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The emergence of the RMB: A "New Normal" for China's exchange rate system?

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Abstract

We investigate RMB pricing differentials for onshore and offshore trading. Testing for long memory, we find strong persistence in the pricing differential. Hence, the Chinese FX market in its bipolar structure still lacks basic conditions for perfectly integrated markets.

JEL classification: F31, F33, G18, C58.

Keywords: CNY, CNH, RMB internationalization, Market integration, Emerging markets

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1. Introduction and institutional background

China's exchange rate policy has been criticized as an important element of the government's protectionist measures to improve the price competitiveness of its export firms (see Frankel and Wei, 2007). Lately, this debate's focus shifted to RMB internationalization (see Batten and Szilagyi, 2016) and the question whether the RMB will succeed the Greenback as the new global anchor currency (see Ito, 2010). Furthermore, the RMB recently gained importance as an international payment currency (see Cheung and Rime, 2014; Funke et al., 2015). However, it is still debatable how far internationalization has gone and whether the RMB has reached a *"New Normal"*.

We argue that one major impediment for RMB internationalization is the bipolar structure of China's FX market caused by the imperfect integration of on- and offshore markets. We test market integration using long memory tests – if both markets are perfectly integrated the underlying exchange rates should be (i) cointegrated (see Cheung and Rime, 2014) and (ii) the differential should be integrated of order zero ($I(0)$). Efficient markets also excludes a mean reverting but strong dependent spread ingrated of order d ($I(d)$) with $0 < d < 0.5$ because in this case the on- and offshore currencies would be cointegrated but priced differently and thus, they would not be perfectly integrated.

The impossible trinity - or *trilemma of international financial economics* - is important in this context (see Bluedorn and Bowdler, 2010). This rule states that a country cannot have a fixed exchange rate, free capital movements and an independent monetary policy. Cooper (1999) argued that it is still unclear what type of currency regime is appropriate for a specific country. It is well documented in the literature that this choice has implications for the monetary policy options (see Cooper, 1999). In the case of rigidly fixed exchange rates all but one central banks participating in this currency regime loose the opportunity to freely use the tools of monetary policy. In fact, the end of the Bretton Woods system was a direct consequence of hopes in some countries that a central bank freed from the need to stabilize the fixed exchange rate would be able to fight more effectively against inflationary pressures (see Basse, 2006; Gray, 2007). Freely floating exchange rates were quite popular in the 1980s and 1990s. However, more recently Calvo and Reinhart (2002) diagnosed a *"fear of floating"*. Moreover, some observers seem to believe that there are alternatives (e.g., dirty floating or target zones) that can help to combine the advantages of freely floating and absolutely fixed exchange rates (see Cooper, 1999; Masson, 2001). With regard to China it could be argued that the middle kingdom has found its own middle way to create at least some flexibility in a system of fixed exchange rates and to mask the lack of CNY convertibility. This special regime is based on the existence of two different exchange rates for one currency.

As a matter of fact, the birth of the offshore RMB in Hong Kong is highly relevant in this context (see Cheung and Rime, 2014). The special administrative region hosts a large FX market and belongs to China, but has its own political system: one country, two systems (see Meyer and Revilla Diez, 2015). And the same holds for the RMB: it is China's unique currency but its quotations are subject to the place where they are traded. On the mainland the quotation CNY is used, CNH is used for offshore trading. USD/CNY and USD/CNH are both rates for the exchange of RMB against USD at different trading locations: one currency, two quotations (see Shu et al., 2015). Although market participants are dealing with the same currency, a significant difference between the USD/CNH and USD/CNY exchange rate is observable (see Cheung et al., 2017a,b). With perfect arbitrage processes the law of one price obviously would predict that the CNH-CNY spread ought to be zero – at least statistically.

The paper is structured as follows. Chapter 2 introduces the data, an initial data analysis and the methodology of our empirical analysis. In Chapter 3 we present the empirical results. Chapter 4 concludes the paper.

2. Data, methodology and initial empirical analysis

We examine weekly data for the CNY spot rate as well as the CNH spot rate from January 1st 2011 to February, 10th 2017 taken from Bloomberg. Our sample ranges from the early days of the RMB offshore market up to the episode of the current RMB weakness and includes the shifts in Beijing's FX policy. We investigate USD/CNY and USD/CNH exchange rates and corresponding pricing differential. Economic theory implies that in a perfectly integrated market these two exchange rates ought to be identical with a spread of zero (see Barros et al., 2016). Since the spread is time dependent (see Figure 1) we examine whether the pricing differences occur systematically (see Craig et al., 2013).

