China's Capital Controls –
Through the prism of covered interest differentials

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(Preliminary and Please Do Not Quote)

ABSTRACT

We study the renminbi (RMB) covered interest differential – an indicator of the effectiveness of capital controls. It is found that the differential is not shrinking over time and, in fact, appears larger after the global financial crisis than before. That is, capital controls in China are still substantial and effective. In addition to exchange rate changes and volatilities, the RMB covered interest differential is affected by credit market tightness indicators. The marginal explanatory power of these macroeconomic factors, however, is small relative to the autoregressive component and the dummy variables that capture changes in China's policy.

Keywords: NDF Implied RMB Interest Rate, Capital controls, Asymmetric Response, Macro Determinants, Credit Market Tightness

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1. Introduction

Following its swift rise to the global economic league, China's economic policies and activities have been put in the limelight. Capital controls, for instance, have been a staple component of China's economic policy since 1949, but only until recently have been scrutinized by the international community. As usual, debates on China bring up different perspectives and the one on China's capital controls is of no exception.

One viewpoint is that capital controls allow China to maintain an undervalued currency and to provide cheap capital to fuel its phenomenal economic growth. Olivier (2012), for example, shows that capital account policies could be designed to have effects of trade protectionism. Indeed, complaints have been lodged against China's (seriously) undervalued currency, which is made possible by its capital control policy, and is seen as a crucial device that gives China an unfair competition edge in global trade.[1] These restrictions not only create distortions in domestic capital markets but also induce imbalances in the global economy.

An alternative view is that, in the case of China, capital controls are a necessary evil. For China to pursue an independent monetary policy to maintain a stable exchange rate and stabilize its economy, capital control policy is perceived to be an indispensable policy tool. Indeed, with its underdeveloped financial sectors and extensive reform agenda, restrictions on capital movement is perceived to be an important attribute that helps insult China from unduly large external financial volatility in the recent global finance crisis (Fernald and Babson; 1999; Yu, 2009).

Capital controls are in general considered to be the culprit of inefficiency and mis-allocations in capital markets that could have severe long-term growth and welfare costs. In practice, when a country adopts a capital control policy, it has to bear the associated political stigma. Despite all these, capital controls in various degrees are quite commonly implemented in, say, developing countries.[2] The apparent change in IMF's policy stance in the early 2010s may have lessened the political stigma that comes with adopting capital controls. In developing a new policy framework for advising countries, a series of IMF studies acknowledge that, under certain circumstances, developing countries could install capital control measures to protect themselves

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[1] It is the majority view on capital controls and undervaluation. For alternative points of view, see, for example, Cheung, Chinn and Fuji (2007) on the RMB undervaluation and He, *et al.* (2012) on capital account liberalization and the RMB real exchange rate.

[2] In fact, capital control policies were not uncommon even among developed countries as recent as in, say, the 1980s.

against macroeconomic and financial instabilities (Ostry *et al*., 2010, 2011; The Strategy, Policy, and Review Department, IMF, 2011).[3] However, capital controls should not replace structural reforms that, for example, enhance the efficiency and capacity of the domestic financial sector.

In the case of China, the country has been undergone sequences of reform initiatives to transform its centrally planned economy towards a market driven one since the 1980s. While making substantial strides in modernizing its economic structure and integrating with the global economy, China has re-iterated its policy of maintaining a stable environment for trade, investment, and growth. A stable exchange rate of the renmimbi – the Chinese currency; henceforth RMB – is one of the policy instruments to achieve the policy objective. According to the holy macroeconomic trilemma, China with a preference for stable exchange rate has to choose between capital mobility and policy independence. In reality, we observe that China imposes capital controls and exercises monetary policy independence. The effectiveness of restrictions on capital flows, thus, has substantial implications for China's ability to manage and stabilize its domestic economy.

Indeed, China was quite conscientious about capital flight and hot money and introduced a few policy measures to curb illicit capital flows in the 2000s (Hung, 2008). Apparently, this episode of tightening of controls is a response to an abrupt surge in illicit capital flows and not a shift away from the pro-claimed policy of continuing financial market reform. The recent official efforts of promoting the international use of the RMB are widely interpreted as an aggressive step to liberalize the financial market. In February 2012, for instance, there is a report in Chinese that outlines a three-stage reform proposal to promote the international use of the RMB and open up China's capital account in ten years.[4] Despite the proposed reform schedule is quite aggressive and is not in line with China's usual gradual reform approach, it adds to the general circumstantial evidence on China's desire to continue with its reform policy.

Against this backdrop, we study China's capital controls. Instead of examining the pros and cons of imposing capital controls or of liberalizing capital accounts, we focus on China's financial capital mobility as measured by the RMB covered interest differential (Cheung, Chinn, and Fujii, 2003; Frankel, 1991) and examine its time profile and economic determinants. It is

[3] Some economists, including Joseph Stiglitz, indicated that emerging economies need capital controls to curb and manage capital flows.

[4] The report in Chinese "我国加快资本账户开放的条件基本成熟" published by the *China Securities Journal* online (http://www.cs.com.cn/xwzx/07/201202/t20120223_3253890.html) was from the Financial Survey and Statistics Department headed by SongCheng Sheng at the People's Bank of China.

hoped that results from an objective empirical analysis could facilitate the normative discussion of China's control capitals.

The RMB covered interest differential variable in our exercise is constructed using the US and Chinese data on exchange rates and interest rates. It is a commonly used price measure of capital controls.[5] In the presence of capital controls, the covered interest differential could deviate from its equilibrium value zero. That is, for assets with similar risk characteristics in different countries, restrictions on capital flow could lead to a substantial difference in their returns after accounting for exchange rates. Sometime, the magnitude of the covered interest differential is used to infer the effectiveness of capital controls (Ma and McCauley, 2008). Specifically, effective controls could support a persistent covered interest differential.

In our analysis of the RMB covered interest differential, we will incorporate the possible effect of policy changes, consider the traditional determinants of deviations from covered interest parity, and include variables that are specific to China and drawn from recent theoretical studies. In addition, we investigate if these determinants have asymmetric effects on the covered interest differential.

To anticipate the results, we find that there is no evidence that the RMB covered interest differential is shrinking over time. The differential has switched from mainly negative around the year of 2000 to mainly positive after the 2008 global financial crisis. Both the differential itself and its absolute value exhibit a moderate degree of persistence, which is weakened after controlling for policy change effects. The time profile of the covered interest differential appears to follow that of exchange rate variables.

The explanatory powers of the traditional economic determinants including GDP growth, exchange rate and its volatility, and inflation volatility depend on the specification of the covered interest differential equation. In addition, our exercise offers some encouraging evidence on the link between measures of credit market tightness and deviations from covered interest parity. Further, the differential responds asymmetrically to some of the selected determinants. In general, it is easier to explain the RMB covered interest differential than its absolute value.

The definition of the RMB covered interest differential is given in the next Section. In the same section, we present some basic descriptive statistics of the differential and its components.

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[5] Alternatively, there are flow/volume measures that are derived from the volume of capital flows between borders. For *de facto* and *de jure* measures, see, for example, Frankel (1992) and Chinn and Ito (2006).

Section 3 studies the basic time series properties of the differential. The roles of selected macroeconomic variables in modeling the differential are examined in Section 5. Additional analyses on the magnitude of the RMB covered interest differential and the asymmetric effects are reported in Section 5. Section 6 offers some concluding remarks.

