Determinants of Swap Spreads in China

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Abstract

Swap spreads in China are priced differently from those in the developed markets due to its unique institutional background. This study develops an illustrative theoretical model based on important Chinese institution features and reports consistent empirical results that official rates, slope of the swap term structure, inflation, monthly time detrended logarithm of the trading volume of one-week repos, as well as the macroeconomic early warning indicator are important determinants of swap spreads in China. Our results are consistent with the hypothesis that swap rates are more sensitive than bond yields to the changes in current and expected future short-term market rates, and can more readily incorporate information of changing economic situation. Our study provides an extension of interest rate swap pricing theory in an incomplete financial market.

JEL classification: G12; E44

Keywords: swap spreads; official interest rates; slope of term structure; inflation; repos

1. Introduction

This paper investigates the pricing of interest rate swap contracts in China and how the pricing mechanism can be different from that used in the government bond market. Despite its short history, Chinese interest rate swap market has been growing fast since its 2006 debut, and plays an increasingly important role for investors to speculate and manage risk in the Chinese fixed income markets. We illustrate how the unique monetary policy implementation and institutional features in China can account for the differential pricing of swap and bond yields, and provide empirical results that the swap spreads can more readily incorporate expectation about the future economic fundamentals in the Chinese market. Our study provides an important case of asset pricing in an emerging market, and extends interest rate swap pricing theory in an incomplete financial market.

The Chinese market of fixed income securities is highly influenced and shaped by the government's monetary policy[1]. The Chinese monetary policy is implemented in a unique format with directive money supply. In contrast to its U.S. counterpart, the central bank in China does not set a short term target rate. Instead, the Chinese central bank regulates money supply, and sets annual growth targets. As an auxiliary tool for the central bank to implement its monetary policy, the central bank also regulates funds available and the price of funds within the banking system by imposing a term structure of base deposit and loan lending interest rates (referred to as "official rates" hereafter). The term structure of official rates is quite flat with a positive slope, and changes only occasionally. The official rates are reset usually after a visible change in inflation. In earlier years, the commercial banks must accept deposits and lend loans exactly with the official rates. With the acceleration of interest rate liberalization, the commercial banks now have more flexibility in setting their own deposit and lending rates. But to date, rates the Chinese commercial banks offer still follow the official rates closely.

The other notable feature is that commercial banks in China are dominant investors in the fixed income market and on aggregate hold more than 60% of the outstanding bonds. For Chinese commercial banks, the opportunity costs for holding bonds are in effect the official rates imposed by the policy maker as their return on loan lending. As a consequence, the data indicate that the term structure of bond yields follows that of official rates, and is not informative of the tightness of money supply and other concurrent economic fundamentals. The shape of bond yield curve is often relatively flat because of the level yield curve of official rates,

[1] See Fan and Zhang (2007), Fan et al. (2011), Fan et al. (2013), and Fan et al. (2014) for more discussion on China's monetary policy and market of fixed income securities.

even when there is strong indication of interest rate to rise in the future. For example, when the economy showed signs of recovery in 2009 after the massive stimulus in 2008 to deal with the aftermath of financial crisis, there was a sharp increase in the slope of term structure of swap rates. However, because of the unadjusted official rates, the bond yields increased much less than the maturity-matched swap yields did.

In contrast to the players in the fixed income market, profit-seeking speculators participating in the swap market behave differently, rapidly incorporating fluctuation of the current and expected future market short-term rates into the pricing of swap yields. The short-term market rate, such as the one-week repo rate, not only correlates with the current official rate, but also moves with the tightness of funds in the money market. Swap yields take in information predictive of future short-term rates, which can include expectation on the future movement of the official rate, the tightness of money supply, and forthcoming economic situations. As a result, swap yields can be affected by the flat term structure of official rates, but not in the same degree as bond yields are. Consider an arbitrageur between the bond and swap markets. For her, holding bonds financed by rolling over one-week repos with the bonds as the collateral will provide similar cash flows to those obtained from a short position in the swap (as the fixed rate receiver) with one-week repo rate as the floating end. As a result, bond and swap yields with similar maturity should be close and not differ by more than the difference in transaction costs. The swap yields are therefore related to the official rates but not so closely as the bond yields are.

Our study aims to uncover determinants of the swap spread, which is the difference between the fixed rates on the fixed-for-floating swap contracts and the yield-to-maturity on the maturity-matched government bonds. In our empirical analysis, we use the maturity-matched zero-coupon yields implied in the swap and government bond term structures to compute the swap spreads. Given the interrelated markets of swaps and bonds but with participation of different investors, we hypothesize that bond and swap yields will be determined by a similar set of variables but with different sensitivities to those variables. As a result, such a set of variables will be determinants of swap spreads. First, the bond yields will be more closely tied to the official rates than the swap yields, and hence the official rates can be one determinant of the swap spreads. Second, bond yields do not incorporate as much information on expected economic variables as the swap yields do. When interest rate is expected to increase in the future, swap yields are expected to increase more than the bond yields do. The swap spreads, especially those of long-term yields, widen in this situation. We use the slope of swap term structure to capture the expectation of future rate increase, and expect that the swap spreads will be positively related to the slope of swap term structure. Similarly, swap yields are more

sensitive than bond yields to reflect the tightness of current and future money supply,[2] so a good measure of fund tightness in the money market will be a determinant of the swap spreads. We use monthly time detrended logarithm of trading volume of one-week repo as the measure of tightness of the short-term fund supply, and examine whether this variable is another determinant of the swap spreads.

To further test our hypothesis that bond yields do not incorporate as much information on expected economic variables as the swap yields do, we collect two macroeconomic variables: the inflation rate and the macroeconomic early warning indicator. As the official rates closely follow the inflation rate, we expect that the inflation rate will have a greater effect on the bond yields than on the swap yields, and will correlate negatively with the swap spreads. The early warning indicator measures the investors' expectation on the future economy. We expect that the long-term swap yields incorporate more of such an expectation than the long-term bond yields do, and the indicator will correlate positively with the long-term swap spreads.

Prior literature on swap spreads concludes that credit risk associated with the underlying LIBOR rate and liquidity premium are the main determinants of swap spreads. Early papers focus on the counterparty default risk to explain the swap spreads (Cooper and Mello, 1991; Litzenberger, 1992; Sun et al., 1993; Brown et al., 1994; Duffie and Huang, 1996; Minton, 1997). With the development of swap market, it is now widely recognized that counterparty default risk is mostly eliminated in today's swap market by collateral posting and netting agreements (He, 2000; Collin-Dufresne and Solnik, 2001). Other studies report that the credit risk premium of the floating leg, the LIBOR spread, is a determinant of swap spreads (Brown et al., 1994). He (2000) further argues that as LIBOR is the financing cost for getting the swap rates while repo rate is the financing cost for obtaining the government bond yields, the LIBOR premium, defined as the difference between LIBOR and repo rates, will affect the swap spreads. Additionally, some papers argue that the liquidity-based convenience yield associated with the government bond is the main factor which drives the swap rates higher than the government bond yields (Grinblatt, 2001). Using the reduced-form credit framework of Duffie and Singleton (1997), Liu et al. (2006) and Feldhütter and Lando (2008) build and estimate different affine multifactor models to show that both the credit risk and the liquidity premium are present in swap spreads. Finally, empirical results show that even after controlling for the credit and liquidity factors, there is still a large fraction of interest rate swap pricing variation left

[2] The central bank of China carries out its open market operation with inverse repo transactions to inject money into the market. When the central bank reduces the reverse repo transactions, the fund in the money market will be tightened.

unexplained (Duffie and Singleton, 1997; Feldhütter and Lando, 2008). Brown et al. (1994), Lang et al. (1998), and Fehle (2003) argue that the demand and supply for swaps can influence the swap spreads. Accordingly, research has pointed to the demand pressure from the underfunded pension plans and the frictions of holding bonds as the possible reasons for the recent anomaly of a persistent 30-year negative swap spread (Klingler and Sundaresan, 2016; Jermann, 2016).

