

Predicting RMB exchange rate out-of-sample: Can offshore markets beat random walk?

By Chen Sichong

School of Finance, Zhongnan University of Economics and Law

Dec 14, 2015 at RIETI, Tokyo, Japan

Motivation

- It is widely accepted that exchange rates are difficult to predict, at least since the seminal work of Meese and Rogoff (1983a, 1983b).
- The results seem to be mixed, depending on the choice of predictor, model specification, country, data type, sample period, forecast horizon (Frankel & Ross (1995), Della Corte & Tsiakas (2012) and Rossi (2013)).
- Since the evidence for the predictive models to beat random walk is still limited, the debate on **Meese and Rogoff puzzle** continues to exist, especially over short horizons.

Motivation

- However, **few studies** have paid attention to investigate the predictability of RMB exchange rates.
- The RMB was not freely floating and convertible to major currencies, and China's capital account was strictly controlled.
- Changes since the overhaul the RMB's exchange rate regime since 2005, and accelerated by the implementation of RMB internationalization strategy around 2009.
- Studies focused on the predictability of RMB exchange rates thus should be of great interest to the finance community.

Research Questions

- 1. Can we predict RMB exchange rate (both CNY and CNH) out-of-sample using information from the offshore markets?
- 2. Investigate the reasons of possible discrepancy between in-sample fit and out-of-sample performance.
- 3. Explore whether or not the predictive performance can be improved if we impose restrictions suggested by economic theory.

Literature

- Earlier studies on RMB rate forecasting were focused on the evaluation of RMB **misalignment** (Chang, 2004; Zhang and Pan, 2004; Wang et al, 2007; Cheung et al, 2007).
- Some studies (Cai et al (2012)) compare alternative **time-series models** of RMB exchange rate forecasting.
- But, we are interested in the **predictive information content of offshore market**.
- Although there is only one currency in China (called RMB), the onshore and offshore environments for trading RMB are largely insulated one from another, causing the emergence of two distinct markets for RMB transactions.
- Both academics and practitioners therefore tend to use a wedge between onshore markets and offshore markets to gauge the future movement of RMB exchange rate.

Literature

- Our study is more related to the two recent studies (Cheung & Rime 2014, Tong et al, 2015)
- Tong et al (2015) find some out-of-sample predictive power of NDF on CNY exchange rate at short maturity before 2013.
- Traditionally, the NDF was showed to be a useful indicator (e.g., Mackel et al, 2011; McCauley, 2011). However, as the establishment of CNH market, the deviations between NDF and CNY quickly lose its predictive power.
- Cheung and Rime (2014) find significant interactions between CNY and CNH rates, in which CNH rather than CNY adjust to deviations on average. They also compared the out-of-sample performance of CNY, CNH, and order flows in predicting central parity rate.
- We focus on the out-of-sample performance of CNH-CNY deviation in predicting CNY and CNH.

Preview contributions

- This study evaluates the in-sample and out-of-sample RMB forecasting with CNH-CNY deviation.
- We find **significant evidence of in-sample fit of conditional models at short horizons**. But, **both CNY and CNH forecasts based on CNH-CNY spreads do not work well out-of-sample**.
- In particular, we compare forecasts in which one estimates a conditional predictive regression using data up to time with forecasts using an unconditional model of random walk in the same period.
- However, our results reveal that the poor performance in predicting CNH rate changes are almost entirely driven by **an unexpected event**: the PBC announcement on improving quotation of the central parity of RMB in Aug. 11, 2015.
- Finally, we show that predictive regressions using CNH-CNY spreads can beat random walk even in the CNY market, as long as we impose **restrictions on the signs of slope coefficients to rule out implausible forecasts**, or **removing noises from the predictor based on moving threshold values**.

Table 1: Key facts of the onshore and offshore markets

Label	Trading	Regulation	Participants	Establishment
CNY	Onshore RMB; CFETS trading.	Regulated by PBC: daily floating band; central rate parity; direct intervention.	Onshore and permitted offshore investor	Reformed in 2005.7; Restart the reform since 2010.6
CNH	Offshore deliverable RMB; OTC trading	Mostly liberalized, Under supervision of HKMA with PBC	Offshore investor	Since 2010.7
NDF	Offshore USD settled Non-deliverable RMB OTC, fix on CNY	Unregulated	Offshore investor	Long before CNH

Table 2: Descriptive Statistics

	Mean	Stdev	Median	Min	Max	Skew	Kurt
Δ CNY	-0.0036	0.1245	-0.0048	-0.6091	1.8097	3.0929	46.055
Δ CNH	-0.0006	0.1816	-0.0149	-1.0418	3.0142	5.0938	77.238
CNH-CNY	0.0003	0.0028	0.0000	-0.0062	0.0203	2.4049	10.243
Spread		w/o	w/		Daily	Weekly	Monthly
	Unit-root tests	-7.15	-7.20	AR(1) Persistence	0.90	0.65	0.56

Note: Unit-root tests are the Augmented Dickey-Fuller test for the absence of a unit root. An ADF value of -3.5 rejects the presence of a unit root at the 1% level. “w/o” and “w/” represent ADF tests with and without a constant term, respectively.

