The Renminbi Central Parity: An Empirical Investigation

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1. Introduction

Why RMB Central Parity?

- Growing importance of the RMB
- Indicative of policy intentions

Revamp the formation mechanism (August 11, 2015)

- Market forces
  - Previous day's closing
  - Demand and supply
  - Valuation of other major currencies
- IMF endorsement

Accompanying depreciation

- 1.9% (the first day)
- 4.4% (the first three trading days)

Market Responded vigorously

Capital outflows; amplified equity market fluctuations

Interventions in onshore and offshore markets

Communication problems, or

Ability to manage, or

Reform commitment, or

Disguised currency war

Even before 2015

Debates on RMB valuation

Globalized RMB

Central Parity (*à la* official fixing)

Foreign exchange policy; liberalization process

The current study

- Empirical RMB central parity formation process
  - Roles of CNH, CNY, and US$, other macro variables
- Before and after the 2015 policy change
  - Changes in determining factors
- In-sample fitting
- Forecast comparison

2. Exchange Rate Policy – A Recap

Since 1979

Long – and still ongoing – liberalization process

1979 to 1993

Dual exchange rate arrangements

1994 -2005

A unified rate

Trading band

±0.3%; ±0.5% (May 07); ±1 % (Apr 12); ±2 % (Mar,14)

July 2005

Managed and regulated floating regime

Demand and supply, basket of currencies

de facto RMB movements; targeting the US$, crawling peg

July 2008 to June 2010

Stable exchange rate policy

June 2010

- "Reverted" back to the 2005 approach

July 2010

- CNH

August 2015

- Revamp the central parity formation mechanism
  - Previous day's closing
  - Market demand and supply
  - Valuation of other major currencies

November 2015

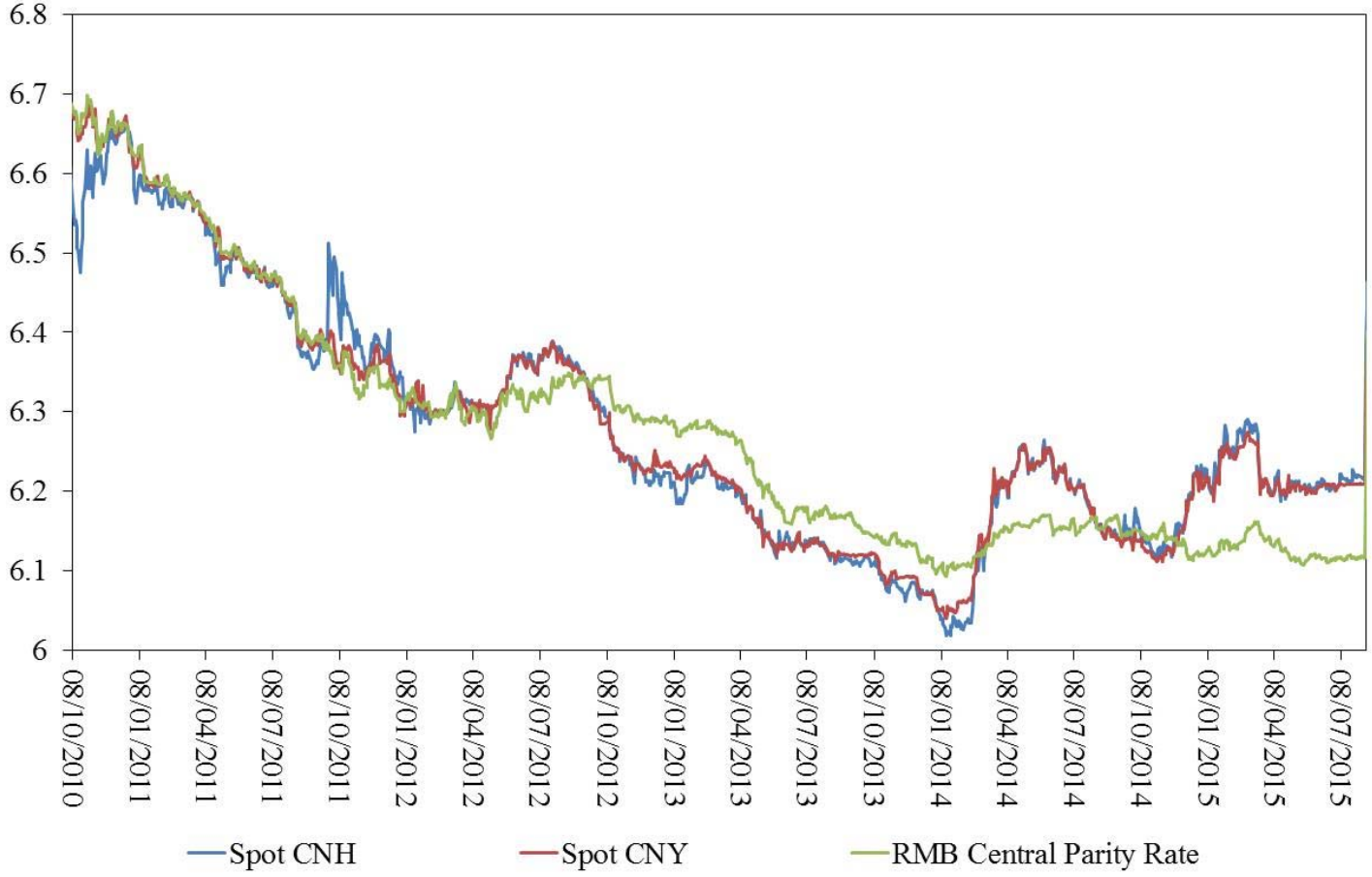
- Admission to SDR basket
  - Effective October 2016