Given the popularity of interest rate swap contracts in the international markets, there exists much research on the swap spreads denominated in the major currencies (Lekkos and Milas, 2001; Rivkin-Fish, 2003; Afonso and Strauch, 2004; Hui and Lam, 2008; Azad et al., 2012; Azad et al., 2015). With the integration of global financial market, the linkage between different interest rate swap markets has been documented. Eom et al. (2002) find spillover effects from U.S. interest rate swap markets to Japanese yen swap market, and Lekkos and Milas (2001) find a similar one-way relation between U.S. and U.K. swap markets. These results indicate the central role of the U.S. in the international financial markets.

Our paper departs significantly from the previous literature by focusing on the Chinese market. Our study provides new evidence and insight on what determines the swap spreads in an emerging market where the monetary policy, especially the term structure of official rates, impacts bond and swap yields differently and then affects the swap spreads. The unique institution features and swap spread pricing in China distinguish our paper from the previous literature on developed markets. The swaps in our analysis are contracts with the one-week repo as their floating rate, which share the same financing as those of government bonds. As a result, difference in the financing cost (as proposed by He (2000)) cannot account for the swap spreads in our study. In China, both bond and swap contracts are traded in the interbank market and transactions are settled via the clearing house. There will be no counterpart risk involved in both the bond and swap trading in China, so the counterparty default risk cannot account for the variation of swap spreads. By exploiting the institutional background, we hypothesize that bond yields are more rigidly tied to the term structure of official rates while swap yields are more susceptible to market expectation on future economy. We develop illustrative theoretical models to provide a few variables as potential determinants of the swap spreads. Our empirical analysis produces consistent results for our proposed hypotheses, with all variables contributing to more than half of the variation in the swap spreads. To the best of our knowledge, this paper is the first to explore swap spreads in China's fixed income market, an emerging market which is now the third largest in the world.

The rest of the paper is organized as follows. Section 2 introduces the institutional background of the interest rate swap market in China. Section 3 proposes the theoretical models for determining the bond yields, swap yields and swap spreads. Section 4 reports the empirical evidence. Section 5 concludes the paper.

2. Interest rate swap market in China

The interest rate swap market is playing an increasingly important role for investors to speculate and manage risk in the Chinese markets. Despite its short history, Chinese interest rate swap market has been growing fast since its 2006 debut. The market size, measured by the total annual notional principal of interest rate swap contracts, was only 401 billion RMB in 2008, which reaches 1.5 trillion RMB in 2010, 2.7 trillion RMB in 2013, and 8.8 trillion RMB in 2015. Finally in 2016, the market size stands at 9.9 trillion RMB, translating to an average annual growth rate of 43% in the nine-year period.

Diverse groups of players participate in the Chinese swap market. The official regulatory guidelines published in 2007 stipulate that members of the interbank market register with the market committee before starting trading interest rate swap contracts with a minimal notional amount of principal per trade of 100,000 RMB. There is a margin requirement for trading interest rate swap contract. While the amount of margin is negotiated by the two counterparties, the central clearing agency maintains the custody of the margin. Based on the recent records disclosed by National Association of Financial Market Institutional Investors (NAFMI)[3], there are 156 financial institutions as participants in the interbank swap market. Among these 156 members, there are forty-one foreign commercial banks, thirty-eight domestic commercial banks and fifty-five security firms, with the remaining members as insurance firms and other financial institutions. Among them, foreign commercial banks have more expertise in swap trading than domestic commercial banks. However, the China's swap market continues to be dominated by commercial banks and security companies.

Interest rate swap contracts in China can be categorized by the reference rates used as the floating leg of the contracts: FR007, 3-Month/overnight SHIBORs, and one-year official deposit rate. FR007 is an interbank repo rate, the median of the interest rates for the one-week repo transactions made between 9 to 11 a.m. in the interbank market. SHIBOR is the Shanghai Interbank Offered Rate, similar to LIBOR, which is the average of quoted interest rates of

[3] Detailed information can be found at the official website of NAFMI.

major interbank dealers. The official one-year deposit interest rate is an official rate for deposits posted by the central bank. Swap contracts with FR007 as the floating rate are most popular in the market, followed by contracts with SHIBORs as the floating rate with much smaller market size. Trading volume of the 1-year deposit rate swaps is tiny. As a result, our following analysis focuses on the FR007 swaps and study how the yields of these contracts compare to those of bond products with similar maturity. Among FR007 swaps with maturities ranging from one to five years, market share of the 1-year swaps is the largest, followed by the 5-year, 2-year, 3-year, and 4-year swaps (the least).

Repo rate and SHIBOR are the two major money market rates with which investors borrow and lend short-term funds. Repo transaction is traded with qualified bonds[4] as the collaterals in the interbank market as well as in the exchange market with a wide range of participants. For example, all individual investors trading in the stock exchanges can lend money through reverse repos, and institutional investors trading in the exchanges and interbank market can borrow funds via repos. Often the trading volume in the repo market is higher than those of stock or bond markets. Notably, the repo market is much larger than the interbank unsecured lending with SHIBORs. In China, repo rate is considered as the most representative short-term market rate, contributing to the popularity of the FR007 swap contracts.

The one-week repo rate is also a good measure of the financing costs for Chinese bond investors. In practice, financial institutions in China hold bonds financed through rolling over one-week repos. As a result, the FR007-swap and levered investment in bonds share the same floating cost. Yet while the levered investment in bonds involves refinancing risk in borrowing through one-week repo, the swap contract doesn't. This is a possible reason why swap yields are often lower than those of default-free bonds with similar maturities. This pattern is different from that observed in developed markets, in which swap rates are usually higher than the government bond yields. This is due to the use of different benchmark rates in the floating leg in the swap contacts: LIBOR in the developed market vs. the repo rate in Chinese market.

Two more institutional details are used in our analysis. First, there are two different categories of default-free bonds in China. One is issued by the Finance Ministry of China, which is the equivalent of US treasury bonds; the other is issued by the policy banks. There are three policy banks, which are government agencies and mainly financed through bond issuance. The China Development Bank (CDB) is the largest. Bonds issued by the policy banks are guaranteed

[4] Government bonds, policy bank bonds, and corporate bonds with credit grades above (including) AA+ are usually considered as qualified bonds and are accepted by the clearing houses as collateral.

by the central government and thus are considered default risk free in China. The bonds issued by the policy banks are given the same credit ranking as the government bonds by Moody and others. Face values of outstanding bonds issued by the policy banks are usually similar to, and even larger than those of the government bonds. Interest from the bonds issued by the Finance Ministry is tax-free, while that from the bonds issued by all others is taxed. In computing the swap spreads, we compare the swap yields with those of bonds issued by the CDB.