Finding cointegration among the two exchange rates would imply convergence between these financial market prices. In fact, Becker and Hall (2007) argued that cointegration is a sign for convergence among non-stationary time series. As stated above, it makes sense to assume cointegration for the two FX quotations. More specifically, market efficiency should lead to cointegration among the prices of two almost identical financial assets (e.g. Alexander, 1999; Westerlund and Narayan, 2013). Despite the fact that capital controls might cause a non-zero spread, a long-term relationship between the USD/CNY and USD/CNH exchange rate should exist.

The existence of cointegration between the two FX rates is well documented in the literature (see Cheung and Rime, 2014). Therefore, the CNH-CNY-spread should be stationary

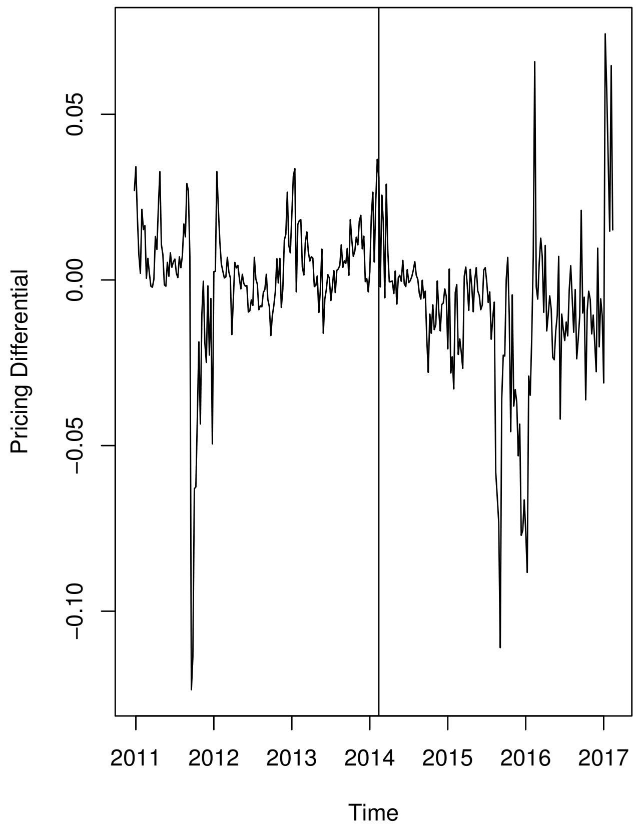

Fig. 1. The graph shows the pricing differential between the CNY and CNH quotations from January 2011 to February 2017. The vertical line indicates a potential break in the persistence on February 7th, 2014.

or integrated of order 0 ($I(d)$ with $d = 0$). Thus, we used recently developed techniques of time series analysis to produce additional evidence of relevance in this context. However, cointegration covers the case of two time series sharing a common stochastic trend and a stationary linear combination of both series ($I(d)$ with $0 \leq d < 0.5$).

In this case the spread (y_t) might also be strongly persistent (for $0 < d < 0.5$) and the assumption of perfectly integrated RMB on- and offshore markets would not be fulfilled. Thus, we estimate the degree of integration d and assume that the spread follows a fractionally integrated process of the form

$$\Phi(B)(1-B)^d y_t = \Psi(B)\epsilon_t \tag{1}$$

where all roots of the polynomials $\Phi(B)$ and $\Psi(B)$ are assumed to lie outside the unit circle and ϵ_t is independent and identically distributed with $E(\epsilon_t) = 0$, $sup_t E(\epsilon_t^2) < \infty$.

The degree of persistence $d \in [0, 0.5)$ determines the degree of integration of the spread and $(1-B)^d$ is defined by its binomial expansion

$$(1-B)^d = \sum_{j=0}^{\infty} \frac{\Gamma(j-d)}{\Gamma(-d)\Gamma(j+1)} B^j \tag{2}$$

with $\Gamma(z) = \int_0^\infty t^{z-1} e^{-t} dt$ and B as the Backshift operator, i.e. $By_t = y_{t-1}$.

