liberalization of deposit and loan rate, establishment of benchmark interest rate, and construction of a central bank interest rate system. Xu (2003) provides three pre-conditions of interest rate liberalization: financial supervision, competitive market, and fiscal balance. He suggests that China should not be hasty in implementing interest rate liberalization if these conditions are not fulfilled. The People's Bank of China has allowed deposit and loan rates to fluctuate in a band since 1982, but the benchmark interest rate still has not been decided thus far. The fixing repo rate and SHIBOR are not yet the benchmark rate, but they are close to it. Chen and Wu (2008) provide empirical evidence for interest rate transmission before and after the introduction of SHIBOR in the market and shows that SHIBOR has a distinct causal effect on other market interest rates. This causality effect,

together with a relatively stable relationship between SHIBOR and the price of financial products, shows that SHIBOR has been recognized by the market as a benchmark rate (Zhang and He, 2009). However, Dai and Liang (2006) compare the characteristics of the Federal funds rate and LIBOR and conclude that the seven-day fixing repo rate (R007) has a larger market and is easier to measure and adjust than the two former rates; thus, the fixing repo rate is a better choice as a benchmark rate. In addition to being a reliable market interest rate, a benchmark interest rate should also have the capacity to be affected by open market operations to enable the central bank to interfere with the money market if necessary (e.g., the Federal funds rate). Huo, Guo, and Feng (2009) investigate the relationship between SHIBOR, central interest rate, and reserve requirement and conclude that Granger's monetary policy leads to SHIBOR. As a suggestion regarding SHIBOR'S path, Wu (2007) compares SHIBOR and the Federal funds rate and proves that SHIBOR should be adopted in financial product pricing and as the settlement interest rate.

CHAPTER 3: Methodology

This paper first compares the interest rate liberalization of different countries and provides a thorough comparison on reform processes and varying benchmark market interest rates. Walsh (2003) analyzes the theory of monetary policy operating procedure and explains that an interest rate monetary target will be preferred to the money-supply procedure when the monetary demand varies considerably. The current study is motivated by the ideas of Bernanke and Blinder (1992), who suggest that a benchmark interest rate should be informative with regard to other open-market interest rates and future movements of real macroeconomic variables and should be a good indicator of monetary policy actions. To test the effectiveness of the benchmark interest rate, we apply the following VAR model:

$$Y_t = B_0 Y_t + B_1 Y_{t-1} + C_0 P_t + C_1 P_{t-1} + u_t, \quad (1)$$

$$P_t = D_0 Y_t + D Y_{t-1} + G P_{t-1} + v_t, \quad (2)$$

where Y represents non-policy variables, such as macroeconomic variables; P represents policy variables, including open-market interest rates such as SHIBOR and Repo rate. We also analyze the interest rate by using the

augmented Dickey–Fuller (ADF) test for stability, EGARCH regression, correlation analysis and the Granger causality test.

CHAPTER 4: Benchmark Interest Rate Systems

4.1 Financial Reform in China

China implemented its interest rate liberalization in 1993, 15 years after its economic reform, when the State Council first proposed interest rate liberalization, macro-control policy of the central bank, and functions of financial institutes and financial market. The interbank credit-offered market was founded in 1996 with market lending and borrowing rates. Two years later, three policy banks (i.e., the China Development Bank, Export–Import Bank of China, and Agriculture Development Bank of China) issues policy financial bonds priced at the market interest rate to support national construction. Thereafter, the People's Bank of China announces that each commercial bank can set the deposit and loan rates based on the basement rate as long as such rates are within the band provided by the central bank.

4.1.1 Dual-Track Interest Rate

The Chinese financial market is currently in transition with a special dual-track interest rate system and a different monetary policy compared with developed countries. In a free money market, the price of money and bonds are decided by supply and demand, and the benchmark rate serves as the upper bound or lower bound of the market interest rate. However, the money and bond markets in China function with the use of market interest rates. However, for commercial bank deposits and loans, both price

limitations and quotas exist, that is, deposit and loan rates are controlled by the central bank. The central bank sets a ceiling for the deposit rate and a floor for the loan rate, and each commercial bank has to distribute their bank loans within the quota allocated by the central bank.

Dual-track economic systems are not rare in Chinese history. The prices of goods are decided in a dual-track system at the beginning of the reform and during the opening up of the market. For the goods that already exist in the planned economy, the prices are controlled by the government; for new goods that are not in the system, prices are decided by the market. In time, the planned economy is gradually replaced by the market. This dual-track interest rate system is similar to the dual-track price system in the current financial sector.

4.1.2 Credit Rationing

Capital will be accumulated as the economy grows. This capital can then be supplied to further investments. At the same time, a growing economy needs capital to open businesses and place investments. In a fully mature market, the supply and demand of capital will be in equilibrium by competition and negotiation, thus forming an equilibrium capital price, which is the interest rate. However, if the market is not well developed or controlled by the government, market distortions will occur. China is currently facing such a situation. According to He and Wang (2011), the current price floor of loan rates and price ceiling of deposit rates in China

are unfeasible and feasible, respectively; thus, the current deposit rate is lower than the market equilibrium rate. This low deposit rate provides commercial banks the benefit of obtaining capital at low costs. Under this circumstance, banks will be willing to provide loans at prices lower than the market equilibrium rate, thus allowing enterprises to borrow more. This excessive supply and demand of bank loans will bring significant liquidity, which may cause inflation if not controlled. To solve this problem, the central bank implements two other restrictions. First, the central bank sets a price floor for loan rates to prevent hostile competition among banks. Second, the central introduces quantitative instruments such as the loan quota to reduce bank loan supply. State-owned corporations and large companies are usually the main borrowers of bank loans. In reality, the ceiling for the deposit rate actually leads to financial repression in the market, thus making interest rates in informal financial markets higher than the interest rates in the bank loan market. This situation leads to the capital shortage of corporations, particularly small and medium private corporations.

4.1.3 Shadow Banking

The shadow banking system has been introduced by McCulley of PIMCO who coined it at Federal Reserve Bank of Kansas City's Economic Symposium in Jackson Hole Wyoming in 2007. Shadow banks refers to non-bank financial intermediaries that provide products and services similar

to those provided by traditional commercial banks, including investment banking, hedge funds, money market funds, bond insurance, structured investment vehicles, and so on. These institutions possess and trade massive volumes of securities, bonds, and other derivatives by leverage. On one hand, shadow banking has boosted the prosperity of the financial market in recent years and has provided a variety of products for investors. On the other hand, the fast development of shadow banking without proper supervision and high leverage makes the financial system fragile and vulnerable. Shadow banking even caused the financial crisis in 2008.

In China, shadow banking is the result of distortions in the capital market caused by the controlled loan interest rate. Shadow banks serve as financial institutions that provide direct financing to enterprises. The shadow banking system includes personal financial management, trust, financial companies, financial leasing companies, automobile financial companies such as GMAC-SAIC, which provide financial services to car buyers and sellers, and off-balance sheet businesses for commercial banks, which include entrusted loans and private loans. The estimated coverage of the shadow banking system in China varies from RMB 10 trillion to RMB 30 trillion[2], according to various statistics. When firms and individuals find difficulties in borrowing money from traditional commercial banks or when people look for different investment channels other than bank deposits, they

[2] Data source: Zhu Haibin (2013). Contributions and Danger in Shadow Banking in China. Financial Times. July 2013. http://www.ftchinese.com/story/001051405

usually have no choice other than to turn to shadow banking for financial services.

In a mature financial market, enterprises can be financed via multiple channels aside from bank loans. These channels include corporate bonds and securities. However, only state-owned enterprises are eligible to issue corporate bonds in China and their credibility is only guaranteed by the government not by the efforts of such companies. The issuing of corporate bonds is strictly examined prior to approval by the government. Furthermore, the size of the corporate bond market is smaller than the Treasury bond, central bill, and security markets. Thus, the functions of corporate bonds market in China are limited.

The Chinese government also places restrictions on domestic institutions to attract foreign investment (QFII). Only qualified foreign institutions can invest directly in China's capital markets. Thus, the volume of foreign investments is small compared to the volume accrued by the global market.