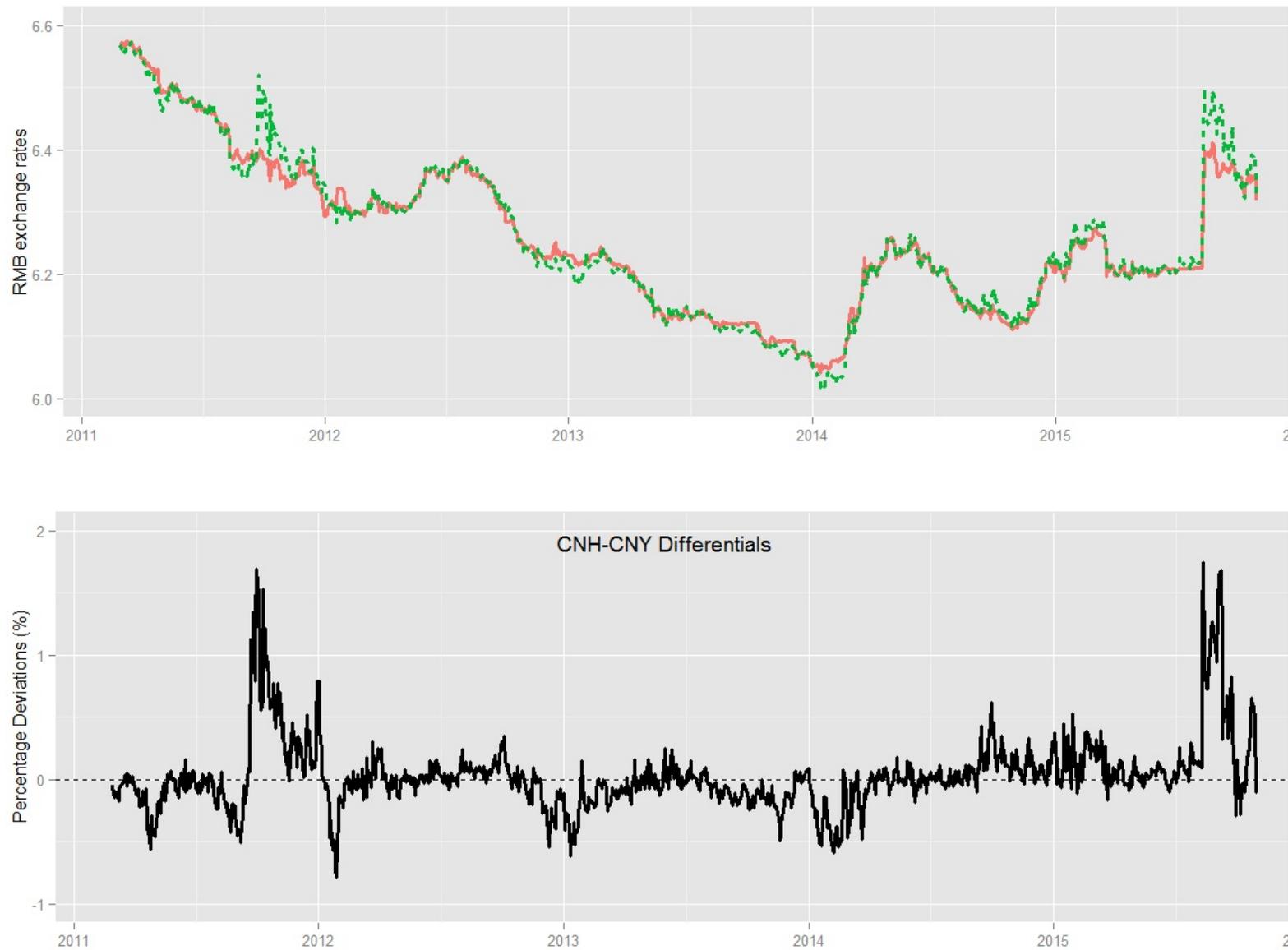


Fig. 1: RMB exchange rates and CNH-CNY spread. The top panel displays the movement of both CNH (dotted line) and CNY (solid line) RMB exchange rate over the sample period from March 2011 to October 2015. The bottom panel shows the CNH-CNY spread over the same period.

Data

- All of our RMB exchange rate data used in this study are quotes from the dataset of the WM/Reuters Historic Rate Data, compiled by WM/Reuters, disseminated by Datastream.
- In addition to the original daily data series, we also convert the daily data into weekly (monthly) data by sampling the data on the last trading day of each week (month).
- Among all the RMB exchange rates, the CNY series of RMB against US Dollar can date back as far as to 1994. However, the newly created CNH series included in Datastream for spot rates of RMB against US Dollar starts only at February 28, 2011.
- We therefore report the baseline results based on the sample period since March, 2011, to the up-to-date available data of October, 2015.

Predictive regressions with CNH-CNY spreads

- The main predictor examined in this study is the deviation between onshore RMB spot rates and the RMB spot rates in the newly created deliverable offshore market.
- The CNH could be viewed as an implied free-market-trading determined RMB rate in the offshore market for the onshore RMB exchange rate.
- We **hypothesize** that a positive deviation of CNH relative to CNY rate can predict CNY RMB exchange rate depreciation or/and CNH RMB exchange rate appreciation in the future, and vice versa.
- Since the CNH-CNY spread is stationary, so that the CNH and CNY rates are co-integrated. In the context of co-integration, our predictive regressions for changes in CNH and CNY market could be viewed as a form of error-correction model.