2. Basic Data analysis

The Chinese and US data on money and exchange rates are used to construct the RMB covered interest differential. Under the covered interest parity condition:

$$NDF_{t,t+1} (1 + i^{*}_{t,t+1}) / S_t = (1 + i_{t,t+1,NDF}), \quad (1)$$

where $NDF_{t,t+1}$ is the one month RMB non-deliverable forward (per US dollar) exchange rate quoted at time t, $i^{*}_{t,t+1}$ is the one month US dollar London interbank offer rate (LIBOR), S_t is the spot RMB (per US dollar) exchange rate, and $i_{t,t+1,NDF}$ is the one month NDF implied RMB interest rate. Theoretically, exchange rate adjusted returns on similar US dollar- denominated and RMB-denominated assets are the same under the covered interest parity, which is attained via arbitrage between money and foreign exchange rate markets. When money is not free to move, there could be a wedge between the two returns. Implicitly, equation (1) assumes the one month NDF implied interest rate is the proxy for the theoretical RMB rate observed under covered interest parity.

The RMB covered interest differential is given by

$$\begin{aligned} Y_t &= (i_{t,t+1,ON} – i_{t,t+1,NDF}) \\ &= i_{t,t+1,ON} – (NDF_{t,t+1} (1 + i^{*}_{t,t+1}) / S_t – 1), \quad (2) \end{aligned}$$

where $i_{t,t+1,ON}$ is the one month Chinese interbank offer rate (CHIBOR). Essentially, the differential is the difference between the on-shore RMB interest rate and the implied interest rate obtained from an off-shore market.

Note that the deviation from the covered interest parity could also be written as

$$(1 + i_{t,t+1,ON})/(1 + i^{*}_{t,t+1}) - NDF_{t,t+1}/ S_t. \quad (3)$$

Thus, we call $(1 + i_{t,t+1,ON})/(1 + i^{*}_{t,t+1})$ the interest rate component and $(NDF_{t,t+1}/ S_t)$ the foreign exchange component of covered interest rate disparity.

The sample covers monthly data from April 1999 to June 2012. The beginning of the sample period is constrained by the availability of some macroeconomic variables used in the subsequent analysis. The definitions of variables and data sources are collected in the Appendix.

Descriptive statistics of the RMB covered interest differential and its components are given in Table 1 in annualized form. The averages of the RMB exchange rate (S_t) and its non-deliverable forward rate ($NDF_{t,t+1}$) are, respectively, 7.66 and 7.65. That is, the RMB tends to have a positive forward premium during the sample period.

The Chinese interest rate CHIBOR ($i_{t,t+1,ON}$) is on the average higher than the corresponding US interest rate LIBOR ($i^*_{t,t+1}$). By comparing the interest differential and the difference between NDF and spot rates, we infer that, on the average, the covered interest disparity given by equation (2) is positive and the parity condition does not hold.

These two interest rate series are plotted in Figure 1. While both series have on average declining trends over time, their dynamics differ quite significantly at higher frequencies. Indeed, two interest rates show obvious signs of divergence in the post 2008 global finance crisis period – a period in which the US has adopted the unconventional quantitative easing monetary policy. The correlation between the two interest rate series is quite low at the +3 %, and the Chinese CHIBOR rate appears being decoupled from the corresponding US LIBOR rate. This observation is in line with the reported finding that China retains its policy independence and the Chinese interest rate does not follow the US one (Cheung *et al.*, 2008). Since the RMB exchange rate is heavily managed, the policy independence is indicative of the effectiveness of capital controls.

The average of the RMB covered interest differential (Y_t) is positive as the on-shore Chinese interest rate ($i_{t,t+1,ON}$) is, on average, higher than the NDF implied RMB interest rate ($i_{t,t+1,NDF}$). One interpretation is that, during the sample period, capital controls have been in place to insulate China from an overly accommodative foreign monetary policy or to resist appreciation pressure.

From equation (2), $Var(Y_t) = Var(i_{t,t+1,ON}) + Var(i_{t,t+1,NDF}) - 2\ Cov(i_{t,t+1,NDF})$. Thus, the standard errors of these variables indicates that the volatility of Y_t resembles that of $i_{t,t+1,NDF}$. Indeed, as evidence in Figure 2, the variations in the covered interest differential mirrors those of the NDF implied rate – the two variables have a very high negative correlation of -95 %. That is the evolution of the covered interest differential is mainly driven by factors affecting the NDF implied RMB interest rate.

An alternative way to look at the breakdown of the covered interest differential is illustrated by Figure 3, which plots the interest rate $((1 + i_{t,t+1,ON})/(1 + i^*_{t,t+1}))$ and foreign exchange ($NDF_{t,t+1}/ S_t$) components of covered interest disparity. Of the two components, the foreign exchange component exhibits a higher level of variability and a larger degree of peakedness as indicated by kurtosis coefficient estimates. Relatively speaking, the movement of the covered interest differential Y_t is more similar to the that of the foreign exchange component than that of the interest rate component. The correlation between Y_t and $NDF_{t,t+1}/ S_t$ is -82% and between Y_t and $(1 + i_{t,t+1,ON})/(1 + i^*_{t,t+1})$ is 52 %. Comparing the spikes observed from Y_t, $i_{t,t+1,NDF}$, and $NDF_{t,t+1}/ S_t$ in Figures 1 to 3, It appears that the covered interest differential is quite heavily affected by some erratic movements originated from the foreign exchange market.

In sum, there is circumstantial evidence on the effectiveness of China's capital control policies. The RMB covered interest differential, on average, is positive and shows no signs of wearing off.

3. Some Time Series Properties

Visual inspection suggests that the RMB covered interest differential exhibits some degree of persistence and experiences a few large swings that could be triggered by extreme events in financial markets. As a first step of studying its time series property, we tested whether the covered interest differential data are stationary or not.

The results from a battery of standard unit root tests including the augmented Dickey-Fuller test, Elliot-Rotherberg-Stock generalized least squares Dickey-Fuller test, the Phillips-Perron test, and the Ng-Perron test show that the covered interest differential is stationary. These unit root test results are robust to the inclusion and exclusion of a trend. The Kwiatkowski-Phillips-Schmidt-Shinn stationarity test, however, rejected the null hypothesis of stationarity at standard levels of significance. It is noted that the Kwiatkowski- Phillips-Schmidt-Shinn stationarity test could be heavily affected by short-term dynamics in data.

Since the covered interest differential shows sign of regime breaks which may undermine the power of standard unit root tests, we further investigated the stability issue using the UR test proposed by Lanne *et al.* (2001 and 2002) and endogenously estimated breakpoints. The UR test rejected the presence of a unit root at standard levels of significance. The UR test was performed with a constant, a trend and a shift dummy placed at an endogenously estimated breakpoint.[6] In

[6] The results of these unit root tests are not reported for brevity and are available upon request.

general, the most likely breakpoints were located close to monetary policy regime changes in China.

To further gauge the basic time series features of covered interest differentials, we consider the following regressions:

$$Y_t = \alpha + \lambda\,\text{trend} + \Sigma_i^p \beta_i Y_{t-i} + \varepsilon_t, \tag{4a}$$

$$Y_t = \alpha + \lambda\,\text{trend} + \Sigma_i^p \beta_i Y_{t-i} + \theta' X_t + \varepsilon_t, \tag{4b}$$

where trend is a time trend variable and X_t is a vector containing shift dummy variables that capture possible structural break effects.[7] The selection of the structural break dummy variables is aided by the results from the unit root tests that allow for breaks. The lag length parameter is chosen to eliminate serial correlation in the estimated residuals. Table 2 presents the estimation results.