Second, the FR007 swaps exchange cash flows quarterly. The floating cash flow is calculated with the rates of FR007 within the quarter. Specifically, the floating cash flow at quarter *t* is calculated as

$$N \times \left(1 + r_1 \times \frac{\text{Number of days of the first week that are in quarter } t}{365}\right) \times \left(1 + r_2 \times \frac{7}{365}\right) \times \ldots \times \left(1 + r_{Last} \times \frac{\text{Number of days of the last week that are in quarter } t}{365}\right),$$

Where N is the notional principle of the swap, and $r_i (i = 1,2,..,\text{last})$ is the FR007 rate in the week i. For example, r_{Last} is the annualized FR007 at the start of the last week in quarter t. In the last week, actual number of days in the quarter is used to calculate the interest. The first week in the quarter is handled similarly.

3. Illustrative theoretical models of market interest rates in China

3.1 Short-term market rate

In the money market, participants demand or supply funds for one period. Suppliers of funds can save it as one-period bank deposit or lend it out as one-period loan, return of which is determined by the one-period official rate, $r_{1,t}$. They can also lend the funds in the money market through a reverse repo transaction, which offers a short-term market interest rate of $y_{1,t}$. Therefore the supply of funds in the money market is determined by

$$S_m = -\alpha_{l1} r_{1,t} + \alpha_{l2} y_{1,t} + \beta_l F_l,$$

where F_l is the total funds available from the suppliers. Short-term bank deposit (loan) and money market instruments are not perfectly substitutes due to market accessibility and other market frictions. We assume that $\alpha_{l1} > 0, \alpha_{l2} > 0,\ \beta_l > 0$, and all are limited numbers.

Similarly, fund demanders could borrow through bank loan with the interest rate $r_{1,t}$ or borrow in the money market through a repo transaction with the interest rate $y_{1,t}$. The demand for funds in the money market is determined as

$$D_m = \alpha_{b1} r_{1,t} - \alpha_{b2} y_{1,t} + \beta_b F_b,$$

where F_b is the total funds demanded by the borrowers. We assume that $\alpha_{b1} > 0, \alpha_{b2} > 0,\ \beta_b > 0$, and all are limited numbers.

When the money market is in equilibrium, the demand and supply are equal and we have

$$\alpha_{b1} r_{1,t} - \alpha_{b2} y_{1,t} + \beta_b F_b = -\alpha_{l1} r_{1,t} + \alpha_{l2} y_{1,t} + \beta_l F_l.$$

The short-term interest rate will be determined as

$$y_{1,t} = \left(\frac{\alpha_{b1}+\alpha_{l1}}{\alpha_{b2}+\alpha_{l2}}\right) r_{1,t} + \frac{\beta_b F_b - \beta_l F_l}{\alpha_{b2}+\alpha_{l2}}. \quad (1)$$

The equation illustrates that the short-term market rate is positively related to current official rate and tightness of funds (money demand in excess of supply) in the money market.

In summary, market interest rate $y_{1,t}$ will be likely to be high, when official rate $r_{1,t}$ is high, or when $\beta_b F_b - \beta_l F_l > 0$, implying fund demand is high relative to the supply in the money market,.

3.2 Long-term bond yields

While the short-term bank loan, bank deposit, and repo transaction have the maturity of one-period, the long-term bond, bank deposit, and loan are long-term instruments lasting for multiple periods. To make it simple, we assume that the long-term instruments have a maturity of two periods. The interest rate on long-term bank deposit and loan is determined by the 2-period official rate, $r_{2,t}$, which is set by the central bank. The return on the long-term bond is measured by the 2-period market interest rate, $y_{2,t}^b$, determined by the market.

Two types of investors exist in the bond markets: preferred-habitat investors and speculators. Preferred-habitat investors always hold long-term assets to maturity. They choose between the long-term bank deposit (loan) and long-term bond, and prefer the one with a higher yield. For example, consider the commercial banks as the preferred-habitat investors choosing between long-term bonds and bank loans as their investment vehicle. When the bond yield is higher than the bank loan lending rate, commercial banks will find bond investment more attractive. We assume that the demand of preferred-habitat investors for the 2-period bond is determined by the two-period loan lending rate, $r_{2,t}$, two-period bond yield, $y_{2,t}^b$, and total fund available F_p of the preferred-habitat investors as

$$D_p = -\alpha_p (r_{2,t} - y_{2,t}^b) + \beta_p F_p,$$

where α_p and β_p are assumed to be limited and positive. In practice, difference in liquidity, tax, trading cost, and even the credit risk between long-term bond and bank loan makes them not perfect substitute to each other.

Other investors in the market are speculators. Speculators construct a portfolio of assets to seek one-period return that maximizes their utility. Their return from holding the long-term bond for one-period is

$$R_{2,t+1}^{b} = \ln P_{1,t+1}^{b} - \ln P_{2,t}^{b} = \ln \exp(-y_{1,t+1}) - \ln \exp(-2 \times y_{2,t}^{b})$$
$$= 2y_{2,t}^{b} - y_{1,t+1}$$

Given their funds available F_S to invest, they invest through short-term instruments like repos and long-term bond. The value-weighted ratio of their demand for the long-term bond is denoted as ω, and the value ratio of one-period repo in the portfolio is $1 - \omega$. Return on arbitrageurs' portfolio at the end of the period is

$$R_{p,t+1} = \omega(2y_{2,t}^{b} - y_{1,t+1}) + (1 - \omega)y_{1,t},$$

with an expected return of:

$$E_t(R_{p,t+1}) = 2\omega\left(y_{2,t}^{b} - \frac{1}{2}(E_t y_{1,t+1} + y_{1,t})\right) + y_{1,t},$$

and a variance of:

$$\mathrm{var}_t(R_{p,t+1}) = \omega^2 \mathrm{var}_t(y_{1,t+1}).$$

The speculators choose weight ω to maximize their mean-variance utility.

$$\max_{\omega} E_t R_{p,t+1} - \frac{1}{2}\lambda \mathrm{var}_t(R_{p,t+1}),$$

The first-order condition of the optimal weight is

$$\omega = \frac{2}{\lambda \mathrm{var}_t(y_{1,t+1})}[y_{2,t}^{b} - \frac{1}{2}(E_t y_{1,t+1} + y_{1,t})].$$

As we can see from the equation above, the long-term market interest rate is higher than that suggested by the pure expectations hypothesis.

$$y_{2,t}^{b} > \frac{1}{2}(E_t y_{1,t+1} + y_{1,t}).$$

If the long-term bond is expected to generate a positive one-period excess return, then the weight in long-term asset, ω, will be positive. The weight is negatively correlated with the risk-preference parameter λ, and the volatility of future short-term market interest rate $\mathrm{var}_t(y_{1,t+1})$. When the speculators are more risk averse or the short-term market rate is more volatile, they will decrease their investment in the long-term bond.