Table 3: In-sample univariate forecasts using the CNH-CNY spread

CNH-CNY	Intercept	Slope	R^2	s.e.	N
Panel A: Forecasting CNY changes					
Daily	-0.004	3.233	0.53	0.124	1105
	(-1.18)	(2.42)			
	[-1.23]	[1.64]			
Weekly	-0.017	2.635	0.08	0.294	243
	(-0.89)	(0.44)			
	[-0.92]	[0.58]			
Monthly	-0.057	-11.571	0.25	0.546	55
	(-0.773)	(-0.36)			
	[-0.774]	[-0.39]			
Annually	-0.770	-84.633	0.64	2.136	44
	(-2.384)	(-0.518)			
	[-0.050]	[-0.522]			
Panel B: Forecasting CNH changes					
Daily	-0.001	-7.173	1.4	0.178	1105
	(-0.15)	(-4.14)			
	[-0.16]	[-2.03]			
Weekly	-0.004	-32.29	6.7	0.387	243
	(-0.16)	(-4.14)			
	[-0.16]	[-4.27]			
Monthly	-0.041	-50.555	3.3	0.648	55
	(-0.476)	(-1.34)			
	[-0.488]	[-1.37]			
Annually	-0.746	-175.367	2.4	2.28	44
	(-2.167)	(-1.008)			
	[-0.119]	[-0.203]			

Note: This table presents the forecasting results of RMB exchange rate changes using the CNH-CNY deviations as the sole predictor. We report results at both daily, weekly, monthly, and annual horizons. The first row of each forecasting exercise is the coefficients; the second row is the corresponding OLS t-statistic; the third row is the heteroscedasticity-autocorrelation robust t-statistic. Since we are using monthly overlapping observations of annual data, we report the Newey-West adjusted t-statistic with 12 lags for annual horizons. The s.e. is the standard error of