For regression equations (4a) and (4b), at least some of the lagged terms are significant. The dynamics of the RMB covered interest differential are usually captured using one or two of their own lags. The positivity of these autoregressive terms validates and quantifies the persistence of the covered interest differential revealed in Figure 3. It is of interest to note that the magnitude of these autoregressive terms is reduced in the presence of the structural break dummy variables. The observation is in accordance with the general notion that structural breaks could lead to spurious evidence of data persistence.

The significance of the time trend variable in the two covered interest differential equations is an interesting result. Indeed, the magnitude of the time trend effect is magnified in the presence of structural break variables. The presence of a positive trend indicates that the RMB covered interest differential on the average has been increasing during the sample period. The plot of Y_t in Figure 3 shows that deviations occurred on both sides of the equilibrium. However, these deviations are mostly negative in the beginning of our sample period and positive towards the end. A reasonable interpretation of the positive trend term, of course, is that it describes only the in-sample phenomenon, and not necessarily the out of sample trending behavior.

Taking all these into consideration, we infer that the RMB covered interest differential is not shrinking but widening over time. The finding is in contrast with those reported in Cheung,

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[7] The definitions of these variables are given in the appendix. Only significant structural break dummy variables are reported in the text for brevity.

Chinn and Fujii (2006) and Ma and McCauley (2008). These authors employed data from before the 2008 global finance crisis and found evidence of the covered interest disparity was declining.

The significant structural break dummy variables yield further evidence that the most likely regime breaks are located around periods of monetary policy changes in China. Around July 2005, China effectively shifted from a heavily managed exchange rate policy to a crawling (slowly appreciating) peg one. Around June 2008, in the midst of the global financial crisis, China re-instated its pre-2005 heavily managed exchange rate policy. Both of these events seem to have been associated with a decrease in the RMB covered interest differential. The return to the crawling peg in the fall of 2010, however, does not lead to a significant level shift in the covered interest differential.[8]

Last, but not the least, it is noted that the explanatory powers of these time series specifications are quite good – they explained up to 63% of variations in the RMB covered interest differential.

4. Economic Determinants

Capital account restrictions will impede capital flows across national borders, thereby limiting the ability of arbitrage activity to bring about covered interest parity. The effectiveness of a capital control policy depends on the intensity it is implemented and economic structure in which it is imposed. Capital controls in China are perceived to be binding but not perfect (Ma McCauley, 2008). That is, capital controls deter but not totally eradicate capital flows; people always find some ways to bypass regulations and move money around. Cheung and Qian (2010), for example, show that China's illicit capital flows in some years could be larger than the official foreign direct investment. Nevertheless, the illicit capital flows are not large enough to eliminate the RMB covered interest differential.

Besides capital controls, covered interest disparity could be induced by country risks (Aliber, 1973; Dooley and Isard, 1980; Frankel and Engel, 1984). Since country risks are not easily quantifiable, economic factors are typically used to capture the country risk effect on the covered interest differentials. In the following subsections, we study some economic determinants of the RMB covered interest differential.

[8] We also considered the shift dummy variables d2003m12, d2007m12 and d2010m10. Since they were insignificant and, thus, were not reported for brevity.

4.1 Canonical Determinants

The ability of selected economic factors to explain variations in the covered interest differential is studied using the regression equation:

$$Y_t = \alpha + \lambda \text{ trend} + \Sigma_i^p \beta_i Y_{t-i} + \theta' X_t + \gamma' W_t + \varepsilon_t, \quad (5)$$

where W_t includes the usual macroeconomic variables considered in the literature. Essentially, equation (5) is equation (4b) augmented with the explanatory variable W_t. We follow Cheung and Qian (2011) to select the elements of W_t.

The amount of capital flight (KF) is used as a proxy for the intensity of the *de facto* capital control effort. It is posited that a high (low) level of capital flight implies a loose (stringent) capital control policy, so that the marginal effect of KF is expected to be negative. The World Bank residual method is used to construct the KF variables from national account data.[9] Since KF may be endogenous, we followed the literature and used the change in China's trade openness (= (Imports+Exports)/GDP) as an instrument.

A few macroeconomic variables are used to capture the country risk effect.[10] The GDP growth rate (dRGDP) is a proxy for economic stability. A declining growth environment leads to a destabilizing economic condition, thereby implying a large covered interest differential. It is noted that both data on KF and GDP are available at the quarterly frequency. The interpolation method proposed by Chow and Lin (1971) is used to obtain the monthly KF and GDP data for our analysis.[11]

Two exchange rate related variables; exchange rate volatility (EV), and change in the nominal effective exchange rate (dNEER), are included to reflect macro policies. A strong RMB is a sign of a strong Chinese economy, while high exchange rate volatility signifies uncertainty perceived by the market. Thus, we expect these two variables have opposite effects on the RMB covered interest differential.

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[9] Claessens and Naudé (1993) and Kar and Cartwright-Smith (2008), for example, describe various capital flight measures and their limitations.

[10] See for example, Favero, *et al.* (1997), Eichengreen and Mody (1998), Kamin and von Kleist (1999), Kaminsky and Schmukler (2001), Mauro, *et al.* (2002), and Baek, *et al.* (2005).

[11] Cheung and Qian (2011, Appendix A.2), for example, offers a description of the interpolation procedure.

Inflation volatility (InflV), which reflects macroeconomic stability in general, is also included. The prior is that an increased in economic instability has a positive influence on the covered interest differential; thus, the expected sign of inflation volatility is positive.

The results of estimating (5) are presented in Table 3. The specification considered under column 1 is the general formulation. The other columns report results following the test-down approach, with which insignificant variables were sequentially dropped. The specification under Column 5 only includes statistically significant regressors.

In general the coefficient estimates of the added macroeconomic variables have their expected signs; that is, positive effects of inflation and foreign exchange volatility, and negative effects of capital flight, growth and exchange rate. While these results are largely in line with those reported in other studies, not all of these macro variables have a statistically significant impact on the RMB covered interest differential.

The results presented under column 5 show that it is the two exchange rate related variables, exchange rate volatility (EV), and nominal effective exchange rate change (dNEER) that have significant impacts. These exchange rate effects corroborate those noted in the analysis of the descriptive statistics in Section 2. Apparently, it is the financial variables that have effects on the covered interest parity, which is a financial capital market parity condition.

The inclusion of these macroeconomic variables does not have a substantial impact on the coefficients estimates of the autoregressive terms, the structural break dummies, and the trend term. That is, the information content of these macroeconomic variables has little overlap with that of the variables included in the time series analysis. The marginal explanatory power of these added variables – as given by the increase of the adjusted R-squares estimate over, say, the one reported under column 2 of Table 2 – is relatively small.

5.2 Additional Determinants

In the previous subsection, we considered the roles of some canonical macroeconomic variables examined in other studies. In this subsection, we investigate a few other determinants. Some of them are drawn from recent discussions on China and some are inspired by a recent study (Jeanne, 2012) on capital account policies. In essence, we include these additional economic determinants to equation (5) and study the specification:

$$Y_t = \alpha + \lambda \text{ trend} + \Sigma_i^p \beta_i Y_{t-i} + \theta' X_t + \gamma' W_t + \phi' Z_t + \varepsilon_t, \quad (6)$$

where Z_t contains the additional economic determinants.