Therefore, Chinese investors, particularly domestic small and medium size enterprises, do have limited investment channels. Thus, Chinese investors usually turn to shadow banking for help. However, the systematic risks in the shadow banking system cannot be ignored. The capital in shadow banking usually comes from short-term bills. Once the market fluctuates, a liquidity risk occurs. Many financial products are also designed

inappropriately, and some high-risk assets are packaged and sold to customers. Given the shadow banking system, considerable banking credit is transferred to off-balance sheets, thus causing banks to suffer from potential risks. In 2012, the wealth management products of many banks encountered problems, with some banks losing more than 50% of their initial value. Finally, lending in shadow banking does not occur in public or under supervision, thus increasing chances of rent-seeking activity and financial corruption.

Strengthening the supervision of the shadow banking system has become a common goal for the People's Bank of China and the financial market. The introduction of interest rate liberalization can restrict the shadow banking business and coverage. Given that a market interest rate will eliminate the credit-rationing problem in the loan market, the development of shadow banking will be restricted.

4.1.4 Monetary Policy in China

Unlike Federal reserves, which can use quantitative instruments such as buying or selling bonds to increase or absorb liquidity and force the market interest rate to move towards the target, the People's Bank of China has to control simultaneously both interest rate and liquidity. This form of control has certain limitations. The central bank can only control the total size of bank loans when the economy is overheating. However, the market will feed capital into the money or bonds market where interest rates are

higher, thus harming the effect of monetary policies. Therefore, China has to implement financial reform and fully liberalize the interest rate to allow the market to decide prices in the financial market gradually.

4.2 Interest Rate Liberalization around the World

4.2.1 Interest Rate Liberalization

Many countries have already completed the process of interest rate liberalization. Countries such as the United States and Taiwan succeeded in interest rate liberalization, whereas countries such as Argentina and Malaysia failed and suffered from serious inflation and economic turmoil.

In the 1930s, the United States set a price ceiling (2.5%) for the deposit interest rate in the "regulation Q" by the Federal Reserve. This type of regulation was useful during the recovery of banks and the financial industry from the Great Depression. However, the disadvantages of a regulated interest rate emerged and the inflation rate surged to 20% during the growth of the US economy in the 1960s. The market interest rate also became higher than the deposit rate. Ten years later, many US banks have filed for bankruptcy, thus prompting the Federal Reserve to implement interest rate liberalization. In 1980, the US Government decided to loosen restrictions on deposit rate gradually over a period of six years, whereas the Federal Reserve targeted the money supply, M1, rather than the interest rate. However, the money supply fluctuated significantly, and the relationship

between M1 and economic growth weakened. In 1990, the Federal Reserve rate was set as the target interest rate in open market operations. This rate was accepted by the market as the benchmark interest rate.

Upon completion of the interest rate liberalization process, both the financial market and the real economy grew rapidly and stably for a relatively long time. From 1990 to 1992, the Federal Reserve decreased the Federal funds rate to stimulate investment and consumption . The interest rate was later increased when the economy overheated. To date, the financial market is more active than ever result of the financial innovations, thus making the interest rate sensitive to monetary policies and the money supply difficult to control. This development makes the Federal funds rate an ideal transmission channel.

By contrast, Argentina started its interest rate liberalization when the domestic economy was unstable. In 1971, the first liberalization failed because capital went from commercial banks to shadow banking and because the government was not able to regulate the capital flow. Four years later, under the pressure of inflation, Argentina tried another financial reform by removing all restrictions on interest rates. However, interest rate liberalization neither helped Argentina combat inflation nor helped the financial market develop. Instead, interest rates increased rapidly and unsettled the financial market. The increasing interest rate led to the debit crisis, thus prompting Argentina to stop interest rate liberalization by the

1990s.

4.2.2 Benchmark Interest Rate

The benchmark interest rate is the most important interest rate in a financial market. Other interest rates, as well as the prices of financial products, are assessed based on this benchmark. In a liberalized interest rate market, investors use this rate to calculate possible returns. For example, people in finance use the benchmark interest rate to estimate costs, and central banks observe this rate as an indicator of the market and use monetary policy instruments to influence this interest rate. To some extent, the benchmark interest rate is the core of a liberalized interest rate market. The inter-bank offered interest rate and bond repurchase rate are the most popular benchmark interest rates around the world (Table 1).

[Insert Table 1 here]

4.3 Federal Funds Rate

Developed countries such as the United States have already completed the interest rate liberalization process several years ago. The Federal funds rate is a representative and influential benchmark interest rate that acts as a sensitive indicator of the change in supply and demand of the money market among banks. The Federal Reserve can affect the capital cost of commercial

banks and further the development of the whole economy by affecting the Federal funds rate.

The interbank market first appeared in the United States in 1913 when the Federal Reserve Act created a system of reserve banks that function as "the lenders of last resort by accommodating the temporary liquidity needs of the banking system and thereby alleviating the periodic financial disruptions that plagued the national bank era."[3] The Federal Reserve requires commercial banks to hold a minimum fraction of customer deposits and notes as reserves (i.e., reserve requirement). As part of the reserve system, commercial banks must deposit the required amount of cash in the Federal Reserve. However, commercial banks also encounter problems in holding a specific percentage of their demand deposits in reserve because their financial position is affected by operating expenses. This situation has led to the emergence of interbank lending and borrowing in the market. Financial institutions with surplus balances lend to institutions (either member banks or the Federal Reserve) that need resources. The "trade price" is the interbank-offered rate negotiated between the two counterparties, and the weighted average of this rate across all such transactions (mostly overnight transactions) is the Federal funds effective rate. Three types of transactions are often found in the market: unsecured liability, which means that the debtor borrows money and pay with interest the next day; secured

[3]JN Feinman, Reserve Requirements: History, Current Practice and Potential Reform, Federal Reserve Bullentin, 1993

liability, when the debtor borrows from the Federal funds on government securities and pay the money the next day; repurchase agreement, which refers to the sale of government securities with an agreement for the debtor to buy back the securities the next day and pay the money to the creditor. Before the 1970s, only member banks were allowed to enter the federal funds market, and long-term transactions were non-existent. All transactions also had to be completed by transferring money to the Federal Reserve, thus limiting market size and development. Thereafter, the Federal Reserve gradually loosened these limitations. For example, 49,000 banks and financial institutions (both members and non-members) were actively trading in the market until 1983. Market size also expanded, and long-term transactions from one to three months were introduced. Technological development enables transactions to be conducted by electronic systems, which provide accurate and rapid information for both parties in the market.

The Federal funds rate can directly reflect the money market price changes and has become the most sensitive interest rate in the US economy. The rediscount rate and best lending rate move together with the Federal funds rate, and the interest rates of repurchase agreements, certificates of deposits, commercial paper, and Eurodollars are also highly correlated with the Federal funds rate.

The Federal Reserve often sets a nominal target to enforce the Federal funds rate as a benchmark rate. The manner in which the Federal Reserve

enforces this rate is primarily open market operations. The target rate is decided by governors at Federal Open Market Committee (FOMC) meetings, which is occasionally held according to economic conditions. Suppose that the Federal Reserve lowers the target rate, banks that need resources will trade with the Federal Reserve, thus causing the market interest rate to decrease. When the Federal Reserve decides to increase the target rate, the Federal Reserve can sell Treasury bills and government bonds to absorb liquidity in the market, thus forcing the market interest rate to increase with the Federal funds rate because of the decreased money supply in the market. Changes in the Federal funds rate are correlated with the balance surplus or deficits of financial institutions and can affect all market interest rates, including loan rate, deposit rate, and prices of financial products. When the Federal Reserve has enough creditability in the market, interfering with market expectations is possible by announcing a new target rate instead of conducting open market operations. This transmission channel allows the monetary policies of the Federal Reserve to influence the money market in an efficient manner and transmit interest rate changes to the public, corporations, and whole economy. To date, more than 14,000 financial institutes are involved in transactions every day.