Out-of-sample CNY forecasting

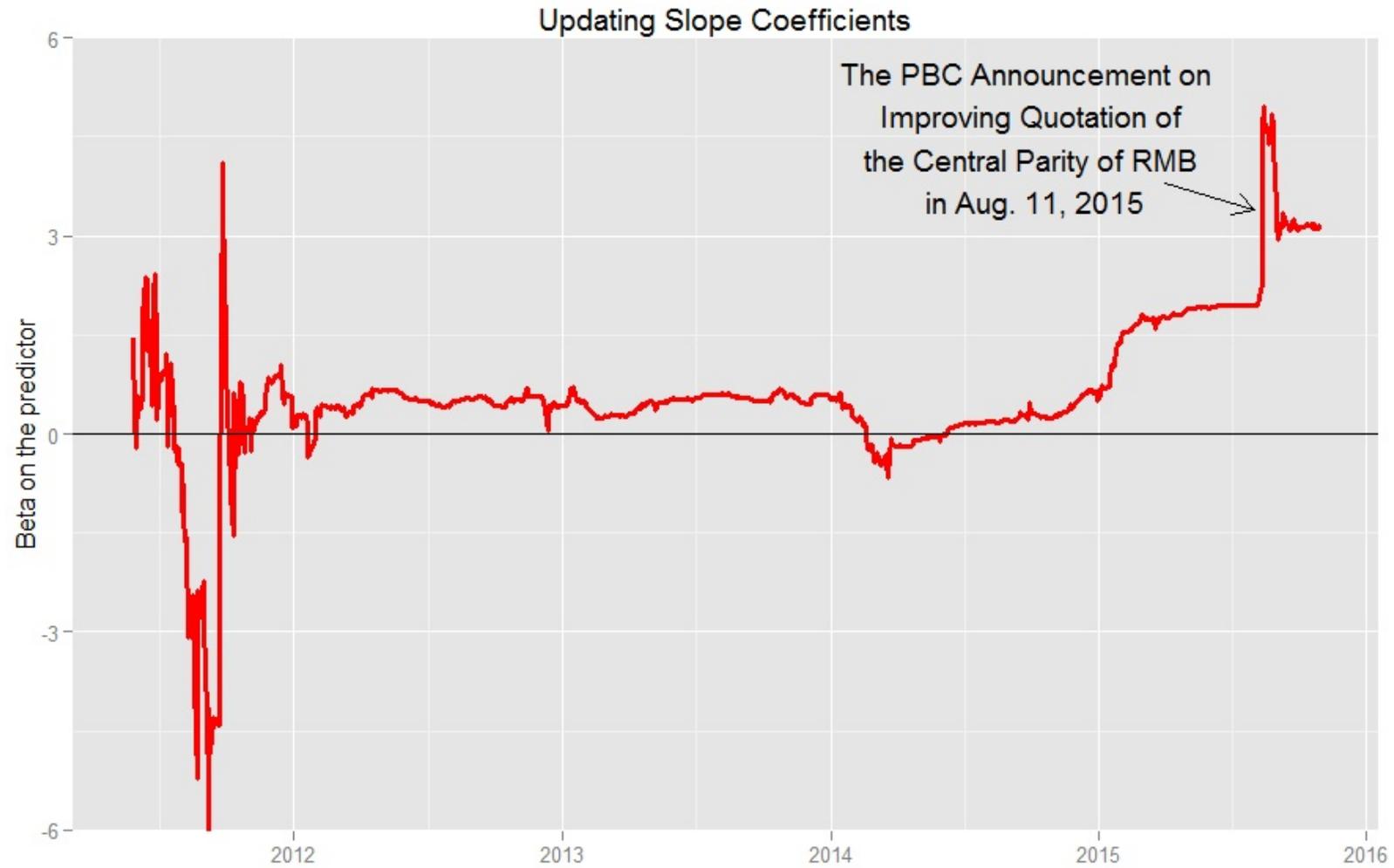


Fig 2: Updating slope coefficients of CNY prediction. This figure plots the recursive slope coefficient estimates in a predictive regression of CNY changes on CNH-CNY spreads using only up to date information.

Out-of-sample CNY forecasting

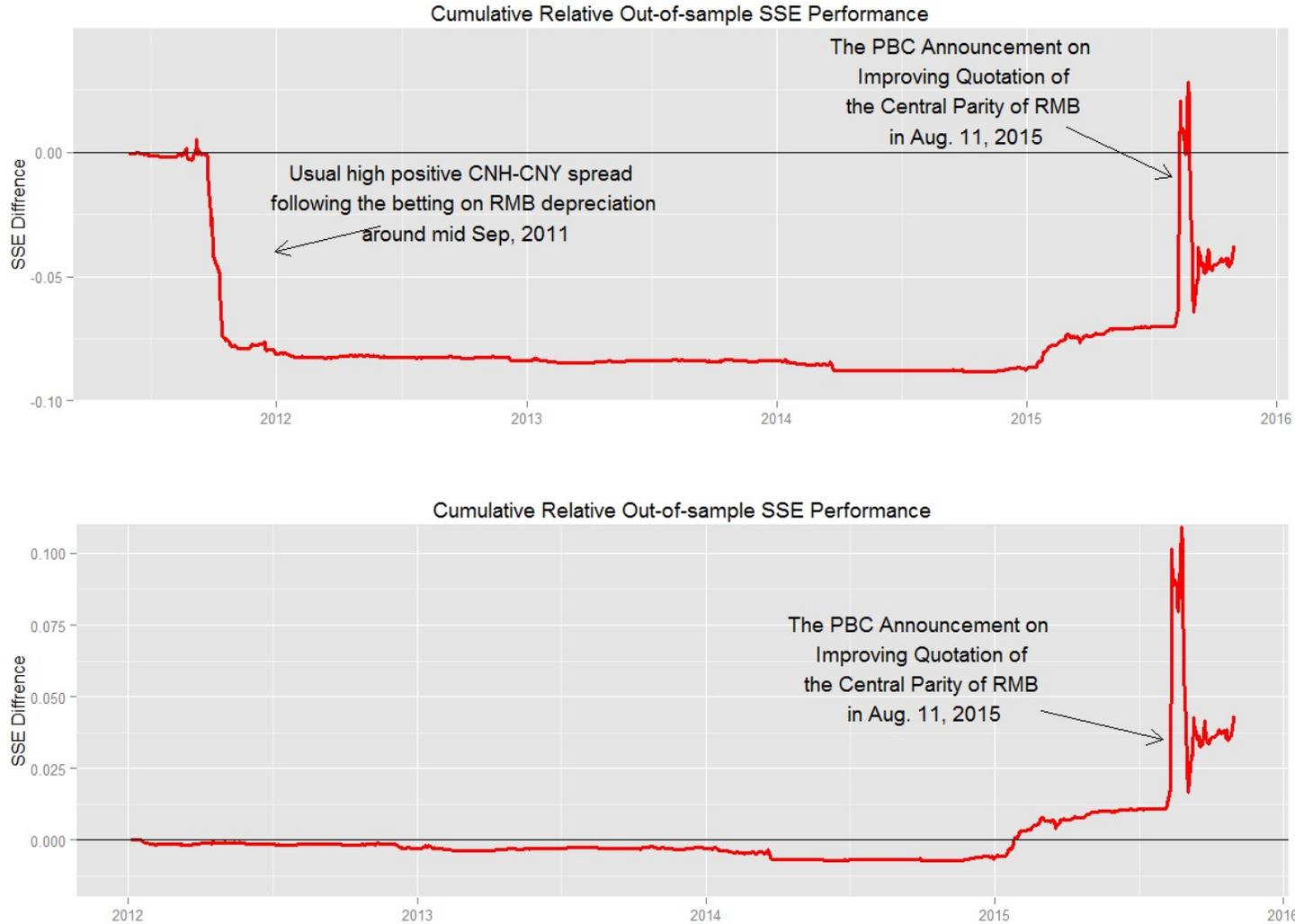


Fig 3: Cumulative relative out-of-sample sum-squared error performance of CNY prediction. The top panel plots the SSE performance using 60 data points as the initial estimation period, while the bottom panel plots the benchmark results that start evaluation from 2012.