First, we investigate the possible effects of China's foreign trade on Y_t. To this end, we include as regressors the change in China's imports (dI) and exports (dX) relative to its GDP. In line with the earlier arguments, increased foreign trade might be indicative of the strength of the Chinese economy, thereby contributing to a decrease in Y_t. It is also posited that trade activity could link to illicit capital movement via trade mis-invoicing. For instance, capital controls could be circumvented and money could be moved in or out of China via, say, over-invoicing exports or under-invoicing imports (Zhang, 2009). A large volume of trade offers chances to manipulate invoicing behavior and, thus, impacts the effectiveness of capital controls and affects the RMB covered interest differential Y_t.

Second, we include the monthly change in the VIX index (dVIX) to control for changes in market's sentiment towards financial risk. The VIX index is a popular measure of implied volatility in the S&P 500 index options. It is quite often used to gauge the level of economic volatility globally, and especially in the developed markets. *A priori*, an increase in VIX reduces investor's risk appetite towards risky assets in emerging markets; including currency investment. Arguably, the interest rates and the spot exchange rate in the RMB covered interest differential specification are policy variables; the risk sentiment is likely to have an impact mainly on the RMB NDF rate. In this case, an increase in VIX will lower Y_t.

Recently, Jeanne (2012) devises a theoretical framework to study the link between capital account policies and real exchange rates. One result of the model is that a capital control policy of resisting appreciation could lead to excess returns on domestic financial assets. That is, a tightening of credit conditions within China is associated with a rising RMB covered interest differential. To evaluate this viewpoint, we include a few credit market tightness indicators in the regression. In addition to the change in the rediscount rate (dRR) and in the reserve requirement ratio (dRRR), we include a survey-based indicator of banks' lending attitudes (dLENDAT).[12] The rediscount rate and the reserve requirement ratio are common monetary policy instruments used by China to manage credit market conditions. Under Jeanne's setup, we expect these two policy instruments to have positive impacts on the RMB covered interest differential. On the other hand, we expect banks' lending attitudes indicator to have a negative sign because improving lending attitudes present a favorable credit market condition.

[12] The survey is conducted by the People's Bank of China.

Table 4 shows the estimation results based on five variants of model (6). The change in imports (dI) influences Y_t in the positive direction, and an increase in exports (dX) in the negative direction. However, the parameter estimate for imports is small and statistically insignificant. The export variable loses its significance when the import variable is dropped from the model. All in all, then, the evidence on the effect of exports and imports on the RMB covered interest differential is relatively weak. Changes in the VIX have a negative but statistically insignificant effect on the covered interest differential.

The encouraging results are from the credit market tightness indicators. The three selected indicators are all statistically significant and their coefficient estimates have the expected signs. Specifically, the tightening via the official rediscount rate (dRR) and the reserve requirement ratio (dRRR) widens the RMB covered interest differential, while an improving lending attitude of banks narrows the differential. The results indicate that an improvement in the lending attitude by one percent within China corresponds with a 0.4% percent decrease in the RMB covered interest differential. By and large, the results collaborate with the theoretical predictions of Jeanne (2012).

As shown by the estimated adjusted R-squares estimates, the marginal explanatory of these additional economic determinants (mainly, the credit market tightness indicators) are comparable to the one reported for the canonical economic determinants discussed in the previous subsection.

In sum, there is evidence that some of the canonical economic determinants and credit market indicators help explain the variability of the RMB covered interest differential. However, the marginal explanatory powers of these two types of economic determinants are small relative to the proportion of variation explained by the time series and dummy variables considered in Section 3.

5. Additional Analyses

To shed further insight on the effectiveness of capital controls, we study a) the magnitude of the RMB covered interest differential, and b) the asymmetric effect of the explanatory variables.

5.1 The Magnitude of the Differential

Restrictions on capital flows could make a domestic interest rate higher than or lower than the corresponding implied interest rate. In view of this, one alternative measure to assess the strength of control efforts is the magnitude of the deviation from the covered interest parity. Thus, we consider $|Y_t|$ the absolute value of Y_t that measures the size of the deviation from the covered interest parity as an alternative measure of the effectiveness of capital controls.

To assess the effective of China's capital controls using this measure of covered interest disparity, we re-do the exercises discussed in Sections 3 and 4, and estimate these regressions:

$$|Y_t| = \alpha + \lambda\,\text{trend} + \Sigma_i^p \beta_i |Y_{t-i}| + \varepsilon_t, \qquad (7a)$$

$$|Y_t| = \alpha + \lambda\,\text{trend} + \Sigma_i^p \beta_i |Y_{t-i}| + \theta' X_t + \varepsilon_t, \qquad (7b)$$

$$|Y_t| = \alpha + \lambda\,\text{trend} + \Sigma_i^p \beta_i |Y_{t-i}| + \theta' X_t + \gamma' W_t + \varepsilon_t, \text{ and} \qquad (8)$$

$$|Y_t| = \alpha + \lambda\,\text{trend} + \Sigma_i^p \beta_i |Y_{t-i}| + \theta' X_t + \gamma' W_t + \phi' Z_t + \varepsilon_t. \qquad (9)$$

The time series regressions (7a) and (7b) are presented under columns (1) and (2) in Table 5. Compared with Y_t, the magnitude of the covered interest differential $|Y_t|$ displays a weaker degree of persistence as measured by the autoregressive estimates. The estimated trend terms are positive though statistically insignificance. When we considered the pure time trend effect using the regression formulation $|Y_t| = \alpha + \lambda\,\text{trend} + \varepsilon_t$ (results are reported under column 3 in Table 5), the trend term is significantly positive. Again, in eye-balling the data, we could see that the size of the covered interest differential variable near the end of our sample period is quite large. Thus, even the trend variable is not statistically significant in the presence of autoregressive terms, the overall evidence indicates that the size of the RMB covered interest differential is non-shrinking, and a possibility of an increasing differential over time.

It is of interest to note that the structural breakpoints estimated for $|Y_t|$ and Y_t are not all identical, though both series experienced a break when China restated its managed exchange rate policy in June 2008.

The results of estimating (8) and (9) are presented in Tables (6) and (7), respectively. Among all the economic variables under consideration, only inflation variability (InflV) garners a positive and significant coefficient estimate across specifications presented in these two Tables. The credit market tightness indicators that show some promising results in Table 4 are not significant in any of the specifications reported in Table 5. Obviously, these policy variables have some specific directional implications for the RMB covered interest differential but not its magnitude.

In comparing the results for the covered interest differential and its magnitude, it is obvious that the models under consideration do not explain the latter variable as well as the former one. For the adjusted R-squares estimates reported in Tables 5, 6, and 7, they are smaller than the corresponding ones in Tables 2, 3, and 4. For instance, the adjusted R-squares estimate is 29% for equation (7b) in Table 5 while it is 66% for equation (4b) in Table 2.

5.2 Asymmetric Effects

The previous estimations are based on the implicit and standard assumption of symmetric responses to explanatory variables. However, the symmetry assumption could be strong when the parameters of interest reflect changes in behavioral constraints related to regulations – because the effect of a change in a constraint reflects the possibly asymmetrical underlying population distributions in the neighborhood of the constraint. A loosening of capital account regulation, for example, may concern a different group of agents compared to a tightening by the same amount.