When the market is in equilibrium, the total demand from the two types of investors for long-term bond will be equal to the total supply of bond, which is assumed to be given exogenously. The market value of long-term bond is assumed to be $B_{2,t}$, and we have

$$\frac{2F_s}{\lambda \mathrm{var}_t(y_{1,t+1})}[y_{2,t}^b - \frac{1}{2}(E_t y_{1,t+1} + y_{1,t})] - \alpha_p r_{2,t} + \alpha_p y_{2,t}^b + \beta_p F_p = B_{2,t},$$

From the equation, the long-term bond yield will be

$$y_{2,t}^b = \frac{\frac{2F_s}{\lambda \mathrm{var}_t(y_{1,t+1})}}{\frac{2F_s}{\lambda \mathrm{var}_t(y_{1,t+1})} + \alpha_p}\frac{1}{2}(E_t y_{1,t+1} + y_{1,t}) + \frac{\alpha_p}{\frac{2F_s}{\lambda \mathrm{var}_t(y_{1,t+1})} + \alpha_p} r_{2,t} - \frac{(\beta_p F_p - B_{2,t})}{\frac{2F_s}{\lambda \mathrm{var}_t(y_{1,t+1})} + \alpha_p}. \quad (2)$$

In equation (2), there are three terms that determine the long-term bond yield. The first term is the average of current short-term rate and the expected future short rate. This term appears in the equation due to the presence of speculators in the market. The second term is the two-period official rate due to the preferred-habitat investors. The third term is the supply effect. The demand of speculators relative to net supply of long-term bond (total supply minus the demand by the preferred-habitat investors) affects the interest rate of long-term bonds. Accordingly, the effect of official rate on market interest rate is determined by the market power of the preferred-habitat investors relative to the speculators. Finally, the volatility in short-term rate discourages the demand by speculators and makes the bond yield deviate more from average of the current and expected short rates. In such a case, the long-term bond yield moves closely with the official rate.

3.3 Swap yield

Following the literature (Chernenko and Faulkender, 2011), there are three groups of participants in our model: risk hedgers, arbitrageurs between bond and swap markets, and speculators. We provide the analysis on the swap contract with a maturity of two periods. Speculators make a profit from the difference between cash flows calculated with the fixed and floating rate, while bearing the risk of the unexpected movement in the floating rate. Analogous to the speculators in the bond market, the demand of short position in swap contract (fixed rate receiver) by the speculators in the swap market is determined as

$$D_s^S = \alpha_s([y_{2,t}^S - \frac{1}{2}(E_t y_{1,t+1} + y_{1,t})] - \frac{1}{2}\gamma \mathrm{var}_t(y_{1,t+1})).$$

In the equation, $y_{2,t}^S$ is the two-period swap rate, and $y_{1,t}$ is the floating rate of the swap (the one-week repo rate in the data). A high long-term rate relative to the average of the current and expected short rates will generate a high demand, whereas a high volatility in short rate will reduce the speculators' demand due to their risk aversion.

Arbitrageurs between the bond and swaps take advantage of the difference between bond and swap yields to earn profits. For example, when bond yield is sufficiently higher than swap yield of similar maturity, the arbitrageurs will hold the bond financed through rolling over short-term repo borrowing with the bond as collateral. At the same time, arbitrageurs enter into the swap contract with the same maturity, paying the fixed rate and getting the floating rate. The arbitrage profit is determined by the difference between the swap and bond yields. Of course the arbitrage is not perfect; rolling over short-term borrowing involves refinancing risk, and borrowing with bond as the collateral through repo transaction only gets the funds of market value of the bond in excess of the margin. Therefore, the demand for swap contracts by the arbitrageurs across the markets is determined as:

$$D_s^a = -\alpha_a(y_{2,t}^b - y_{2,t}^s).$$

When $y_{2,t}^b$ is sufficiently higher than $y_{2,t}^s$, arbitrageurs take the long position in swap contract (as the fixed rate payer) to arbitrage between the difference in the long-term rates. The total demand of the speculators and arbitrageurs across the markets should be equal to supply of the swap contracts. We assume that the risk hedgers provide the supply of swap contracts, which is exogenously given and denoted as *S*.

$$\alpha_s[y_{2,t}^s - \frac{1}{2}(E_t y_{1,t+1} + y_{1,t})] - \frac{1}{2}\alpha_s\gamma \mathrm{var}_t(y_{1,t+1}) - \alpha_a(y_{2,t}^b - y_{2,t}^s) = S.$$

After rearranging the equation, we have the swap rate determine as

$$y_{2,t}^s = \frac{\alpha_a}{\alpha_s+\alpha_a} y_{2,t}^b + \frac{\alpha_s}{\alpha_s+\alpha_a}\frac{1}{2}(E_t y_{1,t+1} + y_{1,t}) + \frac{\alpha_s}{\alpha_s+\alpha_a}\frac{1}{2}\gamma \mathrm{var}_t\left(y_{1,t+1}\right) + \frac{S}{\alpha_s+\alpha_a} \quad (3)$$

The first term in equation (3) indicates that the swap yield is affected by the bond yield with same maturity because of the arbitrage trade between the two markets. The speculators impose their effects on the swap yield in the second term, with the rate reflecting the expectation about the future movement of the short term interest rate. Volatility of the short rate has effects on the swap yield due to the risk aversion of speculators as seen in the third term. The fourth term measures the supply effect on the swap yield.

3.4 Swap yield spread

With equations (1) for short-term market rate, (2) for bond yield, and (3) for swap rate, we have the swap spread determined as

$$
\begin{aligned}
SS_{2,t} &= y^s_{2,t} - y^b_{2,t} \\
&= \frac{\alpha_a}{\alpha_s+\alpha_a} y^b_{2,t} + \frac{\alpha_s}{\alpha_s+\alpha_a}\frac{1}{2}(E_t y_{1,t+1} + y_{1,t}) + \frac{\alpha_s}{\alpha_s+\alpha_a}\frac{1}{2}\gamma \mathrm{var}_t\left(y_{1,t+1}\right) + \frac{S}{\alpha_s+\alpha_a} - y^b_{2,t} \\
&= -\frac{\alpha_s}{\alpha_s+\alpha_a}\left[\frac{\frac{2F_s}{\lambda \mathrm{var}_t\left(y_{1,t+1}\right)}}{\frac{2F_s}{\lambda \mathrm{var}_t\left(y_{1,t+1}\right)}+\alpha_p}\frac{1}{2}(E_t y_{1,t+1} + y_{1,t}) + \frac{\alpha_p}{\frac{2F_s}{\lambda \mathrm{var}_t\left(y_{1,t+1}\right)}+\alpha_p} r_{2,t}\right] \\
&\quad + \frac{\alpha_s}{\alpha_s+\alpha_a}\frac{1}{2}(E_t y_{1,t+1} + y_{1,t}) + others \\
&= -\frac{\alpha_s}{\alpha_s+\alpha_a}\frac{\alpha_p}{\frac{2F_s}{\lambda \mathrm{var}_t\left(y_{1,t+1}\right)}+\alpha_p} r_{2,t} \\
&\quad + \frac{\alpha_s}{\alpha_s+\alpha_a}\frac{\alpha_p}{\frac{2F_s}{\lambda \mathrm{var}_t\left(y_{1,t+1}\right)}+\alpha_p}\frac{1}{2}(E_t y_{1,t+1} + y_{1,t}) + others \\
&= -\frac{\alpha_s}{\alpha_s+\alpha_a}\frac{\alpha_p}{\frac{2F_s}{\lambda \mathrm{var}_t\left(y_{1,t+1}\right)}+\alpha_p}\left[r_{2,t} - \left(\frac{\alpha_{b1}+\alpha_{l1}}{\alpha_{b2}+\alpha_{l2}}\right) r_{1,t}\right] \\
&\quad + \frac{\alpha_s}{\alpha_s+\alpha_a}\frac{\alpha_p}{\frac{2F_s}{\lambda \mathrm{var}_t\left(y_{1,t+1}\right)}+\alpha_p}\frac{1}{2}(E_t y_{1,t+1} - y_{1,t}) \\
&\quad + \frac{\alpha_s}{\alpha_s+\alpha_a}\frac{\alpha_p}{\frac{2F_s}{\lambda \mathrm{var}_t\left(y_{1,t+1}\right)}+\alpha_p}\frac{\beta_b F_{b,t} - \beta_l F_{l,t}}{\alpha_{b2}+\alpha_{l2}} + others. \qquad (4)
\end{aligned}
$$