4.4 LIBOR Rate

European central banks adopt a different benchmark interest rate to

provide guidance to the financial market and transmit monetary policies. This benchmark interest rate is LIBOR, which has been developed by British Bankers' Association (BBA) in 1984. LIBOR is currently the most widely accepted benchmark interest rate in the world today. Before the implementation of LIBOR, the London interbank market developed extremely quickly and new financial instruments were introduced, including interest rate swaps, foreign exchange futures and options, and forward interest rate contracts. However, without a reliable benchmark interest rate, people had difficulty agreeing on the prices of financial products. Under this circumstance, the BBA introduced the BBA Interest Rate Swaps (BBAIRS), in which the BBA interest settlement rate was defined. In 1985, BBAIRS became the general standard for transactions and developed into LIBOR.

LIBOR panel banks include 16 large global banks that are actively operating in London financial markets. These panel banks need to report their respective prices on interbank transactions (i.e., both buying and selling prices) in a reasonable market size every morning. LIBOR rates are calculated for 10 currencies, including the British pound, US dollar, and Euro, and for 15 borrowing periods ranging from overnight to one year. The BBA asks the panel banks to assemble a quotation team for each currency. The quotation team is tasked to calculate the expected interest rates that are rational and unsecured for different currencies and borrowing periods. After eliminating the highest and lowest one-fourths of all quotations from the

panel banks, the average interest rate will be the final LIBOR rate of the day.

LIBOR is similar to the Federal funds rate in terms of interbank loans. However, these rates are different from other in numerous aspects. First, LIBOR is the average interest rate estimated by the leading and creditworthy banks in London and is the rate charged when banks borrow from one another. By contrast, the Federal funds rate is set by the FOMC to implement US monetary policies. LIBOR became the benchmark rate of the loan interest rates of most banks, given that London is the primary market of the Euro currency market. However, LIBOR is not set beforehand by the central bank and may or may not be used to affect the money market and real economy. Compared to the transmission mechanism of the Federal funds rate, the central banks of the United Kingdom, Switzerland, and other European countries often sell/buy bonds and bills in the money market, particularly in the repurchase market, to affect market liquidity and indirectly guide LIBOR toward their targets. Table 2 shows the comparison between the Federal funds rate and LIBOR.

[Insert Table 2 here]

Other similar benchmark interest rates in the international financial markets include the Singapore Interbank Offered Rate (SIBOR) and Hong

Kong Interbank Offered Rate (HIBOR). The mechanisms and applications of SIBOR and HIBOR are similar to LIBOR, although SIBOR functions at a local level.

4.5 Benchmark Interest Rate in China

In the financial system of China, an interbank-offered market exists that is similar to the US interbank-offered market. However, the market size in China is significantly smaller than in the United States. The People's Bank of China trades bonds and bills with 40 commercial banks to implement open market operations. The bond repurchase rate is one of the prices in this market. Repurchase agreements include treasury bonds, central bank bills, and policy bonds. The maturity of repurchase bonds varies from one day to one year.

The repurchase bond market in China is not yet united, and the repurchase rate does not effectively transmit to other market interest rates. The People's Bank of China has tried to learn from the history of LIBOR, thus resulting in the introduction of SHIBOR . SHIBOR was introduced on 7 September 2006 when the People's Bank of China announced the establishment of a monetary market interest rate based on the price quotation by a group of banks with high credit ratings. The price quotation group of SHIBOR consists of 16 commercial banks. These quoting banks are the primary dealers of open market operations or market makers in the

FX market and have sound information disclosure and active RMB transactions in the Chinese money market. The SHIBOR Working Group of the People's Bank of China decides and adjusts the panel banks, supervises and administrates the SHIBOR operation, and regulates the behavior of quoting banks and specified publishers in accordance with the Implementation Rules of SHIBOR. SHIBOR currently consists of 8 maturities: overnight, 1 week, 2 weeks, 1 month, 3 months, 6 months, 9 months, and 1 year.

Approximately 22% of the interest rate swaps and all interest rate futures are priced according to SHIBOR. However, medium term and long-term rates are not reliable because of the limited market. Table 3 shows the comparison between SHIBOR and LIBOR.

[Insert Table 3 here]

CHAPTER 5: Empirical Analysis

5.1 Data Description and Summary

The typical benchmark interest rates based on the international financial market are the Federal funds rate (Funds), three-month Treasury-bill rate (Bill), and LIBOR. Although no single interest rate is the benchmark rate in China, the SHIBOR, bond repurchase interest rate (repo rate), interbank borrowing rate (IBO), interbank bond transaction rate, rediscount Rate, and central bank bill interest rate, among others, all reflect certain parts of the market information and are able to serve as benchmark rates to a certain extent. We compare these three international benchmark rates and Chinese market rates (Table 4) to analyze the interest rate characteristics in China. Funds represent the overnight Federal funds rate from the official Federal Reserve website (www.federalreserve.gov). Bill represents the three-month treasury-bill rate from the US Department of Treasury (www.treasury.gov). LIBOR001 and LIBOR007 are the overnight and one-week Libor rates, respectively, from the Federal Reserve Economic Data (www.research.stlouisfed.org). SHIBOR001 and SHIBOR007 are the overnight and one-week SHIBOR, respectively, obtained from the official SHIBOR website (www.shibor.org). FR001 and FR007 are the overnight and one-week Repo rates, respectively, and IBO001 and IBO07 are the overnight and one-week interbank offered rates, respectively (from the

RESSET database, www.resset.cn). The data window is from 1 January 2001 to 15 April 2013 because all Chinese interest rates have limited data before the year 2000. SHIBOR are only available from 2006; hence, we have fewer observations on SHIBOR compared with the other interest rates.

Central refers to the central bank bill rate, which is used as the instrument of open market operations by the People's Bank of China. We test the relationship between the central bank bill rate and open-market interest rate to determine if monetary policies affect market interest rates. The data window is from 25 June 2002 to 20 October 2011. This interest rate is not continuous because the central bank does not issue bills every day. The data is obtained from CSMAR Solution (www.gtarsc.com).

[Insert Table 4 here]

Conducting a research on the information content and benchmark interest rate standards entails that the international benchmark rates be first compared with the Chinese interest rates in terms of market size, pattern, and other aspects. Thereafter, a comprehensive view should be taken on the transmission mechanism between interest rates and macroeconomic activities. The following sections present that SHIBOR performs better in volatility tests and has effective transmissions in macroeconomic activities than other interest rates even though the repo rate has a relatively larger

market.

5.2 Market Size of Open-Market Interest Rates

The US Department of Treasury issues a massive volume of bills and bonds every year. The three-month T-bill has a complete term structure and represents the short-term interest rate. Funds denote the interbank-offered market rate, which the Federal Reserve changes to implement monetary policies. These two rates are broadly accepted as the benchmark for bond and interbank markets. The average trading volume of the US Treasury market is USD 518.9 billion, and the size of outstanding US Treasury bills is USD 11 trillion dollars until the end of 2012.[4]

The market size of the Chinese interest rate market is smaller than the market size of international interest rate markets, particularly the rediscount rate markets and central bank bill interest rate markets (Table 5). Thus, the rediscount rate and central bank bill interest rate cannot be considered a reliable benchmark rate for the Chinese financial market. The rediscount rate and central bank bill interest rate, which are monetary policy instruments, is not fully decided by the market. These rates instead serve as monetary policy signals. Both trade volume and market size are relatively small for these two interest rates, thus they should not be considered the daily benchmark interest rate of the market.

[4]Data obtained from the SIFMA Web site, http://www.sifma.org/research/statistics.aspx

[Insert Table 5 here]

The bond repurchases market has constantly grown in the past 10 years and is still rapidly expanding. The repo rate seems to have an ideal market size foundation, thus making this rate superior than the interbank-offered market rate. However, this huge market does not have one standard interest rate index for all kinds of bonds, thus resulting in difficulties in determining one benchmark rate.

5.3 Interest Rates Volatility

First, we plot all interest rate trends between 2001 and 2013 to determine the volatility.

[Insert Figure 1 to Figure 8 here]

We can see from the graph that Chinese market interest rates, except for the central bank bill rate, seem to be less volatile than Funds, LIBOR, or Bill. Funds and the central bill rate are instruments of monetary policies; thus, they may reflect the intention of the central banks based on the market. We adopt the ADF test with an interception but without a time trend, given that not all interest rates have significantly obvious trends from 2001 to

2013. The result shows the following function:

$$\Delta i_t = \mu + \varphi i_{t-1} + \sum_j^3 \alpha_j \Delta i_{t-j} + u_t, \quad (3)$$

where *i* is the interest rate. The null hypothesis is as follows:

$$H_0: i_t = i_{t-1} + u_t, \quad (4)$$

which means that the interest rate series is non-stationary.