For this reason we consider the possible asymmetry response of the RMB covered interested differential. The general specification for examining the asymmetry response is given:

$$Y_t = \alpha + \lambda \, \text{trend} + \Sigma_i^p \, \beta_i^+ Y_{t-i}^+ + \Sigma_i^p \, \beta_i^- Y_{t-i}^- + \theta' X_t + \quad (10)$$

$$\gamma^{-\,\prime} W_t^- + \gamma^{+\,\prime} W_t^+ + \phi^{-\,\prime} Z_t^- + \phi^{+\,\prime} Z_t^+ + \varepsilon_t,$$

where $Y_t^+ \equiv \max[Y_t, 0]$ and $Y_t^- \equiv \min[Y_t, 0]$. The definition of elements of W_t^-, Z_t^-, and Z_t^+ depends on the specific variable under consideration. For instance, the reference point zero is employed to assess the asymmetric effects of dRR and dRRR since zero is a natural dividing point between a tightening and loosening policy. Similar, zero is the reference point for dNERR. For the other variables including EV, dLENDdat and InflV, we study asymmetry relative to the mean of the series which is interpreted as the long run expected value. The explanatory variables included are those showed up statistically significant in the regressions reported in previous tables.

The column 1 in Table 8 presents results on the asymmetric effects of the lagged covered interest differential and the two exchange rate variables. For brevity, only the asymmetric effects are reported in the Table.[13] There is no strong evidence of strong asymmetric effects of the lagged differential. In fact, the two coefficient estimates of Y^{+}_{t-1} and Y^{-}_{t-1} are not statistically different from each other.

The marginal effects of the two exchange rate variables are quite sensitive to the sign of these variables. The coefficient estimate of $dNEER^{+}_{t}$ is more than two times larger than the one of $dNEER^{-}_{t}$, and the former one is marginally significant while the latter one is not. That is, a strengthening RMB ($dNEER^{+}_{t}$) has a larger impact than a weakening one ($dNEER^{-}_{t}$).

Both large and small exchange rate volatilities have a significant impact on the RMB covered interest differential. However, a high level of exchange rate volatility (EV^{+}_{t}) displays a much smaller effect than a low level of exchange rate volatility (EV^{-}_{t}). While exchange rate volatility represents macro risk that leads to an increase in the covered interest differential, volatility that is higher than the norm could reduce investor's risk appetite, trigger the risk off mode, and, thus has a smaller impact.

The results of allowing for asymmetric effects of the credit market tightness indicators are given under column 2. The significant indicators are $dLENDAT^{-}_{t}$, dRR^{+}_{t}, and $dRRR^{-}_{t}$. Both a lower than average lending attitude and a higher than average official re-discount rate signify a tightening stance. They tend to have a significant impact on the RMB covered interest differential with the expected signs. The market may have a different reading of the required reserve ratio – it is the lower than average RRR that has a significant impact. One possible reason is that a low RRR could lead to easy bank credit and the subsequent over-heated economy.

The asymmetric effect exercise for the magnitude of the covered interest differential $|Y_t|$ is presented in Table 9. The significant variables are Y^{-}_{t-1} and $InflV^{+}_{t}$. Since Y^{-}_{t-1} is negative by construction, $|Y_t|$ is mainly affected by a negative lagged movement in the differential. On inflation, the result shows that a high level of inflation volatility contributes significantly to the magnitude of the RMB covered interest differential.

All in all, results in Tables 8 and 9 are indicative of the asymmetric responses of the RMB covered interest differential to its determinants – both time series and macroeconomic

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[13] The results pertaining to the trend and X_t that were not reported are available from the authors.

determinants. However, there are two caveats. First, the splitting of explanatory variables may reduce the effective numbers of observations for extracting their effects. Second, the performance of these asymmetric specifications is not too much different from the corresponding specifications with asymmetric effects. Specifically, the adjusted R-squares estimates in Table 8 are slightly less than the corresponding ones in Table 4, and those in Table 9 are slightly larger than those in Table 5.

6. Summary and Concluding Remarks

We study the behavior of the RMB covered interest differential, which is a common yardstick of the effectiveness of capital controls. It is found that the covered interest differential is not shrinking over time. Specifically, the RMB covered interest differential exhibits a noticeable gap in the post-global financial crisis period. The time profile of the differential resembles that of the NDF implied RMB interest rate and appears to be driven by the exchange rate component of the covered interest disparity.

The macroeconomic variables that have a marginal significant effect on the RMB covered interest differential are the change in effective exchange rate, exchange rate volatility, and three credit market tightness indicators. The three indicators are, namely, the official discount rate, the required reserve requirement, and bank's lending attitude. Arguably, our empirical exercise is among the first ones that document the effects of these credit market indicators.

Despite their statistical significance, the marginal explanatory power of these macroeconomic variables is small relatively to the autoregressive terms and structural break dummy variables. For instance, the adjusted R-squares estimate of the time series specification reported under (2) in Table 2 is 63.1% and the specification (4) that includes the significant macroeconomic variables in Table 4 is 68.3%. That is, about 30% of the RMB covered interest differential variability is left unexplained, and most of the explained variability could be attributed to the autoregressive dynamics and the shift variables.

When the models considered for the covered interest differential are used to model the magnitude of the differential, their performance is less impressive. In general, for the magnitude of the covered interest differential, these models offer a lower level of explanatory power and yield a different set of significant macroeconomic variables. Apparently, it is easier to describe the RMB covered interest differential than its magnitude.

While there is some evidence on the asymmetric effects of the selected determinants, the models that incorporate asymmetric effects only offer a slightly different explanatory power than the corresponding ones without asymmetric effects.

There a few inferences. First, despite the ongoing process of integrating with the rest of the world and the proclaimed efforts of liberalizing its capital account, our results affirms the anecdotal evidence that China retains its ability to restrict cross-border financial capital market movements. The policies on capital controls are substantial and binding. Apparently, China still considers capital control policy an indispensable tool to manage and stabilize the economy. A recent example is that, in early May 2013, China's State Administration of Foreign Exchange enacted a few new rules to curb illicit capital inflows and restrict bank's long RBM positions, thereby easing the RMB appreciation pressure. Possibly, before the coming of a fully fledged and efficient domestic financial sector, China will resort to capital control policy whenever it deems necessary to fend off unfavorable capital flows.

Our exercise shows that, even though the contribution of the selected macro variables to the model performance is relatively small, a reasonable portion of variation in the RMB covered interest differential could be explained. The role of foreign exchange variables is suggestive of the link between the capital account policy and the performance of the RMB. Both our estimation results and anecdotal evidence show the feedback of the RMB market to China's capital control policy.

The autoregressive component represents a regular element of the RMB covered interest differential that is attributable to its own history though this element is not associated with the selected macroeconomic variables. One possible interpretation is the prominence of market stickiness and persistence that follow from China's gradualism approach to reform. The question is not whether to reform or not; the relevant questions are on the speed and the extent of the reform program. Thus, it warrants future study on economic factors of China's capital controls.