To estimate the degree of persistence d we employ the local Whittle estimator (see Shimotsu and Phillips, 2005; Shimotsu, 2010). However, we want to test the hypothesis of $H_0 : d = \hat{d}$. Thus, we employ the Augmented Lagrange Multiplier (ALM) test by Demetrescu et al. (2008). The authors suggest a lag augmented version of the Lagrange multiplier test by Robinson (1991). This procedure is based on the regression

$$y_t = \phi y_{t-1}^* + a_1 y_{t-1} + a_2 y_{t-2} + ... + a_p y_{t-p} + \varepsilon_t \text{ for } t = p+1, ..., T \tag{3}$$

with $y_{t-1}^* = \sum_{j=1}^{t-1} \frac{y_{t-j}}{j}$, p as the number of lags in the augmentation, which grows with the sample size, and ε_t as an innovation process. The authors retain limiting normality of the t_ϕ-statistic, which is used to test the null hypothesis $H_0 : \phi = d = 0$. However, we use the estimation result of the local Whittle estimator to use $\hat{d}$th differences of the spread. By using this procedure we are able to test $H_0 : d = \hat{d}$.

Furthermore, we are particularly interested in whether d remains constant over time. Thus, we use the methodology proposed by Sibbertsen and Kruse (2009) to test the hypothesis

$$H_0 : d = d_0, \ \forall \ t \text{ vs. } H_1 : \begin{cases} d = d_1 \text{ for } t = 1, ..., [\tau T] \\ d = d_2 \text{ for } t = [\tau T]+1, ..., T \end{cases} . \tag{4}$$

Here, $[\tau T]$ denotes the biggest integer smaller than τT with τ as the relative breakpoint estimator and T as the number of observations.

The authors restricted $0 \leq d_0 < \frac{3}{2}$ under H_0 and $0 \leq d_1 < \frac{1}{2}$ and $\frac{1}{2} \leq d_2 < \frac{3}{2}$ under the alternative. Moreover, d_1 and d_2 can be exchanged, so a break from stationary to non-stationary long-memory and vice versa can be investigated. Thus, we test against a break in the persistence in the spread using the estimated d under the null hypothesis by the local Whittle estimator.

Thus, our procedure works in three steps:

1. Estimating the persistence parameter d by the local Whittle estimator. The estimated counterpart is indicated by $\hat{d}$
2. Testing the Hypothesis of $H_0 : d = 0$ and $H_0 : d = \hat{d}$ against the fractional alternatives
3. Testing against a break in the persistence

3. Empirical results

We start our empirical analysis by considering the autocorrelation function in Figure 2. The

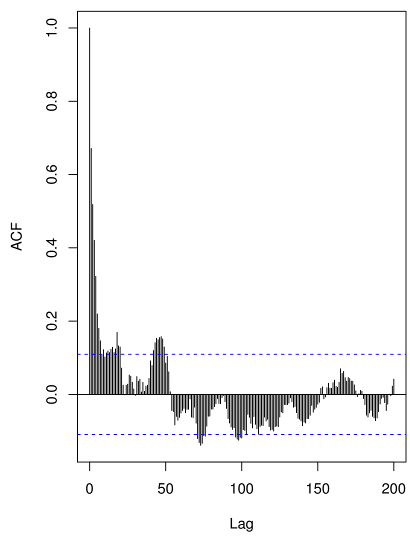

Fig. 2. The graph shows the autocorrelation function of the pricing differential for the full sample with 200 lags (approx. 4 years).

graph shows the autocorrelation of the spread. By considering the function it seems that it declines quite slowly which might be a first indication for strong dependence.

We then estimate the degree of persistence d employing the local Whittle estimator ($\hat{d}$) and draw inference about d considering the results of the test by Demetrescu et al. (2008). For the estimation of d we use two different bandwidths: $m = T^{0.55}$ ($\hat{d}_{0.55}$) and $m = T^{0.70}$ ($\hat{d}_{0.70}$). For the ALM test by Demetrescu et al. (2008), we simulate critical values for the test version with recursive de-meaning for the small sample of 320 observations. We use $100,000$ steps within the Monte Carlo simulation. See Table 1 for the results.

	$\hat{d}_{0.55}$	$\hat{d}_{0.70}$	
Whittle estimation	0.30	0.48	
	$H_0 : d = 0$	$H_0 : d = \hat{d}_{0.55}$	$H_0 : d = \hat{d}_{0.70}$
ALM	1.16*	-0.26	-1.09

Table 1: This table reports the results of the estimation of d as well as the results of the ALM test. We use simulated critical value with $100,000$ test replications for the version of the test using the recursive de-meaning. The critical value are 1.05 (1%), 1.43 (5%), 2.10 (10%).

The results support the hypothesis of a strongly dependent spread and we must reject the null hypothesis of $d = 0$ on a significance level of 10% while we cannot reject the hypotheses of $d = \hat{d}_{0.55}$ and $d = \hat{d}_{0.70}$.