[Insert Table 6 here]

The ADF result also shows that the t-statistics of the Federal funds rate is −1.97, which is larger than the 1% critical value of −3.43. Thus, we know that the Federal funds rate is non-stationary. If we conduct the ADF test to the first difference of the Federal funds rate, we can determine that the new t-statistics is −38.466, which is significantly smaller than the 1% critical value. Thus, the Federal funds rate is stationary after a first difference. Similarly, LIBOR001, LIBOR007, and Bill are all non-stationary series that become stationary after a first difference. SHIBOR, repo, and IBO rates are stationary series because their t-statistics for the ADF test are smaller than the 1% critical value. This result is surprising and may be caused by the

relatively short period chosen for this study, that is, 10 years, which is insufficient for observing the "mean reversion" of interest rates. Schaumburg (2001) assumes that the interest rate is affected by the supply and demand in the market, as well as monetary policies (Funds in the United States). The market itself creates the interest rate to show the "mean reversion" effect. However, if the central bank adjusts monetary policies frequently, the mean reversion effect will be weakened or eliminated. This case shows that Funds, Bill, and LIBOR are more sensitive to monetary policies than Chinese interest rates, and they have complete transmission mechanisms and smooth channels.

When events occur in the market, interest rates often show the volatility clustering effect, which can be verified by using the LM test. However, we need to determine the asymmetric effect of the good news and bad news of each interest rate. We infer that mature market interest rates will react to news rapidly and rationally. This hypothesis provides a more detailed explanation of the leverage effect, that is, asset prices decrease more in bad news than the price increase in good news. We adopt the EGARCH model raised by Nelson (1991) to test the asymmetric effect.

$$\ln(\sigma_t^2) = \omega + \sum_{j=1}^{p}(\alpha_j \frac{|\varepsilon_{t-j}|}{\sqrt{\sigma_{t-j}^2}} + \gamma_j \frac{\varepsilon_{t-j}}{\sqrt{\sigma_{t-j}^2}}) + \sum_{i=1}^{p} \beta_j \ln(\sigma_{t-1}^2), \qquad (5)$$

where ω stands for the long-term interest rate volatility average, γ_j is the

asymmetric coefficient (i.e., leverage coefficient to show the leverage effect), and α_j is the symmetric coefficient. If γ_j is small, the interest rate will not have a significant leverage effect on volatility. If γ_j is positive, the interest rate will fluctuates significantly during good news and vice versa. β_j represents the relationship between the volatility for two days. We use the first-difference interest rates in this study because all international interest rates are I(1) series.

[Insert Table 7 here]

The most obvious result is that Chinese interest rates have significantly stronger leverage effects than international interest rates and the tend to react more to good news than bad news (the γ of Chinese interest rates are higher by 0.2 compared with the γ of international interest rates, which is almost zero). This result reflects market irrationality on interest rates. SHIBOR acts more quickly than the other two types of interest rates and performs better than repo and IBO rates on the leverage effect.

5.4 Benchmark Test for Interest Rates

We use the Granger causality test to test the relationship between interest rates. We can use the following regression equations because interest rates are stationary:

$$X_t = \sum_{i=1}^{l} a_i X_{t-i} + \sum_{j=1}^{l} b_j Y_{t-j} + e_t, \quad (6)$$

$$Y_t = \sum_{i=1}^{l} c_i X_{t-i} + \sum_{j=1}^{l} d_j Y_{t-j} + u_t, \quad (7)$$

where l is the maximum lags of the model. We chose l as one, two, and seven to represent the causality effect in one day, two days, and seven days, respectively.

[Insert Table 8 to Table 10 here]

Table 8 shows that the overnight SHIBOR is the Granger cause of the overnight Repo rate because the probability of rejecting the null hypothesis "Shibor001 does not Granger-cause FR001" is zero in one day, two days, or one week. The conclusion is the same for the one-week SHIBOR as the Granger cause for the one-week repo rate. Inversely, either the overnight repo rate or one-week repo rate is the Granger cause for overnight SHIBOR or one-week SHIBOR, thus showing that these two overnight rates have a two-way causality effect.

Tables 9 and 10 show that the IBO rate has the "weakest" causal power, that is, the IBO rate is neither the cause of the SHIBOR nor the repo rate. Repo rates (overnight and one week) are also the Granger cause of IBO

rates, whereas the overnight SHIBOR is not the Granger cause of the IBO overnight rate.

Given that the SHIBOR and repo rates are the Granger cause of each other and that the Repo rate highly influences the interbank-offered rate, we hypothesize that the repo rate is better than the other rates in showing the benchmark characteristics of the market.

5.5 Monetary Transmission Channels

One of the most important functions of the benchmark interest rate is indicating the changes in the market and macroeconomy. The People's Bank of China tries to control the nominal money supply, inflation, and economic growth while considering that these final targets usually cannot be controlled directly by monetary policies. Central banks need to focus on narrow targets such as short-term interest rates or reserves because these variables can be precisely controlled. Monetary policy implementation involves a series of instruments, trading, and changes that are often called operating procedures.

This transmission mechanism can be divided into two procedures. First, the central bank implements monetary policies that usually involve open market operations to influence the target interest rate. Second, changes on the target interest rate are transmitted to other market interest rates and macroeconomics variables.

5.5.1 Interest Rate as a Policy Target

One of the most commonly used policy instrument of the People's Bank of China is open market operations, that is, the central bank purchases or repurchases bonds with commercial banks and issues central bank bills. When central bank bills are issued, the central bank withdraws the currency from circulation. When the bills mature, the central bank places money into circulation. Figure 9 shows the long-term trend of the central bank bill rate and SHIBOR, which tend to move in the same direction in the long term. Before July 2008, both SHIBOR and the central bank bill rate were relatively high. These rates decreased together from 2008 to 2010 and increased starting May 2010.

[Insert Figure 9 here]

The aforementioned discussion shows that the central bill interest rate is one-stage stationary and SHIBOR is stationary. We conduct a regression of SHIBOR001 on the first difference of central bank bill rate to see their linear relationship and then employ the unit root test on the residual. If the residual is stationary, then we can further test whether Granger causality exists between these two interest rates.

$$\text{SHIBOR001} = 2.101 + 0.375\ \text{d\_Central}, \quad (8)$$

(1.3) (4.54)

$$\text{SHIBOR007} = 3.877 + 0.726\ \text{d\_Central}, \quad (9)$$

(24.1) (5.302)

We then use the ADF test on residuals. The results are −7.4 and −10.3, which are smaller than the t-statistics (−3.43). Thus, we can use Granger causality test to see the relationship between SHIBOR and central bank bill rate.

We determine whether changes in the central bank bill rate can Granger cause SHIBOR to change. This Granger cause is important because it represents the first step of monetary policy transmission. If the central bank bill rate can affect SHIBOR, SHIBOR will be a good intermediate target for the central bank to implement monetary policies and affect the financial market.

[Insert Table 11 here]

We conclude that changes in the central bank bill rate do not strongly Granger cause SHIBOR changes (both probabilities are very close to 0.1; Table 11). This conclusion may be caused by the smaller frequency of open

market operations than SHIBOR changes. Furthermore, observing the direct effects of monetary policies on SHIBOR is difficult. However, the central bank bill rate can still influence the SHIBOR because the probabilities are not significant to reject the null hypothesis.

5.5.2 Information Content of Market Interest Rates

The second procedure of monetary transmission to be determined on SHIBOR is that whether changes in SHIBOR will affect the real economy. We also conduct a battery of Granger-causality tests reported to test this idea (Table 12). Each row of the table represents an equation that forecasts several macroeconomic indicators. We also add lags of M1 and M2 to compare the effects of interest rates.[5] Macroeconomic indicators include investment, real estate investment, real estate sale, consumption, and consumer price index (CPI).