Appendix: Variable Definitions and Data Sources

S: RMB/USD spot rate; Source: Bloomberg
NDF : RMB non-deliverable forward against USD in 1 month maturity; Source: Bloomberg
i*: USD LIBOR 1 month interest rate; Source: Bloomberg
i: One month CHIBOR rate; Source: Bloomberg.
KF: the calculated China's capital flight in 100 million USD; stock data; Source:CEIC.
dRGDPG: monthly change (%) of real GDP. Quarterly nominal GDP is disaggregated to monthly level, deflated by the consumer price index, seasonally adjusted by the X12 method, and the monthly change in % calculated; Source of original series: CEIC.
dNEER : Monthly change (%) of the nominal effective exchange rate; Source: IMF
InflV: China's infalation volatility, calculated as the standard diviation of GARCH(1,1) conditional variance of inflation. Source of original series: CEIC
EV: Exchange rate volatility, calculated as standard deviation of the RMD exchange rate vs dollar during calendar month, last price, only trading days included. Source: Bloomberg
dI: monthly change (%) of merchandise imports to GDP; Source of original series CEIC.
dX: monthly change (%) of merchandise exports to GDP; Source of original series CEIC.
dVIX: monthly change (%) of VIX index; Source:Bloomberg.
dLENNDAT: monthly change (%) in the People’s Bank of China index of Lending attitudes by banks; Source CEIC.
dRR: monthly change (%) in the rediscount rate; Source: CEIC.
dRRR: monthly change (%) of the required reserve ratio; Source: CEIC.

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Table 1. Descriptive statistics

Variable	Obs	Mean	Std.Dev.	Min	Max	Skew	Kurtosis
S	160	7.6600	0.7299	6.2795	8.2800	-0.6200	1.6800
NDF	160	7.6523	0.7299	6.2975	8.3270	-0.6000	1.6600
CHIBOR	160	3.2206	1.4730	1.0000	9.9000	1.6400	6.4200
LIBOR	160	2.6091	2.1630	0.0606	6.6788	0.3400	1.6600
iNDF	160	1.4059	4.3187	-11.5710	16.8134	0.4900	3.9300
Y	160	1.8146	4.4581	-12.9634	13.9059	-0.2300	3.8200
FCOMP	160	0.9990	0.0032	0.9879	1.0108	-0.0800	4.8200
iCOMP	160	1.0005	0.0021	0.9964	1.0066	0.2700	2.7700

Note. Variables: CHIBOR=1 month CHIBOR rate (annualized); LIBOR=1 month USD LIBOR rate (annualized); S=RMB to USD spot exchange rate; NDF=1 month RMB non-deliverable forward exchange rate; iNDF=1 month NDF forward implied interest rate (annualized), Y=covered interest differential (annualized), FCOMP=foreign exchange component of Y; iCOMP=interest rate component of Y. Sources: see data appendix.

Table 2. Time Series Regressions: The RMB Covered Interest Differential

	(1)	(2)
Y_{t-1}	0.430***	0.249***
	(0.0945)	(0.0930)
Y_{t-2}	0.206*	0.0747
	(0.111)	(0.127)
Y_{t-3}	0.114	0.0659
	(0.0863)	(0.0870)
TREND	0.0137**	0.107***
	(0.00573)	(0.0360)
d2001m6		0.856
		(0.970)
d2005m7		-3.489**
		(1.337)
d2008m6		-6.032**
		(2.313)
Constant	-0.779	-6.001***
	(0.491)	(1.486)
Observations	157	157
adjusted R2	0.585	0.631

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: LN.Y =Nth lag of Y; dTmM=shift dummy for year T month M.

Table 3 Canonical Economic Determinants of the RMB Covered Interest Differential

	(1)	(2)	(3)	(4)	(5)
Y_{t-1}	0.221**	0.218**	0.267***	0.309***	0.329***
	(0.0990)	(0.0978)	(0.0948)	(0.0913)	(0.0879)
Y_{t-2}	0.104	0.104			
	(0.105)	(0.104)			
KF	-0.000353	-0.000352	-0.000449	-0.000321	
	(0.000279)	(0.000278)	(0.000287)	(0.000288)	
dRGDPG	-0.0120				
	(0.0678)				
dNEER	-0.478**	-0.480**	-0.428*	-0.410*	-0.440*
	(0.234)	(0.236)	(0.234)	(0.233)	(0.231)
InflV	0.173	0.176	0.257		
	(0.212)	(0.210)	(0.192)		
EV	41.02	40.63	43.87	55.26*	46.93*
	(27.72)	(27.41)	(28.62)	(31.20)	(25.92)
d2005m7	-3.770***	-3.789***	-3.830***	-4.053***	-4.190***
	(1.250)	(1.231)	(1.186)	(1.147)	(1.169)
d2008m6	-4.201***	-4.216***	-4.133***	-4.217***	-5.019***
	(1.514)	(1.504)	(1.415)	(1.462)	(1.253)
TREND	0.106***	0.106***	0.108***	0.110***	0.112***
	(0.0245)	(0.0241)	(0.0220)	(0.0222)	(0.0222)
Constant	-6.198***	-6.235***	-6.448***	-6.025***	-5.854***
	(1.313)	(1.282)	(1.130)	(1.160)	(1.148)
Observations	158	158	159	159	159
adjusted R2	0.651	0.654	0.645	0.642	0.640

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Models 1-4 estimated by 2SLS with KF instrumented by dOPEN, and model 5 by OLS.

Table 4 The RMB Covered Interest Differential Regression with Additional Variables

	(1)	(2)	(3)	(4)
Y_{t-1}	0.178*	0.178*	0.183*	0.181*
	(0.0941)	(0.0952)	(0.0955)	(0.0948)
dNEER	-0.470**	-0.510**	-0.523**	-0.514**
	(0.184)	(0.212)	(0.213)	(0.212)
EV	47.77**	48.60**	48.15**	47.78**
	(20.90)	(20.37)	(20.39)	(20.29)
d2005m7	-4.689***	-4.831***	-4.775***	-4.752***
	(1.137)	(1.175)	(1.170)	(1.181)
d2008m6	-5.159***	-5.258***	-5.233***	-5.239***
	(1.194)	(1.247)	(1.244)	(1.251)
TREND	0.124***	0.126***	0.125***	0.125***
	(0.0217)	(0.0226)	(0.0225)	(0.0227)
dI	0.0212	0.0227		
	(0.0157)	(0.0156)		
dX	-0.0317*	-0.0330*	-0.0118	
	(0.0177)	(0.0174)	(0.00926)	
dVIX	-0.0197			
	(0.0171)			
dLENDAT	-0.407**	-0.411**	-0.399**	-0.399**
	(0.160)	(0.162)	(0.160)	(0.158)
dRR	0.0699***	0.0613**	0.0619**	0.0632**
	(0.0266)	(0.0269)	(0.0283)	(0.0281)
dRRR	0.0907*	0.0868*	0.0807*	0.0828*
	(0.0515)	(0.0477)	(0.0487)	(0.0480)
Constant	-6.447***	-6.557***	-6.515***	-6.538***
	(1.080)	(1.138)	(1.138)	(1.146)
Observations	158	158	158	158
adjusted R2	0.689	0.684	0.683	0.683

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Models estimated by OLS

Table 5. Time Series Regressions – The Magnitude of the RMB Covered Interest Differential

	(3)	(4)	(5)
$\lvert Y_{t-1} \rvert$	0.323***	0.206*	
	(0.103)	(0.109)	
$\lvert Y_{t-2} \rvert$	0.148	0.0248	
	(0.0972)	(0.110)	
$\lvert Y_{t-3} \rvert$	0.150*	0.0493	
	(0.0872)	(0.0894)	
TREND	0.00528	0.0276	0.0143***
	(0.00476)	(0.0331)	(0.00491)
d2001m6		-3.076***	
		(1.043)	
d2005m7		-1.705	
		(1.211)	
d2008m6		-3.798**	
		(1.853)	
Constant	0.962**	2.546*	2.401***
	(0.447)	(1.322)	(0.488)
Observations	157	157	160
adjusted R2	0.255	0.290	0.0422