Because the term structure of official rates is often flat, we assume that $r_{2,t} = r_{1,t}$. In the regression analysis of equation (1), the coefficient on the official rate is significantly less than one, and thus we assume that

$$\frac{\alpha_{b1}+\alpha_{l1}}{\alpha_{b2}+\alpha_{l2}} < 1.$$

Equation (4) indicates that the swap spread is negatively related to current official rate. The swap spread positively correlates with the expected future (short term) interest rate. When the interest rate is expected to increase, the spread widens. Swap spread is also related to tightness of funds in the money market. When funds are scarce in the money market and short-term market rate increases, the swap rate will increase by a larger amount than bond yield. In summary, the bond yield tends to tie to the flat term structure of the official rates, while the swap rate is able to incorporate information of the tightness of money supply and the expectation on the economic fundamentals into its pricing.

We formulate our hypothesis based on equation (4). First we focus on the correlation between the official rates and the swap spreads.

Hypothesis 1: Swap yields are less restricted by the official rates than the bond yields, and therefore swap spreads are negatively affected by the official rates.

If the central bank is expected to raise the official rates in the future, both the long-term swap and bond yields will increase and will be at high levels relative to that of the short-term rate. Equation (4) indicates that the long-term bond yields are more restricted by the term structure of official rates which is flat almost all the time, and increase less than the long-term swap rates do. As a result, the swap spreads, especially the long-term ones, will widen when investors expect a future increase in the interest rate. Because the expectation is unobservable, we use the slope of swap term structure to measure the expectation about future movement of the short-term rates. A steep slope of the swap yield curve indicates a large probability of a rise in the future interest rates, and is predictive of high swap spreads. That constitutes our second testable hypothesis about the swap spreads.

Hypothesis 2: Swap spreads are positively related to the slope of the swap yield curve.

When the supply for money is tight, we observe a low trading volume in the repo market. We use the monthly logarithm of the trading volume of one-week repo as the measure of tightness of fund supply in the money market. Because the trading volume grows with the scale of the economy and has an obvious upward trend over time, we use the detrended logarithm of the trading volume[5] to gauge the stance of money supply in the money market. Based on equation (4), we hypothesize that a lower trading volume is accompanied with a higher market rate and a higher swap spread:

Hypothesis 3: Swap spreads are inversely related to the (de-trended logarithm of) trading volume of one-week repo.

It is widely reported that the central bank in China sets the official rates by following the inflation rate to achieve a balance among the three types of participants in the commercial lending market: offering reasonable real yields for depositors, keeping a low cost for bank loan borrowers, and securing a stable margin for the commercial banks. If this is the case, official rates should closely follow the inflation rate. A high inflation will prompt an increase in official rate, and result in higher bond and swap yields. But the swap rates are not so tightly connected to the official rates and the inflation rate as the bond yields are. In that case, inflation rate can

[5] We use the Hodrick-Prescott filter to estimate the de-trended logarithm of trading volume of one-week repo.

be one factor predictive of the swap spreads. The macroeconomic early warning indicator, an index obtained by analyzing a comprehensive set of economic leading variables, is an indicator of future economic trend. The future economic trend presumably has an effect on the slopes of both the yield curves in the bond and swap markets. We find that the correlation between the slope of swap yield curve and the early warning indicator is 0.72 in our data. The early warning index reflects the expectation about future interest rate and impact the swap rates more than the bond yields, and therefore is predictive of the swap spread. This is our final hypothesis.

Hypothesis 4: Inflation rate affects the swap spreads negatively, and the early warning indicator has a positive impact on the swap spreads.

4. Empirical analysis

4.1 Data

We gather monthly data of swap and bond yields for the sample period of January 2008 to December 2016, covering nine sample years with 108 monthly observations. We start our sample period from 2008, as the first year when the trading activity in swap market reached economically meaningful level after its trading debut in 2006. Figure 1 displays the time series diagram of the term structures of yields[6] of swaps and zero coupon bonds, as well as swap spreads of maturities of one to five years. We also provide time series data of the official one-year deposit rate set by the central bank for comparison in Figure 1. We compare the swap yields with those of the bonds issued by the CDB rather than with those of government bonds for tax consideration. The CDB bonds carry the same credit risk as the government bonds do, while interests from CDB bonds and swaps are both taxable. Interests from government bonds are tax-free.

We see from the Figure 1 that the yields of swaps and CDB bonds have similar trends but with subtle differences. There are four valleys and four peaks in the market yields, which indicates a variation in the economic situation in the nine years of our sample period. We also observe that both the swap and bond yields have high correlations with the official rate, proxied by the one-year deposit rate. When the official rate is at its peak or valley, the market yields also reach their relatively high or low level most of the time. Despite the overall similar trend, we observe a large difference at times. For example, the official rate was at a modest level in 2009 and 2014, while the swap and bond yields were at their peaks. Finally, we see that, contrary to that in developed market, swap spreads were negative most of time. As a swap

[6] The swap rates (or swap yields) are the zero coupon yields implied in the swap curve.

position is similar to a levered investment in bonds financed with repo, with refinancing risk for the latter, swap yields are less than the corresponding bond yields.

A simple visual comparison between the figures indicates that the swap spreads have a negative correlation with the official rate. The official rate was at a high level at the start when the swap spreads were at their lows; when the official rate reached a low level around the first half of 2010, the spreads were at their highest. When the official rate was at a top level around 2012, the swap spreads were at the lowest. Finally, when the official rate was at a bottom again most recently, the spreads went up again. The average correlation coefficient between the official rate and the swap spreads with different maturities is around -0.55.