[Insert Table 12 here]

Table 12 shows that the overnight SHIBOR is the best predictive variable among the eight variables considered based on the Granger-causality criterion. All interest rates are superior to M1 and M2, with M1 having virtually no predictive power at all. The overnight SHIBOR is also superior to the interbank-offered overnight rate in three of five cases.

[5]All the interest rates used are adjusted to monthly averages of daily figures and expressed at annual rates

5.6 Interest Rate Term Structure

This section uses and explores the suggestions of Estrella and Hardouvelis (1991), who argue that the term structure of interest rates should have good predictive power over the future economic trend. They prove that the term structure of US Treasury bill rates has a strong predictive power on the US economy for four years by employing Treasury bill rates from 1955 to 1988. The model employed is presented as follows:

$$Y_{t,t+k} = \alpha_0 + \alpha_1 i_t + e_t, \tag{10}$$

$$Y_{t,t+k} = \left(\frac{400}{k}\right) \ln(y_{t+k}/y_t), \tag{11}$$

where k is the prediction term, and y_t is the GDP at time t.

$$i_t = i_t^{long\ term\ rate} - i_t^{short\ term\ rate}. \tag{12}$$

We use the seven-day interest rate and overnight rate as the long-term rate and short-term rate, respectively. Most IBO rate coefficients on the GDP are negative, which does not make sense, and the coefficients are insignificant. When i_t is larger than zero, the expectation of the future economy is optimistic; thus, the coefficient should be positive. Repo rates

perform slightly better than IBO rates but are still insignificant.

[Insert Table 13 here]

CHAPTER 6: Conclusion

6.1 Conclusion

Financial reform is an important issue in the global economy, and China is adopting numerous policy changes to implement this reform. Interest rate liberalization is one of the most important changes in this process. The Chinese interest rate market has been in transition from a fully controlled market to a dual-track interest rate market, wherein banks and capital markets work together on monetary resource allocation with different prices. However, regulatory controls over interest rates have not been implemented yet. A distinct market distortion also exists, along with quantitative controls on credits.

In this paper, we consider both international experiences and the Chinese reform background in analyzing the choice of benchmark rate in the financial market after the reform. China can adopt a benchmark rate system similar to LIBOR or the US Federal funds rate. Although no current interest rate is perfect as a benchmark rate in China, SHIBOR is a stationary interest rate and has a relatively large daily trading volume and close relationships with other open-market interest rates. Although SHIBOR may not be a good transmission intermediate target for monetary policies at this moment, this rate can affect the market and the economy. Thus, SHIBOR is considered a potential benchmark interest rate.

We believe that the central bank should continue to pursue a systematic interest rate liberalization approach and encourage the use of SHIBOR in financial markets. Interest rate liberalization in China is currently in progress, and the benchmark interest rate will play a large role in the reform in the near future.

6.2 Limitations and Future Direction

Given that China is currently using the dual-track interest rate system, findings under this system may be influenced by a torched market. One of the main concerns presented in the results is that neither SHIBOR nor the repo rate is the choice of the central bank as the benchmark rate and not the market. A benchmark rate will fail if not followed by the market.

The trial conducted by the Hong Kong Monetary Authority (HKMA) on offshore RMB interbank-offered market interest rate may be a good indicator for the future development of SHIBOR. In June 2013, HKMA announced the choice of a panel of 16 active commercial banks to offer their interest rate on offshore RMB (CHN HIBOR). This system is similar to SHIBOR, and will facilitate the development of a variety of RMB products and help the market participants to evaluate better the interest rate risk of the RMB. This approach can also support interest rate liberalization by first providing a benchmark for loan facilities offshore.

On 20 June 2013, SHIBOR surged in one day because the overnight

SHIBOR increased to 13.4% as a result of temporary liquidity shortage in the interbank market. This situation can be dangerous if financial institutions have to default, thus causing panic in the market. The systematic risks of new financial products may cause financial institutes to default or even experience a bank run because of the current existence of a large shadow banking system in the financial market. This unusually high SHIBOR reflects one significant fact. The de-leveraging of capital in the financial market by the central bank by merely relying on rescue policies or pouring money into the market is not satisfactory. Instead, interest rate liberalization has to be implemented to enable investments through multiple channels rather than on completed and unsupervised financial products in the shadow banking system.

In this paper, we also observe the relationship between SHIBOR and other market interest rates. The result shows that such relationship has certain influence on the market. Thus far, the open market operations of the central bank have several effects on these market interest rates but are not powerful enough to treat them as policy target rates. In the future, the central bank needs to find a smooth channel to implement monetary policies.

In 2012, the manipulation scandal of LIBOR revealed several serious problems of the quote interest rate system in choosing the benchmark rate for the market. The BBA is reforming the system to guarantee the

creditability of LIBOR. The Federal funds rate can avoid this kind of manipulation because it is based on real transactions. The lesson learned in the LIBOR scandal that fully relying on the quoted interest rate system can be flawed and risky. Thus, the People's Bank of China should emphasize the regulation and mechanism of SHIBOR to prevent market manipulation. However, identifying a better or more suitable mechanism for China is difficult, and the market can always choose a combination of existing interest rates as the benchmark interest rate.

Tables

Table 1. Benchmark Interest Rate around the World

Country	Benchmark Interest Rate
United States	Federal funds rate
United Kingdom	LIBOR
France	One-week bond repurchase rate
Germany	One-week and two-week bond repurchase rate
Japan	TIBOR
Singapore	SIBOR
China	One-year deposit and loan rate

Table 2. Federal Funds Rate and LIBOR

	Federal Funds Rate	**LIBOR**
Area	United States	Europe
Market	US interbank market	London interbank market
Rate Nature	Announced by the Federal Reserve	Average of quotations submitted by panel banks
Central Bank Policy Rate	Fully controlled by the Federal Reserve	Can only be affected by monetary policies

Table 3. SHIBOR Rate and LIBOR

	SHIBOR	LIBOR
Panel Banks	16 domestic and foreign banks	16 large global banks
Foundation	Introduced by the central bank to build the benchmark rate	Driven by market demand
Price for Banks	The operating expenses of Chinese banks are based on the controlled loan rate rather than SHIBOR, and only a small fraction of financial products are priced based on SHIBOR	LIBOR decides almost all prices of financial products, thus directly affecting the profit of banks

Table 4. Interest Rate Summary

Interest Rate	Start Time	End Time	Number of Observations
Funds	2001/01/02	2013/03/29	3080
Bill	2001/01/02	2013/03/29	3070
LIBOR001	2001/01/02	2013/04/05	3098
LIBOR 007	2001/01/02	2013/04/05	3098
SHIBOR001	2006/10/09	2013/03/19	1614
SHIBOR007	2006/10/09	2013/03/19	1614
FR001	2001/01/01	2012/12/31	3009
FR007	2001/01/01	2012/12/31	3009
IBO001	2001/01/01	2010/12/31	2222
IBO007	2001/01/01	2010/01/28	2483
Central	2002/06/25	2011/10/20	125

Table 5. Trade Volume of Different Interest Rates in China

(RMB, billion)[6]

Year	Interbank Borrowing Market	Bond Repurchase Market	Interbank Bond Market	Rediscount Market	Central Bank Bill
2001	808	4013	84	65.5	
2002	1211	10189	441	6.8	194
2003	2222	11720	3085	74	764
2004	1392	9311	2504	22	1496
2005	1232	15678	6338	2.5	2766
2006	2148	26302	10922	40	3652
2007	10651	44067	16591	14	4057
2008	15049	56382	40827	11	4296
2009	19351	67701	48868	25	3824
2010	27868	84653	64003		4235
2011	33441	96665	63620		1414
2012	46704	136617	70840		

[6]Data Source: People's Bank of China, www.pbc.gov.cn

Table 6. ADF Test for Interest Rates

Interest Rate	ADF Test			First-difference ADF Test		
	t-statistic	1% critical	p-value	t-statistic	1% critical	p-value
Funds	−1.97	−3.43	0.2998	−38.466	−3.43	0.00
LIBOR001	−3.273	−3.43	0.0161	−38.102	−3.43	0.00
LIBOR007	−1.019	−3.43	0.7463	−33.458	−3.43	0.00
Bill	−1.721	−3.43	0.4202	−29.485	−3.43	0.00
Central	−2.727	−3.502	0.0694	−4.651	−3.502	0.00
SHIBOR001	−7.422	−3.43	0.00			
SHIBOR007	−6.909	−3.43	0.00			
FR001	−5.661	−3.43	0.00			
FR007	−7.708	−3.43	0.00			
IBO001	−6.364	−3.43	0.00			
IBO007	−8.145	−3.43	0.00			