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6. Canonical Economic Determinants of the Magnitude of the RMB Covered Interest Differential

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\|Y_{t-1}\|$	0.242***	0.242***	0.242***	0.242***	0.243***	0.245***	0.248***	0.249***	0.289***
	(0.0895)	(0.0890)	(0.0904)	(0.0898)	(0.0901)	(0.0921)	(0.0920)	(0.0928)	(0.0864)
$\|Y_{t-2}\|$	0.113	0.114	0.114	0.114	0.116	0.106	0.107	0.106	
	(0.0907)	(0.0903)	(0.0897)	(0.0899)	(0.0892)	(0.0885)	(0.0885)	(0.0887)	
KF	2.92e-05	2.40e-05							
	(0.000272)	(0.000265)							
dRGDP	0.0354	0.0352	0.0350	0.0345	0.0373	0.0356	0.0362		
	(0.0595)	(0.0585)	(0.0578)	(0.0572)	(0.0565)	(0.0578)	(0.0588)		
dNEER	-0.130	-0.131	-0.128	-0.123	-0.110				
	(0.204)	(0.201)	(0.196)	(0.197)	(0.189)				
InflV	0.604***	0.607***	0.610***	0.609***	0.628***	0.628***	0.582***	0.579***	0.631***
	(0.211)	(0.197)	(0.198)	(0.197)	(0.193)	(0.194)	(0.175)	(0.174)	(0.162)
EV	14.17	13.41	14.00	11.82					
	(26.28)	(25.37)	(25.09)	(23.77)					
d2005m7	-0.0819								
	(1.065)								
d2008m6	0.149	0.173	0.242						
	(1.356)	(1.258)	(0.869)						
TREND	-0.00491	-0.00577	-0.00602	-0.00384	-0.00303	-0.00318			
	(0.0179)	(0.0101)	(0.00921)	(0.00537)	(0.00511)	(0.00512)			
Constant	1.402*	1.429**	1.418**	1.298***	1.241***	1.277***	1.064***	1.104***	1.209***
	(0.780)	(0.606)	(0.625)	(0.441)	(0.442)	(0.448)	(0.323)	(0.319)	(0.316)
Observations	158	158	158	158	158	158	158	158	159
adjusted R2	2.537	2.528	2.520	2.512	2.506	2.501	2.496	2.491	2.496

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 7. The Magnitude of the RMB Covered Interest Differential Regression with Additional Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\|Y_{t-1}\|$	0.263***	0.264***	0.266***	0.272***	0.274***	0.277***	0.286***
	(0.0896)	(0.0894)	(0.0893)	(0.0884)	(0.0880)	(0.0870)	(0.0871)
InflV	0.637***	0.636***	0.601***	0.602***	0.613***	0.605***	0.636***
	(0.186)	(0.186)	(0.170)	(0.169)	(0.177)	(0.173)	(0.162)
TREND	-0.00250	-0.00245					
	(0.00512)	(0.00506)					
dI	0.00411						
	(0.0138)						
dX	-0.0200	-0.0161*	-0.0161*	-0.0157*	-0.0160*	-0.0155*	-0.0148
	(0.0145)	(0.00920)	(0.00924)	(0.00916)	(0.00918)	(0.00904)	(0.00905)
dVIX	0.0127	0.0126	0.0128	0.0116			
	(0.0156)	(0.0155)	(0.0155)	(0.0151)			
dLENDAT	-0.215	-0.214	-0.220*	-0.200	-0.197	-0.152	
	(0.134)	(0.133)	(0.133)	(0.134)	(0.136)	(0.128)	
dRR	-0.0211	-0.0210	-0.0213				
	(0.0306)	(0.0305)	(0.0304)				
dRRR	-0.0563	-0.0574	-0.0619	-0.0656	-0.0625		
	(0.0816)	(0.0817)	(0.0814)	(0.0799)	(0.0828)		
Constant	1.610***	1.609***	1.452***	1.428***	1.412***	1.373***	1.239***
	(0.466)	(0.464)	(0.338)	(0.335)	(0.332)	(0.327)	(0.320)
Observations	158	158	158	158	158	158	159
adjusted R2	0.304	0.309	0.312	0.315	0.314	0.314	0.312

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 8. Asymmetric effect - The RMB Covered Interest Differential

	(1)	(2)	(3)
Y^{+}_{t-1}	0.162		0.156
	(0.108)		(0.108)
Y^{-}_{t-1}	0.173		0.193
	(0.175)		(0.189)
$dNEER^{+}_{t}$	-0.778		-0.765
	(0.486)		(0.496)
$dNEER^{-}_{t}$	-0.226		-0.253
	(0.307)		(0.316)
EV^{+}_{t}	70.06***		70.23***
	(24.67)		(26.65)
EV^{-}_{t}	475.0*		472.2*
	(256.0)		(258.2)
$dLENDAT^{+}_{t}$		-0.273	-0.306
		(0.238)	(0.256)
$dLENDAT^{-}_{t}$		-0.563**	-0.636**
		(0.277)	(0.307)
dRR^{+}_{t}		0.0573*	0.0542*
		(0.0300)	(0.0288)
dRR^{-}_{t}		0.0704	0.0696
		(0.0468)	(0.0513)
$dRRR^{+}_{t}$		0.0319	0.0488
		(0.103)	(0.100)
$dRRR^{-}_{t}$		0.127***	0.109**
		(0.0483)	(0.0445)
Observations	158	158	158
adjusted R2	0.686	0.679	0.681

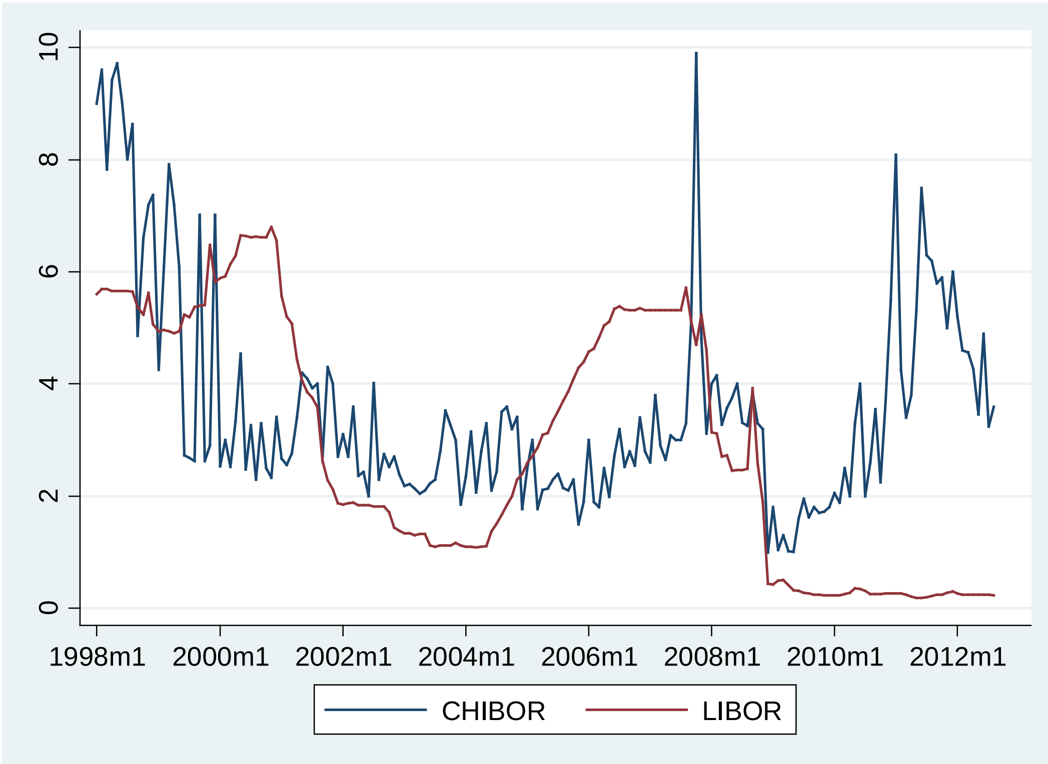
Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 9 Asymmetric effect - The Magnitude of the RMB Covered Interest Differential