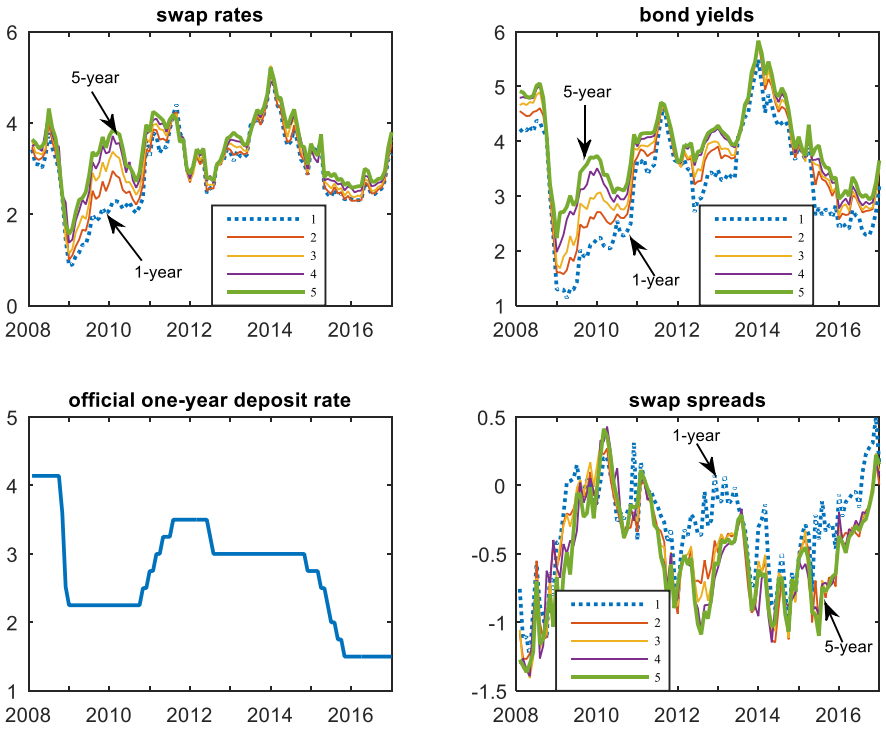

Figure 1. Swap/bond yields the official rates and, the swap spreads

This upper left panel displays the time series plots of the swap yields with maturities of 1 to 5 years. The upper right panel displays the time series plots of the CDB bond yields with maturities of 1 to 5 years. The lower left panel displays the time series plot of the one-year deposit rate set by the central bank. The lower right panel displays the swap spreads of 1to 5 years relative to the CDB bond yields of the same maturities. The sample period is from January 2008 to December 2016.

Figure 2 displays the two most important macroeconomic variables that affect the interest rates in our study: the inflation rate and the macroeconomic early warning indictor. The macroeconomic early warning indicator was published by the China Economic Monitoring and Analysis Center (CEMAC), an affiliate of National Bureau of Statistics of China. It is composed of eight macroeconomic leading indicators with different weights, which includes Hang Seng Mainland Freefloat Index, Industry Product Sales Rate, M2, Number of Projects Started This Year, Freight Traffic Index, Real Estate Investment Index, Index of Consumer Expectations,

and Interest Rate Spread[7]. Figure 2 also shows the detrended trading volume of one-week repos, which is used to gauge the tightness of fund supply in the money market. We see that the inflation rate took the highest value at the start of the sample period and quickly went to its lowest level with negative value, and rose again soon after that. The inflation rate was quite stable in the second half of the sample period. The official rate seems to follow the inflation rate with a lag. The 5-year swap yield also follows the inflation most of the time but with a few exceptions. The swap yield went up in the middle of 2009 when the inflation and official rate were at low levels, and the yield was at the highest level during the first half of 2014 when the inflation rate and the official rate were modest. Comparing these rates with the detrended trading volume of one-week repos, we find that in these two short periods when the swap yield moved in the opposite direction of the inflation rate, the repo trading was at the lowest level. This pattern can possibly indicate that the swap yield not only follows the inflation rate and the official rate, but can also be affected by the tightness of funds in the money market. We utilize the macroeconomic early warning indicator, a variable to gauge the expectation on the future economy and can affect the future official rate and monetary policy. As a result, the macroeconomic indicator presumably will have much more impact on the long-term yields than on the short-term ones. Coincidentally, we observe a close correlation between the early warning indicator and the slope of swap yield curve. We compute the slope as the difference between the swap yields of 5-year and 1-year contracts.

[7] These leading indicators can be found from the National Bureau of Statistics of China and Wind database. Detailed construction process refers to the website of CEMAC.)

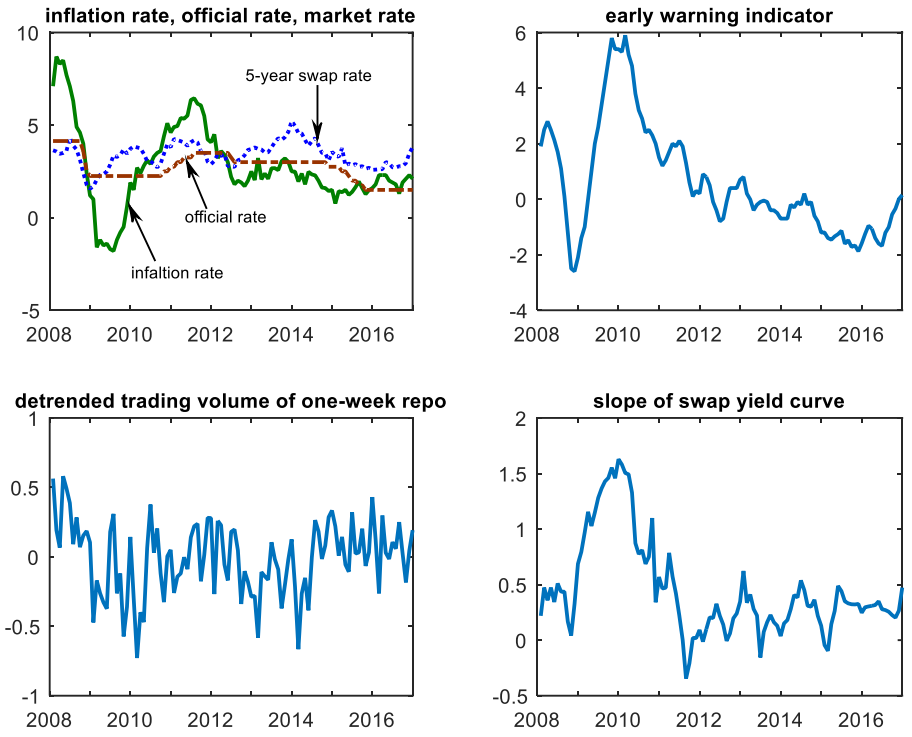

Figure 2. Inflation rate, early warning indicator, de-trended monthly trading volume of one-week repo, and slope of the swap yield curve

The upper left panel displays annual growth of CPI, the official 1-year deposit rate, and the 5-year swap yield. The upper right panel displays the macroeconomic early warning indicator. The lower left panel displays the detrended logarithm of the monthly trading volume of one-week repo. The lower right panel reports the slope of the swap yield curve. The sample period is from January 2008 to December 2016.