Table 7. EGARCH Regression

Interest rate	ω	p-value	α	p-value	γ	p-value	β	p-value
Funds	−0.71	0.00	0.53	0.00	0.02	0.00	0.94	0.00
Bill	−0.06	0.00	0.21	0.00	0.01	0.00	0.87	0.00
LIBOR001	−0.09	0.00	0.45	0.00	0.05	0.00	0.98	0.00
SHIBOR001	−1.2	0.00	0.47	0.00	0.36	0.00	0.99	0.00
FR001	−1.3	0.00	0.61	0.00	0.42	0.00	0.97	0.00
IBO001	−1.42	0.00	0.33	0.00	0.55	0.00	0.89	0.00

Table 8. SHIBOR and Repo Rate

(Probability)

H0	Lags(1)	Lags(2)	Lags(7)
SHIBOR001 does not Granger cause FR001	0.0000	0.0000	0.0000
FR001 does not Granger cause SHIBOR001	0.0000	0.0000	0.0000
SHIBOR007 does not Granger cause FR007	0.0000	0.0000	0.0000
FR007 does not Granger cause SHIBOR007	0.0069	0.0188	0.0003

Table 9. SHIBOR and IBO Rate

(Probability)

H0	Lags(1)	Lags(2)	Lags(7)
IBO001 does not Granger cause SHIBOR001	0.2881	0.4807	0.9380
SHIBOR001 does not Granger cause IBO001	0.0873	0.1057	0.6623
IBO007 does not Granger cause SHIBOR007	0.0899	0.5984	0.0476
SHIBOR007 does not Granger cause IBO007	0.0000	0.0000	0.0000

Table 10 Repo Rate and IBO Rate

(Probability)

H0	Lags(1)	Lags(2)	Lags(7)
IBO001 does not Granger cause FR001	0.4600	0.1414	0.6478
FR001 does not Granger cause IBO001	0.0000	0.0000	0.0000
IBO007 does not Granger cause FR007	0.0126	0.1506	0.0004
FR007 does not Granger cause IBO007	0.0000	0.0000	0.0000

Table 11. Granger Causality Test of SHIBOR and Central

H0	Probability
SHIBOR001 does not Granger cause Central	0.508
Central does not Granger cause SHIBOR001	0.27
SHIBOR007 does not Granger cause Central	0.682
Central does not Granger cause SHIBOR007	0.109

Table 12. Interest Rates for Forecasting Economic Activity

(Marginal significance level)

Forecasted Variable	M1	M2	SHIBOR 001	SHIBOR 007	FR001	FR007	IBO 001	IBO 007
Consumption	0.52	0.06	0.00	0.31	0.43	0.96	0.57	0.12
Investment	0.17	0.16	0.04	0.03	0.83	0.53	0.83	0.86
Real Estate Investment	0.65	0.43	0.00	0.00	0.49	0.71	0.00	0.02
Real Estate Sale	0.87	0.94	0.07	0.10	0.00	0.12	0.00	0.11
CPI	0.41	0.68	0.12	0.05	0.16	0.02	0.06	0.00

Table 13. Interest Rate Term Structure (with GDP)

K (term)	IBO Rate		Repo Rate	
	Coefficient	p-value	Coefficient	p-value
1	−1597	0.46	−82.4	0.92
2	123.6	0.914	1489.2	0.33
3	−150.8	0.823	1112.8	0.26
4	−389.6	0.28	1123.6	0.21
5	−332.2	0.233	265.5	0.11
10	−139.3	0.25	589.2	0.08
15	488.6	0.148	536.6	0.16
20	479.6	0.016	64.1	0.52

Figure 1. Federal Funds Rate (2001–2013)

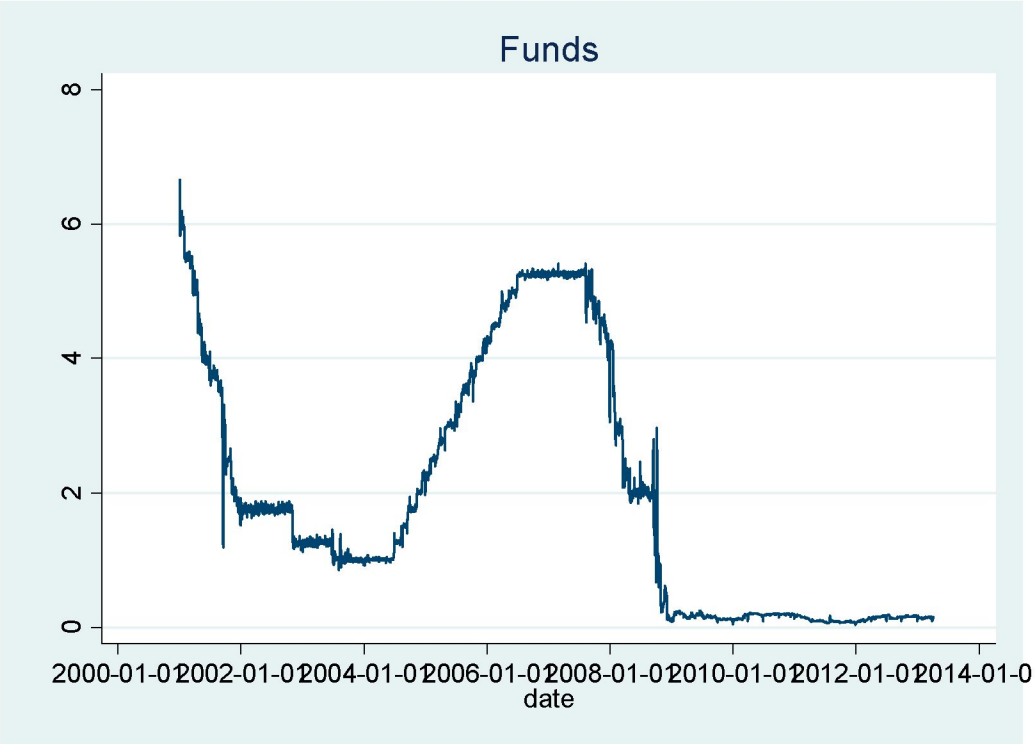


Figure 2. Treasury Bill Rates (2001-2013)

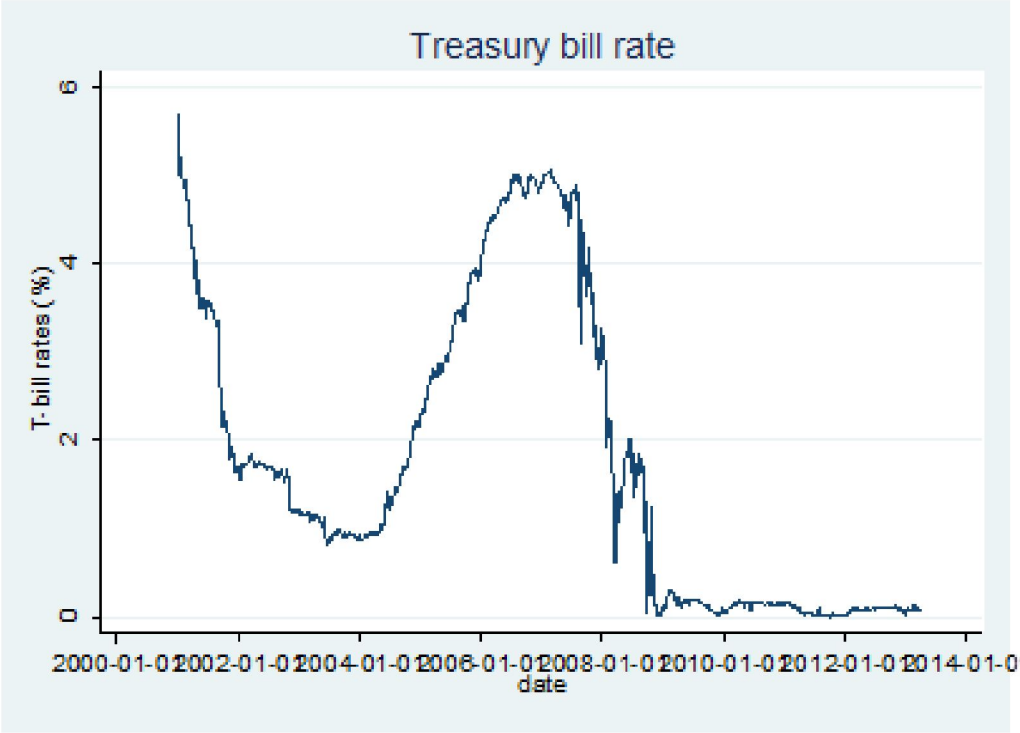


Figure 3. Overnight LIBOR Rate (2001–2013)