Furthermore, we are interested whether the persistence is stable over time. To test against a break in the persistence we use the test proposed by Sibbertsen and Kruse (2009). All results are reported by Table 2.

τ_{low} τ_{up}	0.2 0.8	0.4 0.6
$d_0 = \hat{d}_{0.55}$	Cannot reject H_0 -	Increasing Persistence February 7th, 2014
$d_0 = \hat{d}_{0.7}$	Cannot reject H_0 -	Increasing Persistence February 7th, 2014

Table 2: This table reports the results of the structural break test by Sibbertsen and Kruse (2009). Here, we consider two cases concerning the choice of τ_{low} and τ_{up}.

We find results in favor of a break for a combination of $\tau_{low} = 0.4$ and $\tau_{low} = 0.6$ – that means we allow in this particular example for a break from observation $0.4T$ to $0.6T$. However, if we set $\tau_{low} = 0.2$ and $\tau_{low} = 0.8$ we cannot reject the null hypothesis. Thus, even if we find indication for a break the persistence increases – this gives even more support for the finding that China's FX markets are far away from being perfectly integrated.

To summarize our empirical results: We find evidence for a strong dependent pricing differential – which does not support that the CNH and CNY quotations are integrated.

Furthermore, by investigating potential structural breaks we find no support for decreasing persistence at all – which underlines the result that the *"New Normal"* of China's FX markets is not reached. Figure 3 and Figure 4 show also indications for strong dependence before and after the break point. Our results confirm earlier findings in the literature in the sense that financial market practitioners have to consider basis risk when hedging CNY exposure with CNH contracts (see Craig et al., 2013).

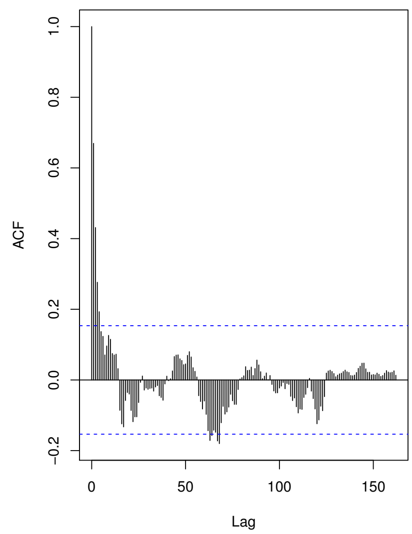

Fig. 3. The graph shows the autocorrelation function of the pricing differential until the break point (February 7th, 2014) sample with 163 lags (approx. 3 years).

4. Conclusions

We examine the CNH-CNY pricing differential and document empirical evidence for cointegration. This result can be seen as an indication for ongoing arbitrage processes between the onshore and the offshore market. However, we also show that the spread contains strong persistence. Even by testing against a break in the persistence we find no indications that the two time series have become more integrated over time. Regarding the present state of the Chinese FX market these results have to be seen as empirical evidence that the RMB has not reached its *"New Normal"* yet. Our findings show a substantial weakness of the *"one currency, two quotations approach"*. The enduring CNH-CNY pricing differential reduces the effectiveness of the offshore RMB as an hedging tool. Hence, Beijing's monetary policy makers may benefit from the special architecture of a neither fixed nor floating FX

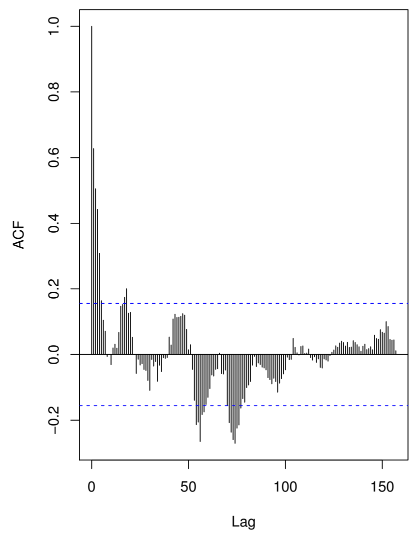

Fig. 4. The graph shows the autocorrelation function of the pricing differential after the break point (February 7th, 2014) sample with 157 lags (approx. 3 years).

regime. However, the bipolar structure of China's FX markets generates substantial challenges. Speculators, for example, have been utilizing the Hong Kong market to bet against the RMB (see Neely, 2017). Prevailing pricing differentials between the two FX rates made substantial interventions both on the mainland and in the offshore market necessary and demonstrated the costs of a managed float with two exchange rates.

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