	(1)	(2)	(3)
Y_{t-1}^{+}	0.153		0.148
	(0.109)		(0.108)
Y_{t-1}^{-}	-0.443**		-0.417**
	(0.189)		(0.193)
$InflV_{t}^{+}$	0.627***		0.626***
	(0.213)		(0.212)
$InflV_{t}^{-}$	0.564		0.456
	(0.500)		(0.498)
dX_{t}^{+}		-0.00997	-0.00947
		(0.0151)	(0.0153)
dX_{t}^{-}		-0.0262	-0.0281
		(0.0212)	(0.0213)
Observations	158	158	158
adjusted R2	0.295	0.288	0.296

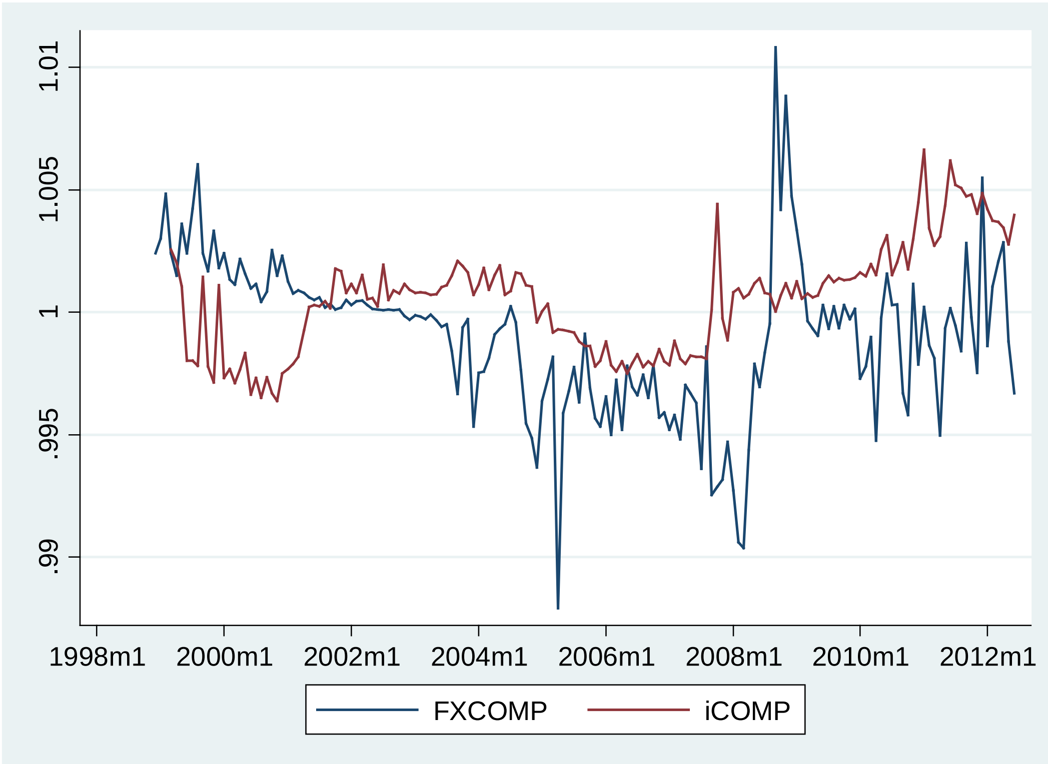
Note: Models estimated by OLS.

Figure 1 Chibor and Libor at 1 month maturity, %.



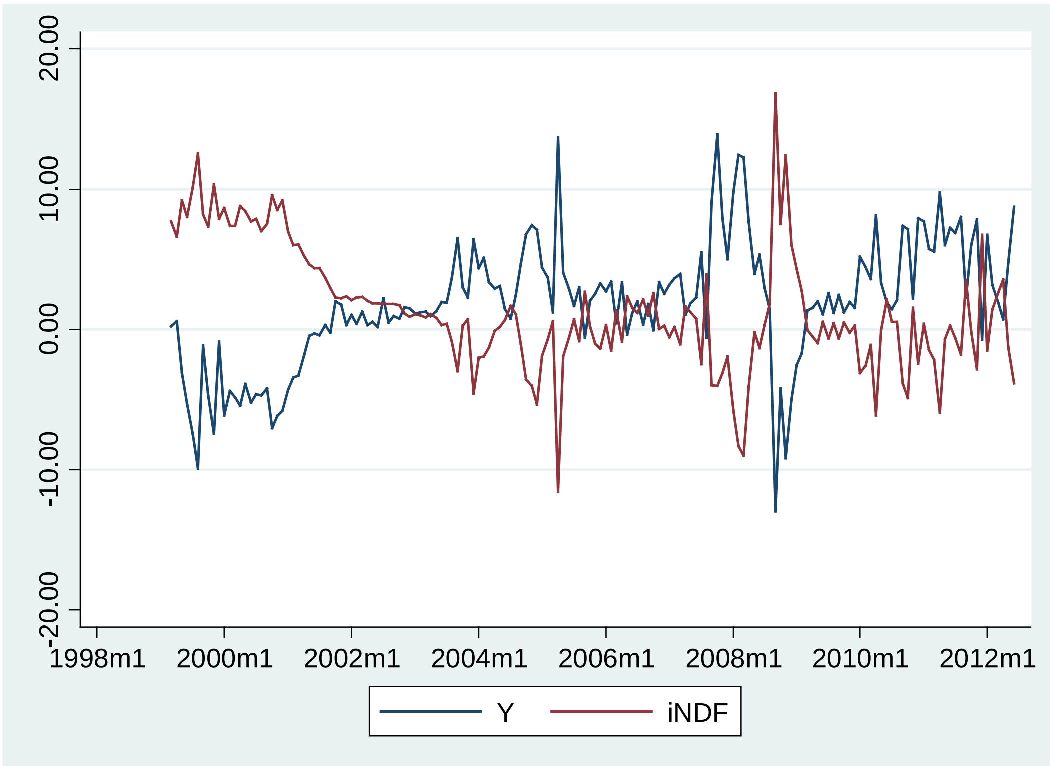
Note: Annualized rate, Source: Bloomberg.

Figure 3 The foreign exchange (FCOMP) and interest rate (iCOMP) components



Note: FCOMP=NDF/S, iCOMP=(1+CHIBOR/1200)/(1+LIBOR/1200). Data sources CEIC, Bloomberg.

Figure 2 The covered interest differential (Y) and the NDF implied interest rate (iNDF), %



Sources: CEIC, own calculations.