December 2015

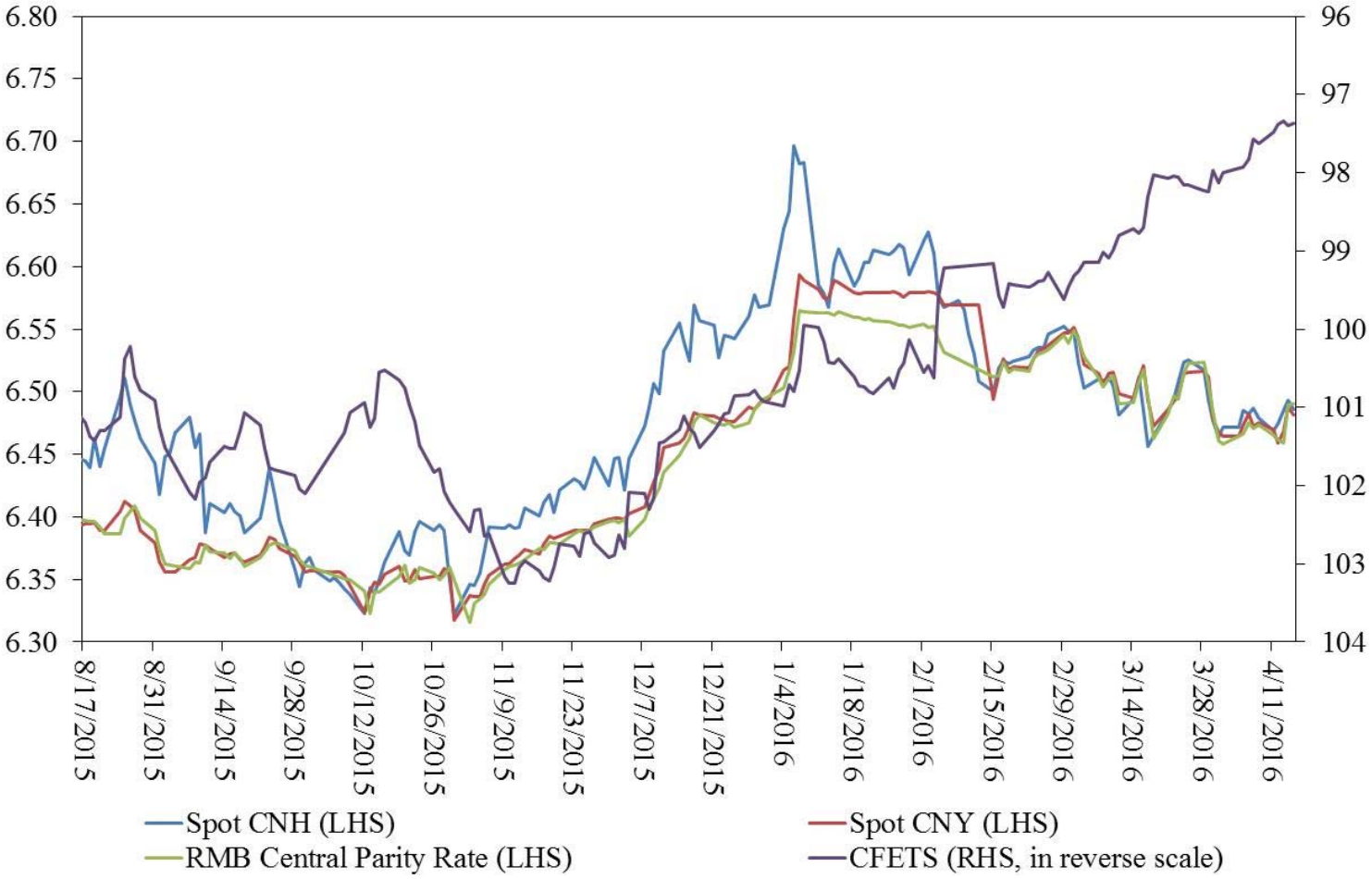
- CFETS currency basket, RMB index

3. Central Parity, On-Shore and Off-Shore Rates

Pre-Change Period (Oct 8, 2010 to Aug 10, 2015)



Post-Change Period (Aug 17, 2015 - Apr 15, 2016)



Observations

- Pre-change period – appreciation trend; then steady
- Post-change period – depreciation tendency
- CNY and CNH move in tandem; exceptions
- Var(CNH) > Var(CNY) > Var(P)
- CFETS RMB index – no readily recognized pattern
- Var(CNH) > Var(B) > Var(CNY) > Var(P)

Pre-Change Period behaviors

$$\Delta P_t = \alpha + \beta_1(P_{t-1} - Y_{t-1}) + \beta_2 \Delta P_{t-1} + \beta_3 \Delta Y_{t-1} + \varepsilon_t \quad (1)$$