Table 4: Out-of-sample statistics

	R_{oos}^2	RMSE			MAE		
		U	C	Δ	U	C	Δ
Panel A: CNY							
Plain (L)	-0.0023	0.1267	0.1268	-0.0001	0.0778	0.0781	-0.000
Plain (B)	0.0030	0.1268	0.1266	0.0002	0.0757	0.0758	-0.000
Panel B: CNH							
Plain (L)	-0.0157	0.1826	0.1840	-0.0014	0.1016	0.1004	0.012
Plain (B)	0.0054	0.1701	0.1697	0.0004	0.0948	0.0932	0.001
Plain (EX)	0.0212	0.1614	0.1597	0.0017	0.0913	0.0895	0.001

Note: This table reports the out-of-sample statistics (R_{oos}^2 , RMSE, and MAE) based on prediction errors from a null of unconditional model of random walk with drift, and an alternative conditional model of CNH-CNY spreads. Both models use only prevailing up-to-date data. The sample period is from March 2011 to October 2015. A positive (negative) number of R_{oos}^2 , Δ RMSE or Δ MAE indicate that our conditional model of CNH-CNY has better (worse) predictive power than the unconditional random walk model. “B” represents the benchmark case, “L” denotes the evaluation for a longer period; “EX” is a special case for CNH out-of-sample forecasting evaluation that exclude from the benchmark results the one-month data points starting at Aug. 12, 2015 following the PBC announcement on improving quotation of the central parity of RMB.

Out-of-sample CNH forecasting

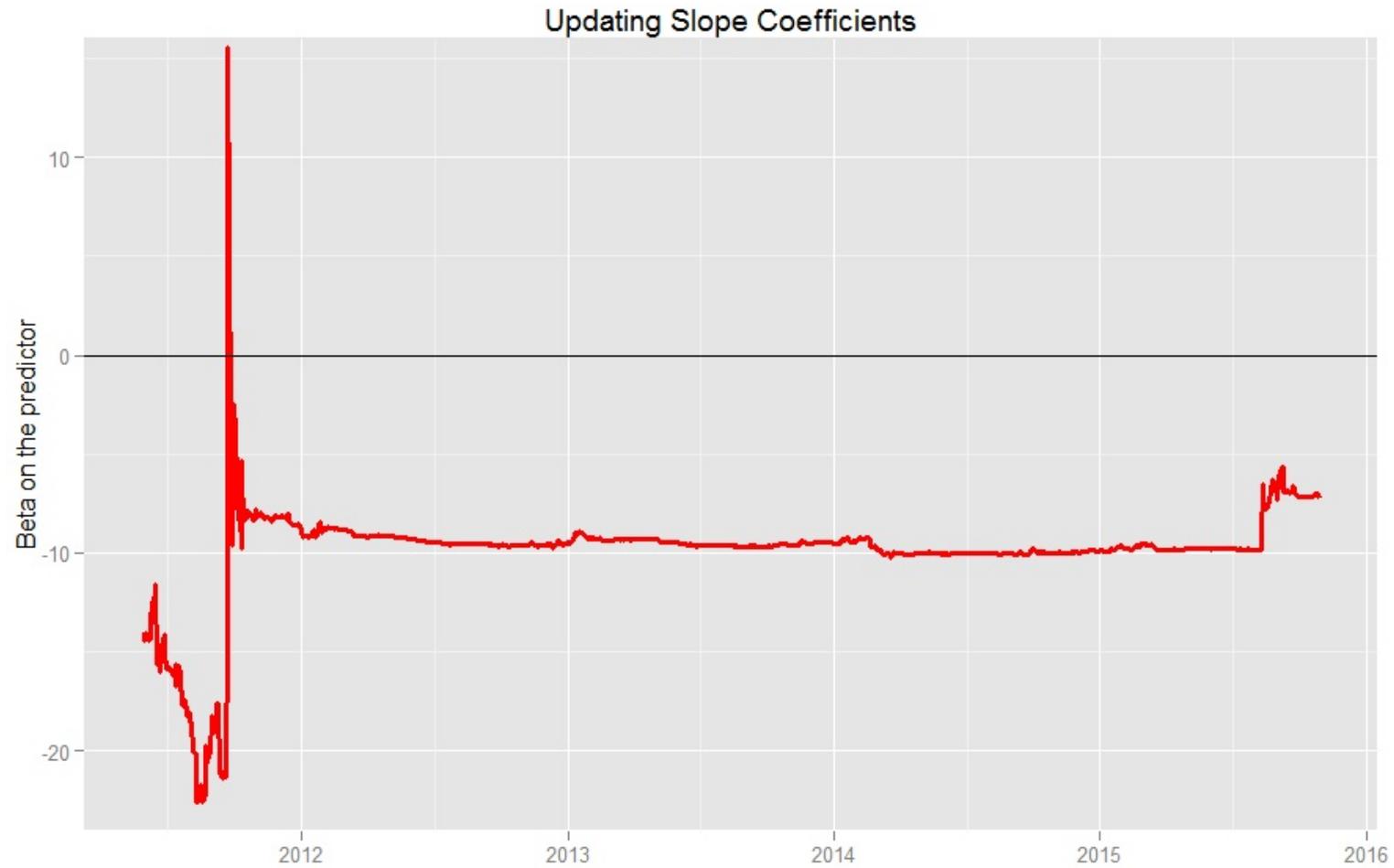


Fig 4: Updating slope coefficients of CNH prediction. This figure plots the recursive slope coefficient estimates in a predictive regression of CNY changes on CNH-CNY spreads using only up to date information.