Table 1 reports the summary statistics of the swap yields, the CDB bond yields, and the swap spreads as the difference between yields of the swaps and the CDB bonds with maturities of one to five years. On average, the swap yields are lower than the bond yields of the same maturity by 30 to 50 bps, and the swap spreads of longer-terms are larger in magnitude. The standard deviation of each swap spread takes similar value as its mean in magnitude. The spreads took a minimal value of around -130 bps, and a maximum value of 27 to 50 bps.

Table 1. Summary statistics of swap yields, CDB bond yields, and swap spreads

The statistics include mean, standard deviation (std), minimum (min) and maximum (max) values of swap yields, bond yields, and swap spreads with maturities of 1 to 5 years. Numbers are all in percentage.

	1	2	3	4	5
			swap yields		
Mean	2.93	3.04	3.17	3.30	3.39
Std	0.85	0.77	0.74	0.68	0.68
Min	0.88	1.00	1.13	1.38	1.56
Max	5.18	5.13	5.26	4.95	5.22
			CDB bond yields		
Mean	3.23	3.52	3.65	3.81	3.92

Std	0.99	0.92	0.88	0.81	0.75
Min	1.14	1.57	1.68	1.98	2.23
Max	5.49	5.80	5.81	5.83	5.84
			swap spreads		
Mean	-0.29	-0.48	-0.48	-0.51	-0.53
Std	0.36	0.37	0.40	0.39	0.40
Min	-1.26	-1.27	-1.41	-1.39	-1.36
Max	0.50	0.27	0.36	0.43	0.41

Table 2 reports the summary statistics of the explanatory variables. The explanatory variables are the official one-year deposit rate (o_t), the slope of swap yields curve (s_t), the inflation rate (π_t), and the macroeconomic early warning indicator (w_t), the detrended logarithm of trading volume of one-week repo (f_t). Following our theoretical analysis, we will use these variables to explain the swap spreads. From the correlation analysis, we see that the official rate is highly correlated with the inflation rate, and the slope of swap yield curve is closely related to the macroeconomic early warning indicator. The high correlation coefficients are consistent with our argument that the official rate follows the inflation rate, and the early warning index affects investors' expectation about the future, and has an effect on the slope of the yield curve.

Table 2. Summary statistics of explanatory variables

The variables are the official one-year deposit rate (o_t), the slope of swap yield curve (as the difference between the 5-and 1-year swap yields) (s_t), the inflation rate (π_t), and the macroeconomic early warning index (w_t), the detrended logarithm of trading volume of one-week repo (f_t). The upper panel reports the simple statistics of these variables, including mean, standard deviation (std), minimum (min) and maximum (max) values. The lower panel reports correlation coefficients among these variables. *, **, *** Indicate statistical significance at the 0.10, 0.05 and 0.01 levels, respectively.

	o_t	s_t	π_t	w_t	f_t
Mean	2.71	0.45	2.74	0.57	-0.01
Std	0.75	0.43	2.16	1.98	0.26
Min	1.50	-0.35	-1.80	-2.60	-0.73
Max	4.14	1.63	8.70	5.90	0.58
			Correlation		
o_t	1.00				
s_t	-0.31***	1.00			
π_t	0.65***	-0.38***	1.00		
w_t	0.12	0.72***	0.14	1.00	
f_t	0.18*	-0.35***	0.31***	-0.22**	1.00

4.2 Regression results

We test the four hypotheses proposed in Section 3.4 by conducting the regression analysis on the swap spreads. The regression equation is specified as follows:

$$ss_t^{(n)} = c_n + \beta_{n,o} o_t + \beta_{n,s} s_t + \beta_{n,\pi} \pi_t + \beta_{n,w} w_t + \beta_{n,f} f_t + \varepsilon_{n,t} \qquad (n = 1,2,3,4,5). \tag{5}$$

We assume that $\varepsilon_{n,t}$ is auto-correlated with a lag of 6 months, and calculate the *t*-ratio for each estimated coefficient with the Newey-West method. As seen in our earlier analysis, the official rate can impact the swap and bond yields differently. We perform three separate regressions to examine how the official rate affects swap yields, bond yields and then swap spreads. The regression results are presented in Table 3.

As indicated by the results of Table 3, the official rate has a larger effect on the CDB bond yields than on the swap yields. With a change of 100 bps in the official rate, the one-year CDB bond yield will change by 88 bps and the 5-year yield will change by 68 bps; and the adjusted R-squared of the regression is increased to almost 50%. In contrast, effect of the official rate on the swap yields is much smaller. A change of 100 bps in official rate is predicted to result in a change of 59 bps in the swap yield of a 1-year contract and a change of 40 bps in that of a 5-year contract, and the adjusted R-squared of the regressions is just around 25%. With different effects on the two term structures of swap and bond yields, it is not surprising that a change of 100 bps in the official rate is predictive of a change in the swap spreads by 30 bps for the 1-year contract and by 28 bps for the 5-year contracts, and adjusted R-squared of the regressions is around 30%. These empirical findings support our first hypothesis on the swap spread.

Table 3. Effect of official rate on swap yields, bond yields, and swap spreads

The left panel reports the results for regressing the swap yields of 1-to 5-year on the official interest rate. The middle panel presents results of regressing the CDB bond yields of 1-to 5-year on the official rate, and the right panel for regressing swap spreads of 1- to 5-year on the official rate. Numbers in parentheses are the Newey-West t ratios. *, **, *** indicates the statistical significance at the 0.10, 0.05 and 0.01 levels, respectively.

	c	o_t	$\bar{R}^2$	c	o_t	$\bar{R}^2$	c	o_t	$\bar{R}^2$
	swap yields			The CDB bond yields			swap spreads		
1	1.34***	0.59***	0.26	0.83*	0.88***	0.44	0.51***	-0.30***	0.38
	(3.01)	(3.86)		(1.79)	(6.00)		(2.81)	(-4.43)	
2	1.58***	0.54***	0.26	1.34***	0.80***	0.42	0.24	-0.27***	0.29
	(4.52)	(4.24)		(3.30)	(6.09)		(1.01)	(-3.41)	
3	1.82***	0.50***	0.24	1.51***	0.79***	0.45	0.31	-0.29***	0.30
	(5.82)	(4.27)		(4.48)	(6.93)		(1.17)	(-3.37)	
4	2.05***	0.46***	0.24	1.77***	0.75***	0.47	0.28	-0.29***	0.31
	(7.26)	(4.34)		(6.92)	(7.78)		(1.13)	(-3.68)	
5	2.29***	0.40***	0.19	2.06***	0.68***	0.46	0.23	-0.28***	0.27
	(8.13)	(3.81)		(9.53)	(7.79)		(0.90)	(-3.42)	

Table 4 reports effects of the slope of swap yield curve, s_t, and the detrended logarithm of trading volume of one-week repo, f_t on swap spreads. We use f_t to measure the tightness of

fund supply in the money market, which we hypothesize has more effect on the swap yields than on bond yields. We use the slope of the swap yield curve to proxy for the market expectation. As the official rate is one important determinant of swap spreads, we also add the official rate as a control variable. From the results in Table 4, we see that when the swap yield slope increases, the swap spreads also go up. The swap spreads of the long-term contracts are more sensitive to the change in the yield slope. When money supply is tight with a small value of f_t, the swap spread increases. Together with the official rate, they contribute to 39% to 47% variation in the swap spreads, which is in support of Hypotheses 2 and 3.