$$\Delta P_t = \alpha + \beta_1(P_{t-1} - H_{t-1}) + \beta_2 \Delta P_{t-1} + \beta_3 \Delta H_{t-1} + \varepsilon_t \quad (2)$$

$$\Delta P_t = \alpha + \beta_1(P_{t-1} - Y_{t-1}) + \beta_2(P_{t-1} - H_{t-1}) + \beta_3 \Delta P_{t-1} + \beta_4 \Delta Y_{t-1} + \beta_5 \Delta H_{t-1} + \varepsilon_t \quad (3)$$

$$\Delta P_t = \alpha + \beta_1(P_{t-1} - H_{t-1}) + \beta_2 \Delta H_{t-1} + \varepsilon_t \quad (4)$$

Central Parity Estimation Results (Pre-Change Period)

	I	II	III	IV
$(P_{t-1}-Y_{t-1})$	-0.007		-0.007	
	(-2.989)		(-0.479)	
$(P_{t-1}-H_{t-1})$		-0.005	-1.99E-04	-0.005
		(-2.298)	(-0.016)	(-2.309)
ΔP_{t-1}	0.024	0.017	0.020	
	(0.614)	(0.449)	(0.505)	
ΔY_{t-1}	0.069		-0.009	
	(2.720)		(-0.303)	
ΔH_{t-1}		0.093	0.097	0.095
		(4.769)	(3.965)	(5.099)
Adj. R^2	0.016	0.041	0.040	0.042