Out-of-sample CNH forecasting

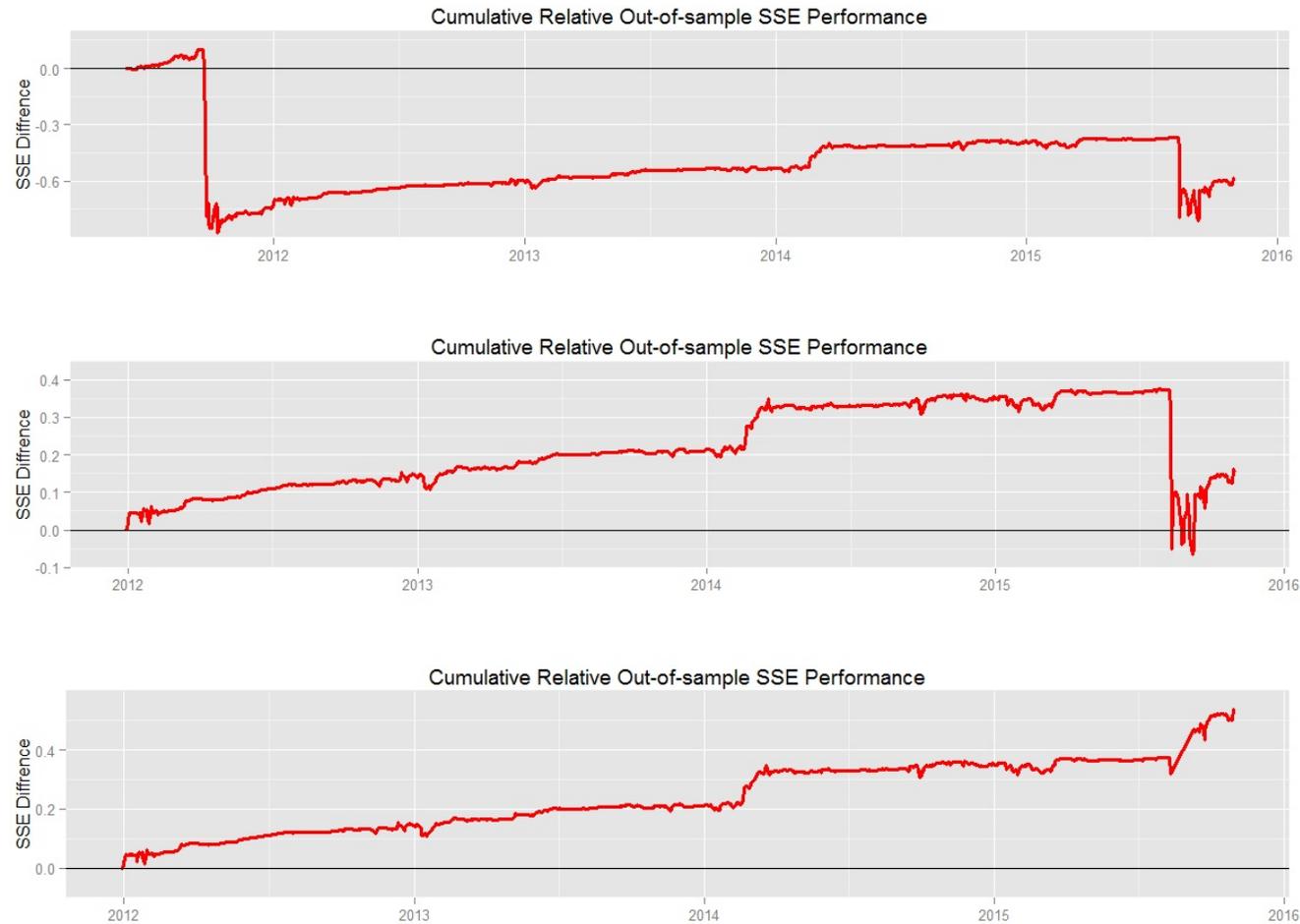


Fig 5: Cumulative relative out-of-sample sum-squared error performance of CNH prediction. The top panel plots the SSE performance using 60 data points as the initial estimation period. The middle panel plots the benchmark results that start evaluation from 2012. The bottom panel further exclude one-month sample from the benchmark results (starting from Aug. 12, 2015 following the PBC announcement on improving quotation of the central parity of RMB) in out-of-sample evaluation.