Table 4. Effect of the slope of term structure and tense of money supply on swap spreads
The table reports results of regressing swap spreads of 1-to 5-year on the official rate, slope of term structure of swap yields, and the detrended logarithm of trading volume of one-week repo. Numbers in parentheses are Newey-West t ratios. *, **, *** indicates a statistical significance at the 0.10, 0.05 and 0.01 levels, respectively.

	c	o_t	s_t	f_t	$\bar{R}^2$
1	0.40**	-0.27***	0.05	-0.34***	0.44
	(2.16)	(-4.32)	(0.73)	(-2.97)	
2	-0.06	-0.20***	0.29***	-0.19*	0.44
	(-0.28)	(-2.80)	(3.45)	(-1.67)	
3	-0.04	-0.22***	0.32***	-0.25**	0.47
	(-0.17)	(-2.76)	(3.42)	(-2.07)	
4	-0.05	-0.22***	0.31***	-0.17	0.44
	(-0.21)	(-3.02)	(2.95)	(-1.37)	
5	-0.07	-0.22***	0.28***	-0.19	0.39
	(-0.31)	(-2.78)	(2.72)	(-1.37)	

In Table 5, we report how swap spreads respond to the two macroeconomic variables, the inflation rate, and the early warning indicator. Our results indicate a negative effect of the inflation rate, and a positive effect of the early warning indicator on the swap spreads. We report a larger effect of the inflation rate on the swap spreads of short-term contracts than on those of long-term contract. Effects of the early warning indicator, however, are larger on swap spreads of long-term contracts than on those of short-term contracts. This pattern is consistent with the effects of official rate and swap yield slope on the swap spreads. We note that as variation of the CDB bond yields are more restricted by that of the official rate, and therefore the CDB bond yields follow more closely with the inflation rate than the swap yields do. Swap yields are relatively more flexible and can more readily incorporate the market expectation, and thus are more closely tied to the early warning indicator. The empirical evidence is consistent with the Hypothesis 4 we proposed.

In the second panel of Table 5, we include all the explanatory variables as determinants of the swap spreads. We first report that more than 55% variation of the swap spreads are explained by the five variables. The official rate is a significant determinant of the swap spreads, due to

the different degrees of impact of the official rate on the market bond vs. swap yields. We also see that the inflation and the slope of swap yield curve are no longer significant, especially for swap spreads of long-term contracts, after controlling for the official rate and the macroeconomic early warning indicator. This finding can indicate that the information of the slope of the inflation rate and the early warning indicator in explaining swap spreads is subsumed by the official rate and swap yield curve.

Table 5. Effect of all the explanatory variables on swap spreads

The upper panel reports results of regressing swap spreads of 1- to 5-year on two macroeconomic variables: the inflation rate and the early warning index. The lower panel reports results of regressing swap spreads of 1-to 5-year on all the explanatory variables. Numbers in parentheses are Newey-West t ratios. *, **, *** indicates a statistical significance at the 0.10, 0.05 and 0.01 levels, respectively.

	C	o_t	s_t	f_t	π_t	w_t	$\bar{R}^2$
1	-0.12				-0.08**	0.05**	0.24
	(-1.28)				(-2.46)	(2.54)	
2	-0.33***				-0.07**	0.09***	0.37
	(-3.96)				(-2.46)	(4.77)	
3	-0.32***				-0.08**	0.10***	0.40
	(-3.43)				(-2.36)	(4.94)	
4	-0.39***				-0.06*	0.10***	0.31
	(-3.82)				(-1.79)	(3.69)	
5	-0.42***				-0.06	0.10***	0.31
	(-3.99)				(-1.63)	(3.95)	
1	0.82***	-0.34***	-0.41***	-0.32***	-0.03	0.12***	0.55
	(5.16)	(-5.31)	(-4.43)	(-2.80)	(-0.92)	(6.33)	
2	0.40**	-0.30***	-0.21	-0.18*	-0.02	0.12***	0.56
	(2.22)	(-4.99)	(-1.36)	(-1.75)	(-0.70)	(3.69)	
3	0.47**	-0.32***	-0.22	-0.24**	-0.02	0.14***	0.61
	(2.47)	(-5.54)	(-1.38)	(-2.28)	(-0.62)	(4.44)	
4	0.43**	-0.36***	-0.13	-0.20*	0.01	0.12***	0.58
	(2.09)	(-6.09)	(-0.72)	(-1.84)	(0.38)	(3.2)	
5	0.49**	-0.37***	-0.26	-0.21	0.00	0.14***	0.57
	(2.53)	(-6.39)	(-1.53)	(-1.61)	(0.09)	(4.68)	

4. Conclusion

Swap spreads, the difference between the fixed rates on fixed-for-floating swap contracts and the yields-to-maturity on maturity-matched government bonds, are used as a key benchmark for pricing and hedging in the global markets of fixed-income securities. Our study, by using the unique laboratory of Chinese swap market, report that the financial institutional background could have a great impact on pricing swap spreads in an emerging market.

Our analysis exemplifies how the role of large institutions play in the process of determining market interest rates. China continues to be a bank-centered economy, with the effective deposit rates and loan lending rates of commercial banks anchored by the official rates imposed by the government. Furthermore, as the commercial banks are dominant players in the fixed income market, the influence of official rates spills over to the government bond markets and bond yields are greatly affected by the official rates. In contrast, swap rates are more closely tied to the current and expected future short-term market rate, and readily incorporate relevant change in economic situations such as tightness of money supply and expectation of future economic situations.

Our study uncovers the empirical determinants of swap spreads in China, following our theoretical hypotheses formulated based on important Chinese institution features. We use the one-year deposit rate set by the central bank as the representative official rate, the de-trended logarithm of trading volume of one-week repo transaction as the measure of tightness of funds in the money market, and the slope of swap yield curve as the measure of expectation about future interest rate movement. Our regression analysis confirms that swap spreads are negatively correlated with the official rate. Swap yields, compared with bond yields, are more sensitive to the tightness of money supply. Furthermore, swap yields tend to increase with a high slope of the swap term structure. Such a pattern is especially significant for the long-term swap contracts. We also relate swap spreads to the economic fundamental variables: the inflation rate and the early warning indicator. The official rates are set to follow the inflation rate. The slope of the market rates is closely connected to the early waning indicator, which is informative of the expectation on future economic situations. We find that these two macroeconomic variables explain variation of swap spreads, as bond yields are more tied to the official rate and thus more closely follow inflation, while swap rates are more sensitive to the change in the expected future economic situations and thus more closely related to the early warning indicator.

China is in the process of accelerating interest rate liberalization. Our study can provide important information for this impending reform. Relaxing the control over deposit and loan lending interest rates is only the first step in this process of liberalization. To build a more efficient market in which interest rates sufficiently reflect economic fundamentals, it is necessary to reform the official rates system and actively develop the direct financing market.

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