Post-Change Period

$$\Delta P_t = \alpha + \beta_1(P_{t-1} - Y_{t-1}) + \beta_2 \Delta P_{t-1} + \beta_3 \Delta Y_{t-1} + \varepsilon_t \quad (1)$$

$$\Delta P_t = \alpha + \beta_1(P_{t-1} - H_{t-1}) + \beta_2 \Delta P_{t-1} + \beta_3 \Delta H_{t-1} + \varepsilon_t \quad (2)$$

$$\Delta P_t = \alpha + \beta_1(P_{t-1} - Y_{t-1}) + \beta_2(P_{t-1} - H_{t-1}) + \beta_3 \Delta P_{t-1} + \beta_4 \Delta Y_{t-1} + \beta_5 \Delta H_{t-1} + \varepsilon_t \quad (3)$$

$$\Delta P_t = \alpha + \beta_1(P_{t-1} - Y_{t-1}) + \beta_2(P_{t-1} - H_{t-1}) + \beta_3 \Delta P_{t-1} + \beta_4 \Delta Y_{t-1} + \beta_5 \Delta H_{t-1} + \beta_6 \Delta B_{t-1} + \varepsilon_t \quad (5)$$

$$\Delta P_t = \alpha + \beta_1(P_{t-1} - H_{t-1}) + \beta_2 \Delta Y_{t-1} + \beta_3 \Delta H_{t-1} + \varepsilon_t \quad (6)$$

Central Parity Estimation Results (Post-Change Period)

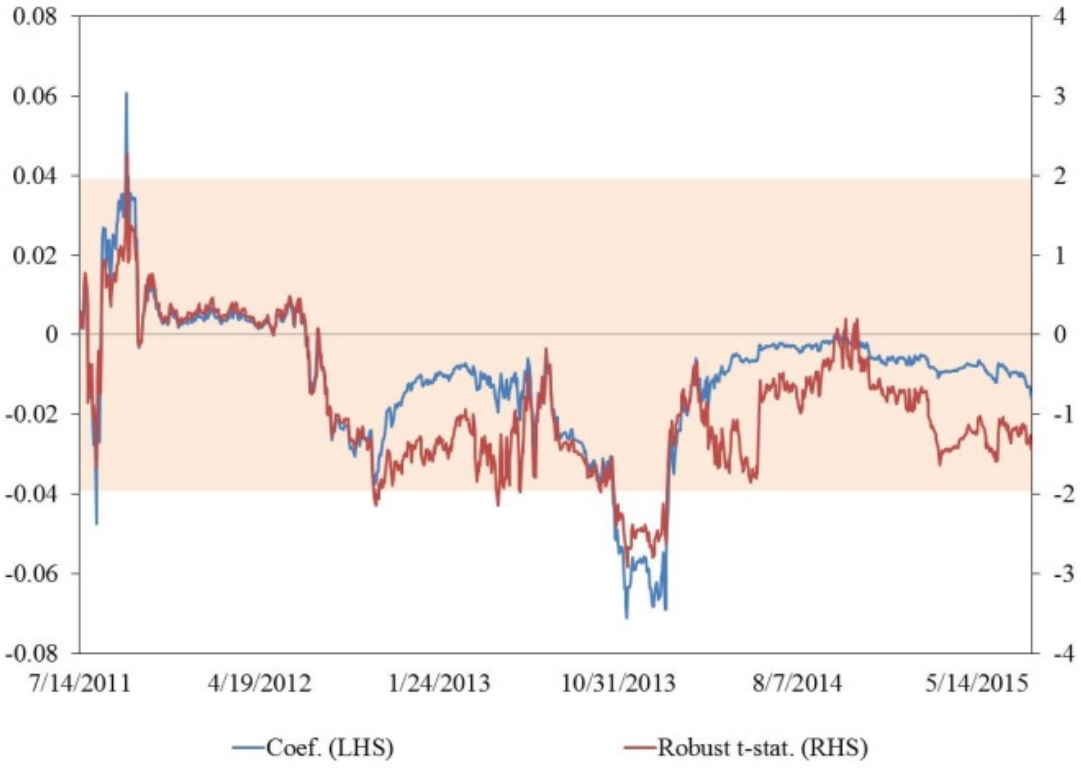
	I	II	III	V	VI
$(P_{t-1}-Y_{t-1})$	-0.103		-0.060	-0.038	
	(-1.088)		(-0.640)	(-0.384)	
$(P_{t-1}-H_{t-1})$		-0.064	-0.047	-0.048	-0.050
		(-3.065)	(-2.256)	(-2.277)	(-2.368)
ΔP_{t-1}	-0.118	0.056	-0.101	-0.106	
	(-1.024)	(0.621)	(-0.977)	(-0.996)	
ΔY_{t-1}	0.467		0.292	0.310	0.258
	(2.457)		(1.517)	(1.510)	(1.776)
ΔH_{t-1}		0.195	0.126	0.127	0.132
		(3.974)	(2.814)	(2.782)	(2.810)
ΔB_{t-1}				-0.037	
				(-0.907)	
Adj. R^2	0.293	0.313	0.378	0.377	0.373