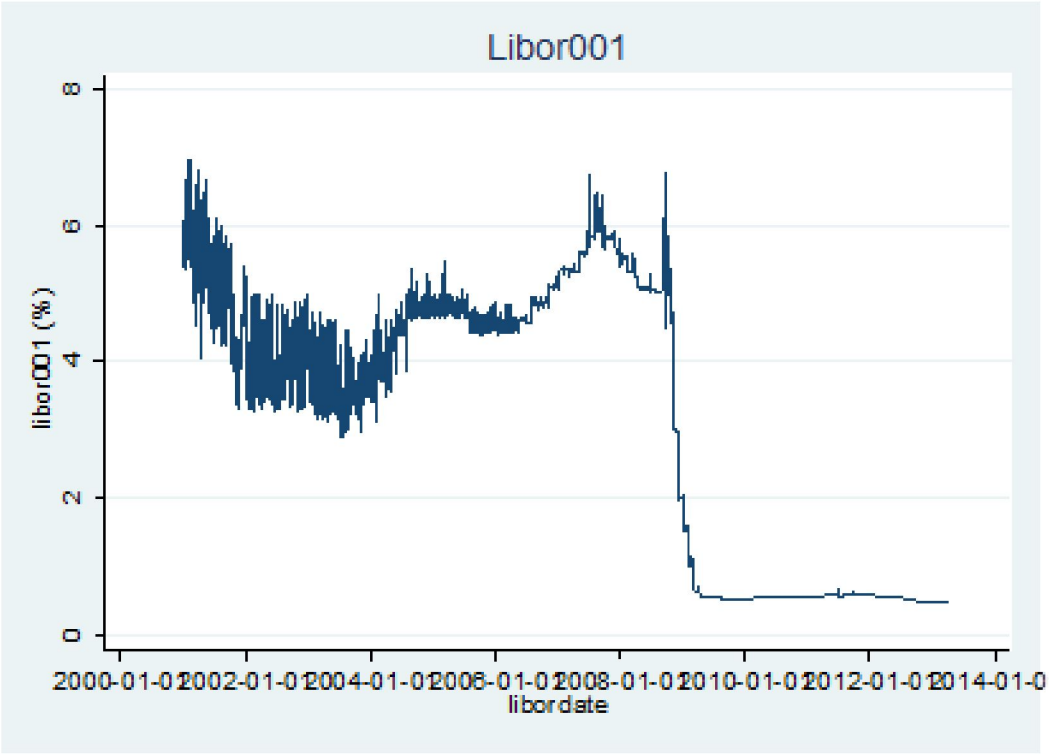


Figure 4. Seven-Day LIBOR Rate (2001–2013)

Figure 5. Central Bill Rate (2002–2011)

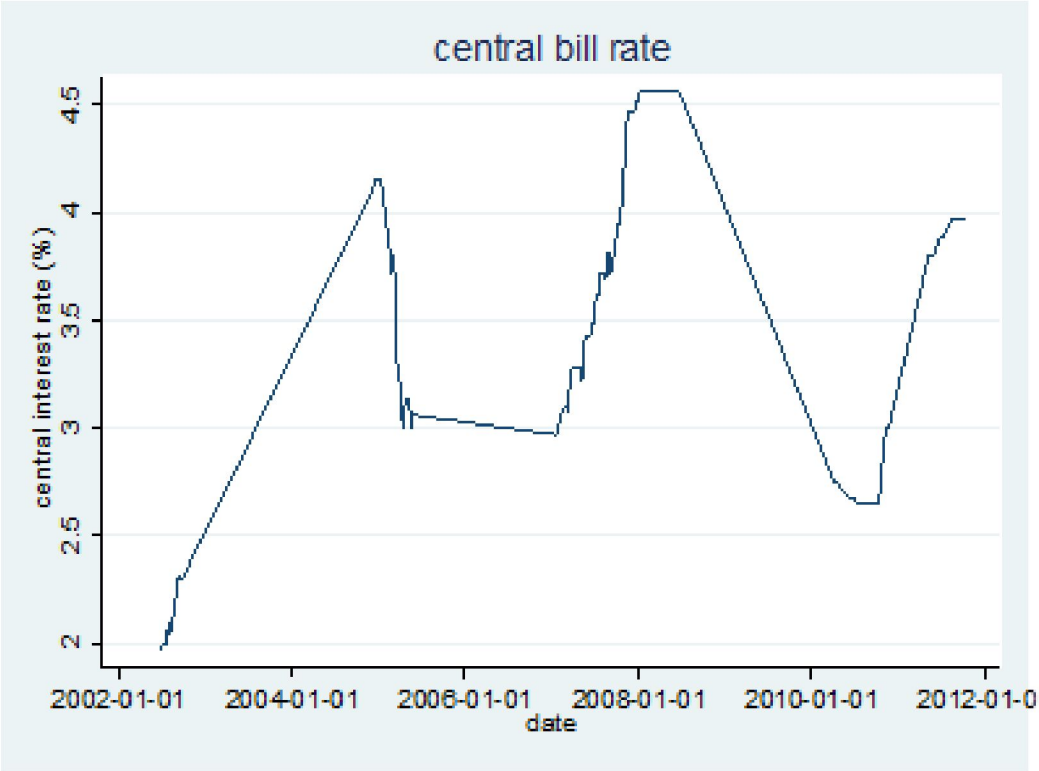


Figure 6. Overnight and Seven-Day SHIBOR Rate (2006–2013)

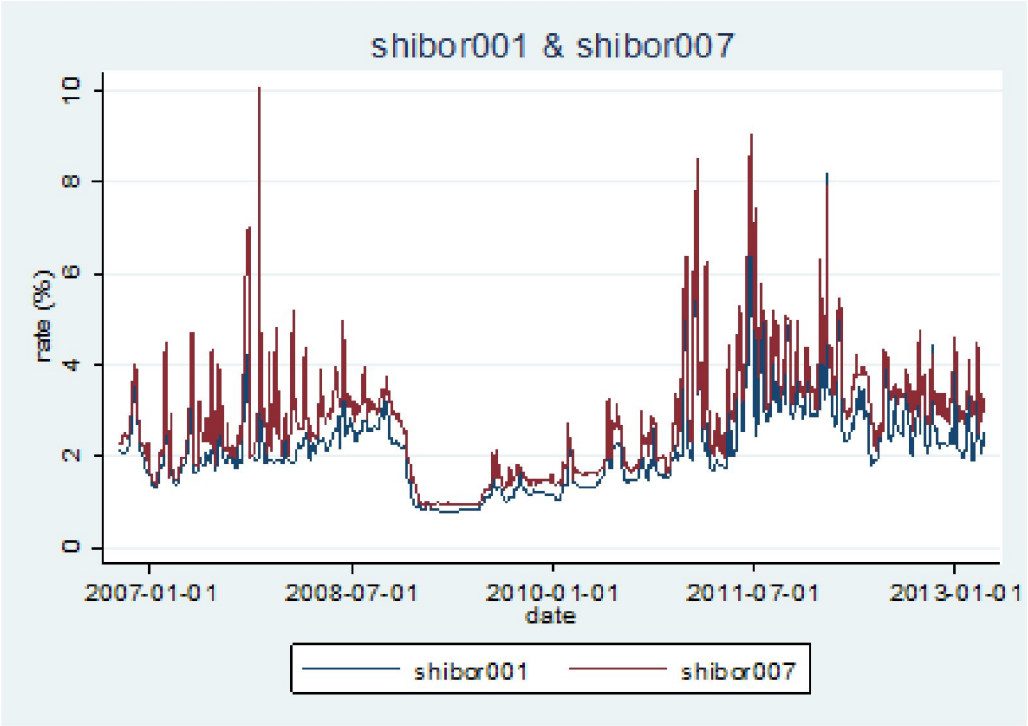


Figure 7. Overnight and Seven-Day Repo Rate (2001–2013)