Out-of-sample forecasting by imposing sign restrictions

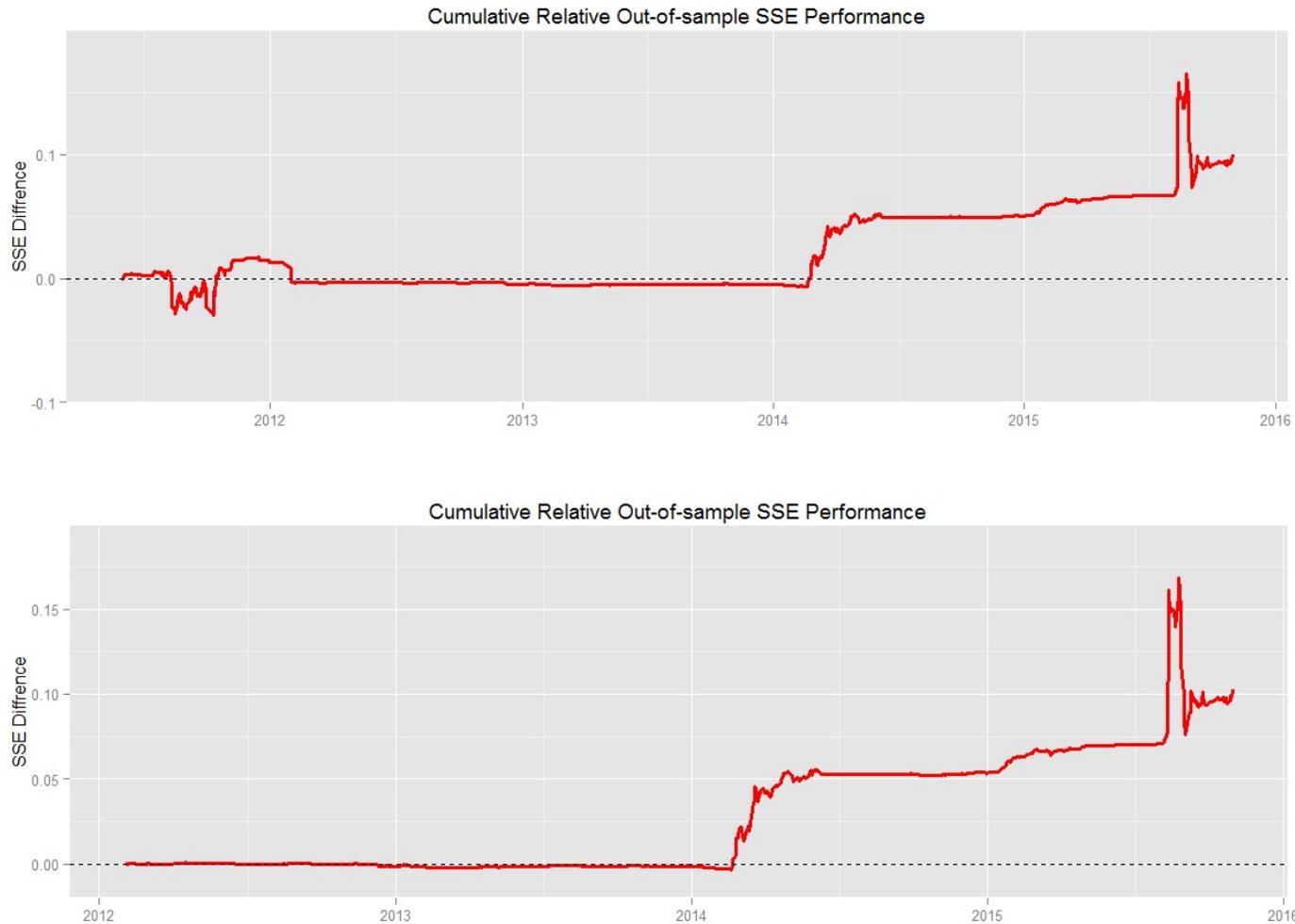


Fig 6: Cumulative relative out-of-sample sum-squared error performance of CNY prediction by imposing restrictions on predictive coefficients. The top panel plots the SSE performance using 60 data points as the initial estimation period, while the bottom panel plots the benchmark results that start evaluation from 2012.

Out-of-sample forecasting by removing “noise”