Rolling Regressions

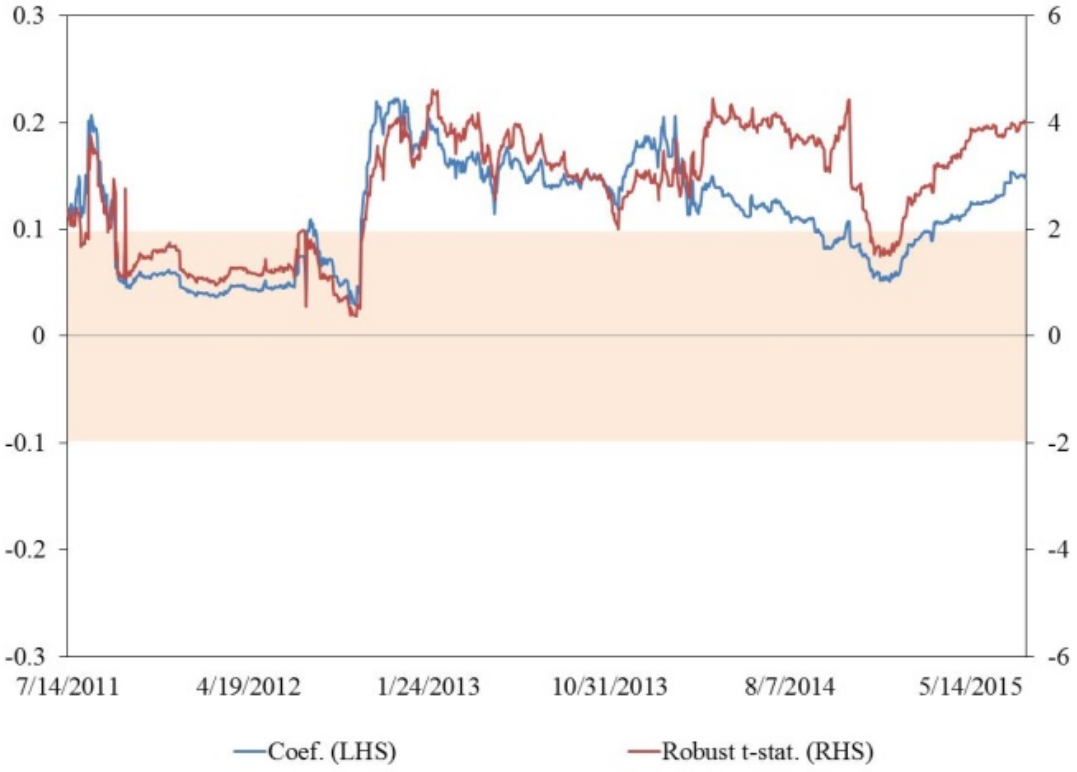
Pre-change: moving window size, 200

Parsimonious specification

Coefficient of (P_{t-1}-H_{t-1})