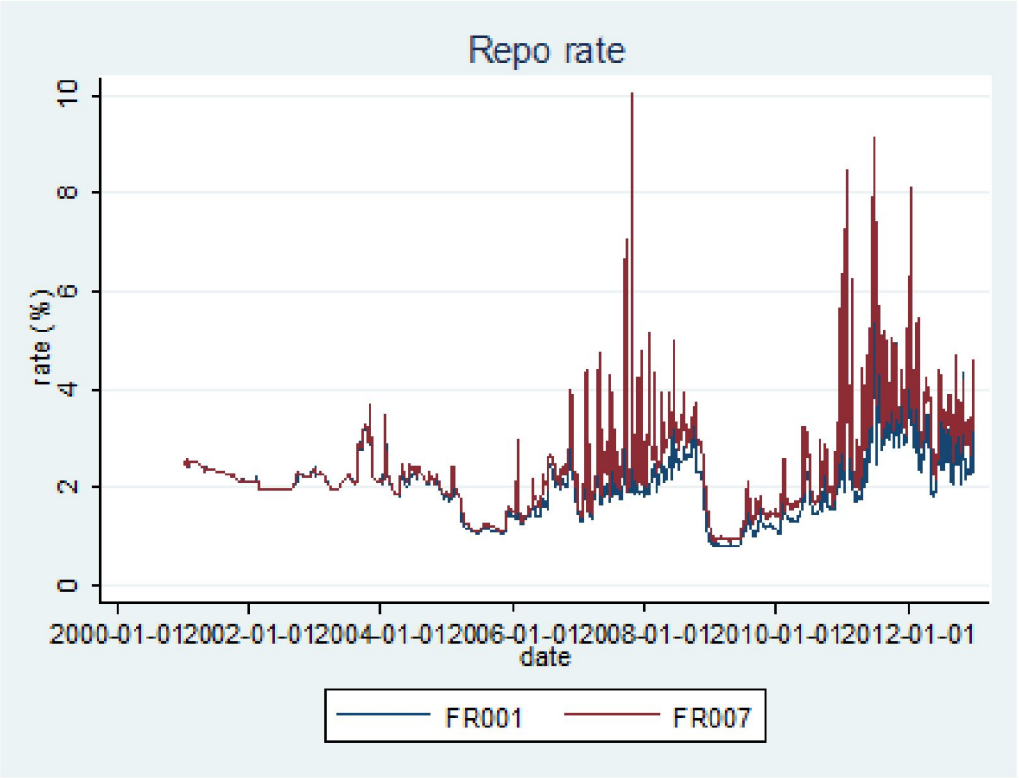


Figure 8. Overnight and Seven-Day Interbank Offered Rate

(2001–2013)

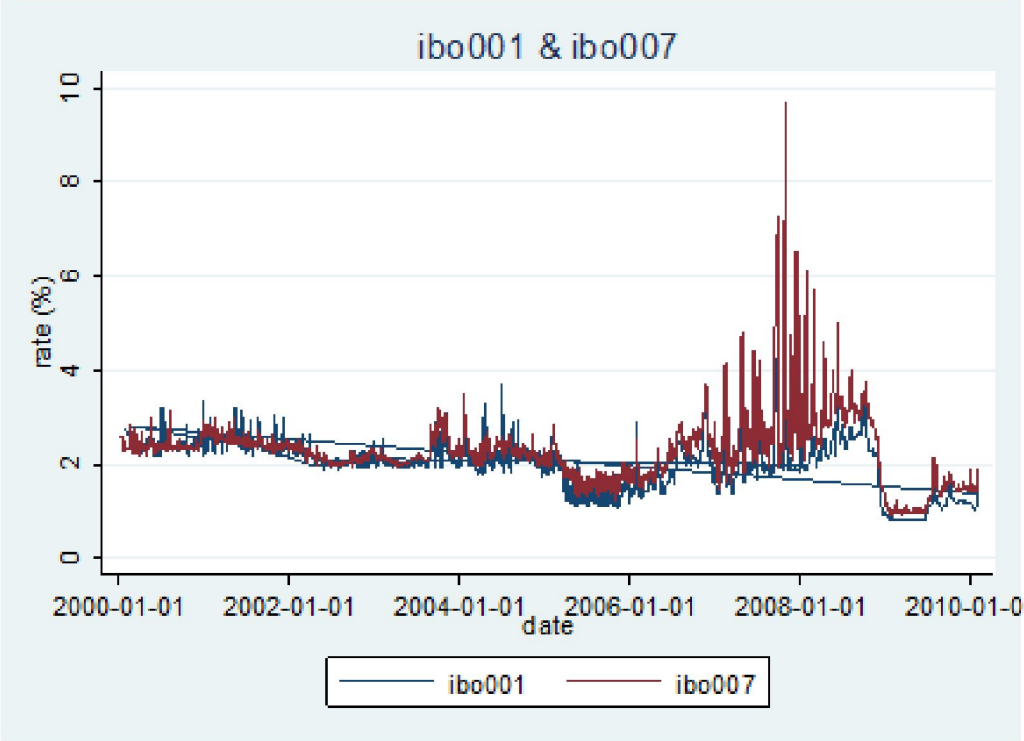
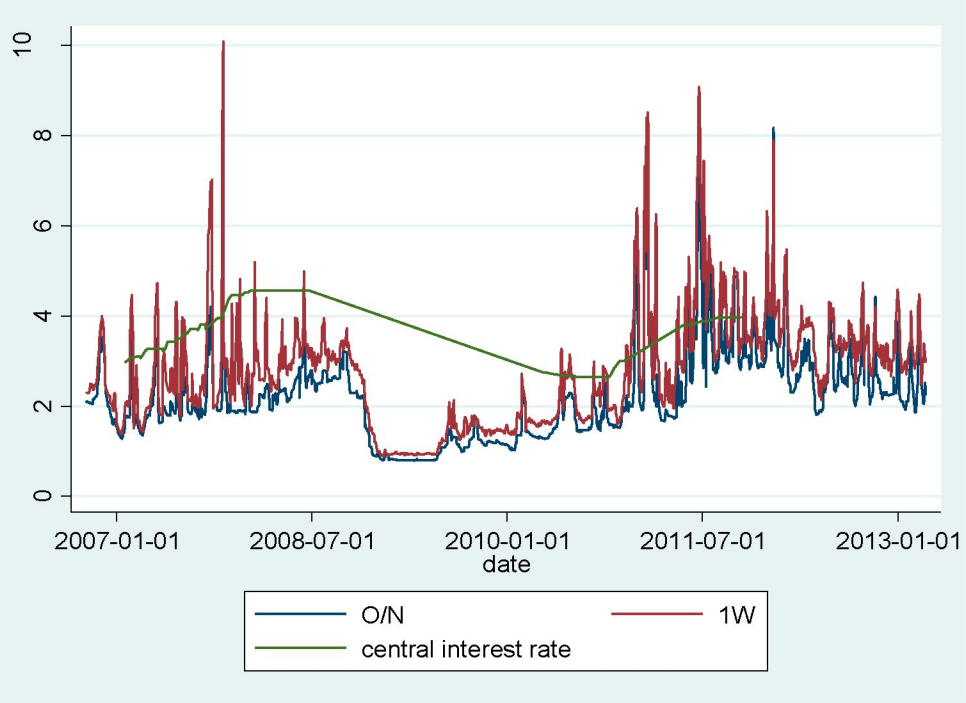


Figure 9. SHIBOR and Central Bank Bill Rate (2006-2011)



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