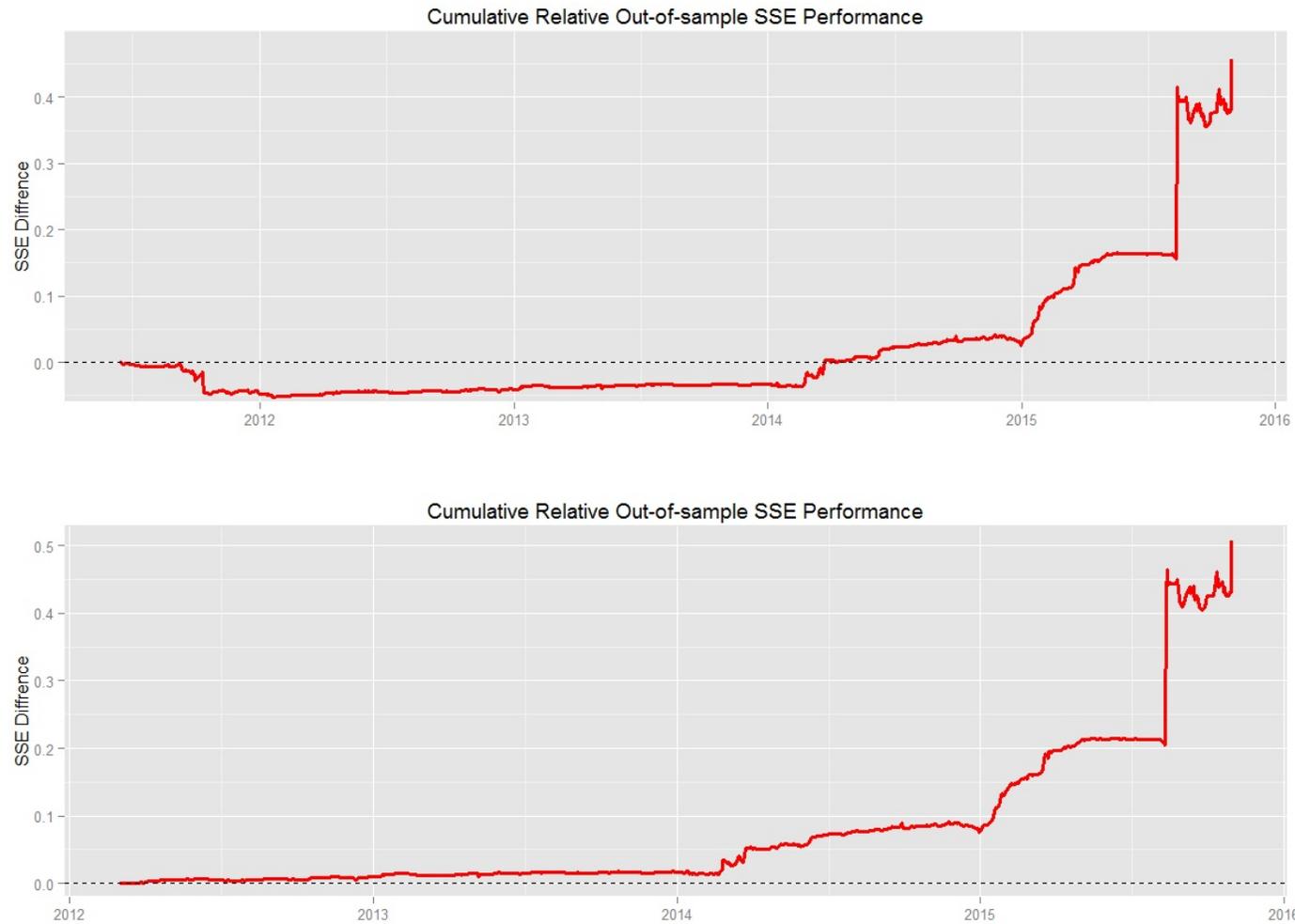


Fig 6: Cumulative relative out-of-sample sum-squared error performance of CNY prediction by removing a moving average threshold from the predictor. The top panel plots the SSE performance using 60 data points as the initial estimation period, while the bottom panel plots the benchmark results that start evaluation from 2012.

Table 5: Out-of-sample statistics of CNY forecasting with restrictions

	R_{oos}^2	RMSE			MAE		
		U	C	Δ	U	C	Δ
Panel A: Sing restrictions							
Slope constraints (L)	0.0060	0.1267	0.1262	0.0004	0.0778	0.0777	0.0001
Slope constraints (B)	0.0073	0.1268	0.1257	0.0010	0.0757	0.0749	0.0008
Panel B: Removing threshold value							
Threshold (L)	0.0273	0.1271	0.1253	0.0018	0.0781	0.0772	0.0009
Threshold (B)	0.0363	0.1272	0.1249	0.0023	0.0755	0.0743	0.0012

Note: This table reports the out-of-sample statistics (R_{oos}^2 , RMSE, and MAE) of CNY forecasting with restrictions based on a null of unconditional model of random walk with drift, and an alternative conditional model of CNH-CNY spreads. Both models use only prevailing up-to-date data. The sample period is from March 2011 to October 2015. A positive (negative) number of R_{oos}^2 , Δ RMSE or Δ MAE indicate that our conditional model of CNH-CNY has better (worse) predictive power than the unconditional random walk model. Panel (A) reports statistics by introducing the restriction that the coefficients on our predictor of CNH-CNY spreads must be of the “correct” sign, otherwise the slope coefficients are set to zero instead. Panel (B) reports results by removing a threshold calculated as a two-week moving average from the “noise” predictor of CNH-CNY spread. “B” represents the benchmark case, “L” denotes the evaluation for a longer period.

Concluding remarks

- CNH-CNY spreads can deliver **better out-of-sample performance** than random walk in predicting future RMB rate changes at short horizons.
- But, we need to:
- for CNH forecasting, exclude unexpected event: the PBC announcement on improving quotation of the central parity of RMB in Aug. 11, 2015.
- for CNY forecasting, 1). impose restrictions on the signs of slope coefficients to rule out implausible forecasts, or 2). removing noises from the predictor based on moving threshold values.
- As long as the coexistence of onshore and offshore markets and the restrictions on capital flows between them continue, the arbitrage opportunities between them seem to prevail in the future.
- Arbitrages in CNY and CNH markets depend on the degree of interventions in CNY.

Thank you!