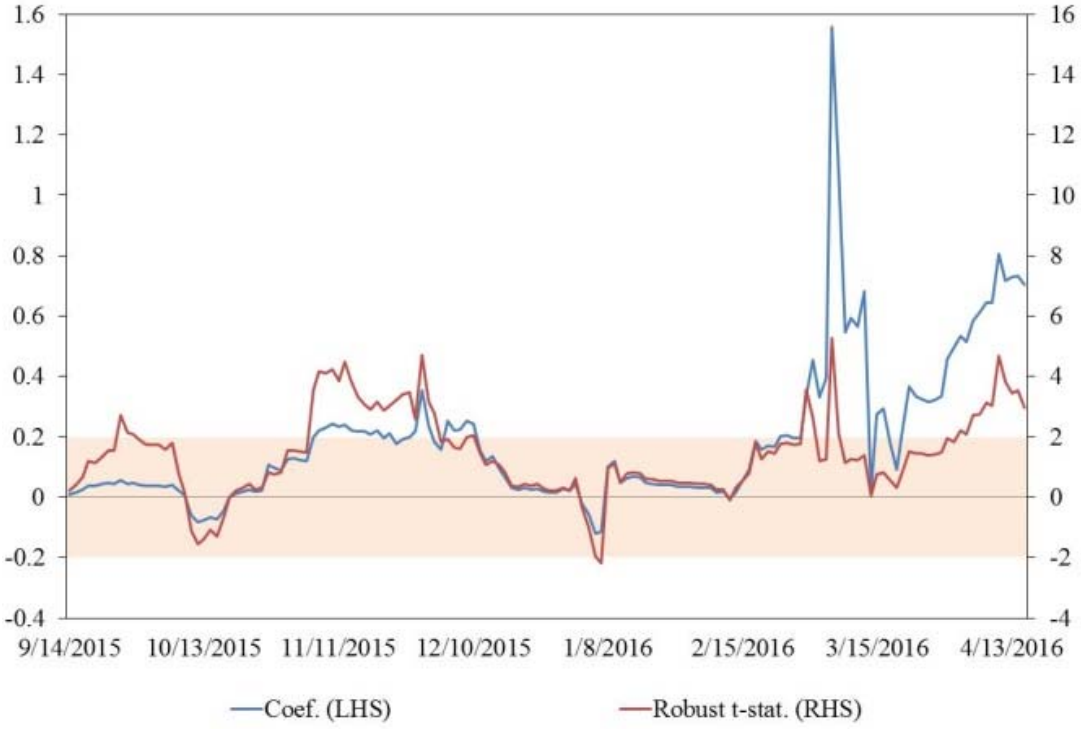
Coefficient of ΔH_{t-1}



Post-change: moving window size, 20
Parsimonious specification

Coefficient of (P_{t-1}-H_{t-1})

Coefficient of ΔH_{t-1}



Coefficient of ΔY_{t-1}

Forecast Performance

Forecasts: One-step ahead rolling regressions

Models: As indicated

Criteria: RMSE, MAE, DoC

Benchmark: RW

Forecasting the Central Parity Rate: Pre-Change Period

	RMSE	MAE	DoC
Model IV (Parsimonious model)	0.474	0.348	0.514
	(0.906)	(3.251)	(0.885)
Model III (Full model)	0.480	0.352	0.518
	(-0.418)	(1.494)	(1.138)
Model II	0.477	0.350	0.516
	(0.138)	(2.219)	(1.012)
Model I	0.488	0.364	0.476
	(-1.822)	(-1.478)	(-1.518)
RW	0.478	0.359	0.473

Forecasting the Central Parity Rate: Post-Change Period

	RMSE	MAE	DoC
Model VI (Parsimonious model)	1.020	0.624	0.685
	(-0.044)	(1.800)	(4.432)
Model V (Full model)	0.761	0.521	0.706
	(2.395)	(4.004)	(4.934)
Model III	0.729	0.498	0.755
	(2.731)	(4.450)	(6.105)
Model II	0.903	0.672	0.678
	(1.360)	(1.688)	(4.265)
Model I	0.903	0.601	0.713
	(1.262)	(2.757)	(5.101)
RW	1.011	0.759	0.573

4. Economic variables

Pre-change period

$$\Delta P_t = \alpha + \beta_1(P_{t-1} - H_{t-1}) + \beta_2 \Delta H_{t-1} + \beta_3 Z_{t-1} + \varepsilon_t, \quad (7)$$

Post-change period

$$\Delta P_t = \alpha + \beta_1(P_{t-1} - H_{t-1}) + \beta_2 \Delta Y_{t-1} + \beta_3 \Delta H_{t-1} + \beta_4 Z_{t-1} + \varepsilon_t, \quad (8)$$

Z:

- US dollar
- VIX
- Offshore Expectations

Central Parity Estimation Results: with augmented variables (Pre-Change Period)

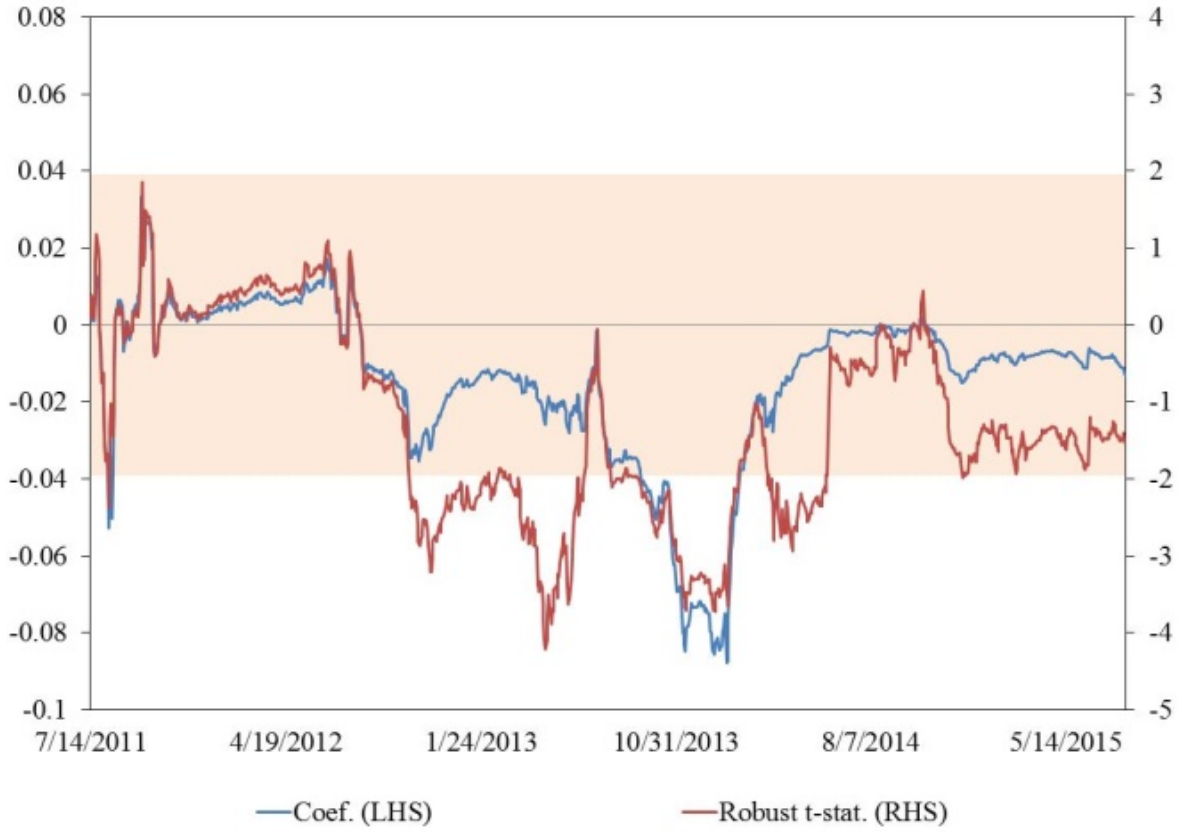
	IV	IVa-i	IVa-ii	IVa-iii	IVb	IVc
$(P_{t-1}-H_{t-1})$	-0.005	-0.004	-0.006	-0.005	-0.004	-0.004
	(-2.309)	(-1.961)	(-2.382)	(-2.311)	(-2.001)	(-2.087)
ΔH_{t-1}	0.095	0.011	0.082	0.095	0.008	
	(5.099)	(0.602)	(4.340)	(5.119)	(0.399)	
ΔU_{t-1}		0.095			0.094	0.094
		(18.951)			(18.731)	(19.876)
ΔVIX_{t-1}			0.002		0.001	0.001
			(4.631)		(1.954)	(2.022)
ΔFP_{t-1}				-0.002	0.002	
				(-0.413)	(0.816)	
Adj. R^2	0.042	0.341	0.063	0.041	0.343	0.343

Central Parity Estimation Results: with augmented variables (Post-Change Period)

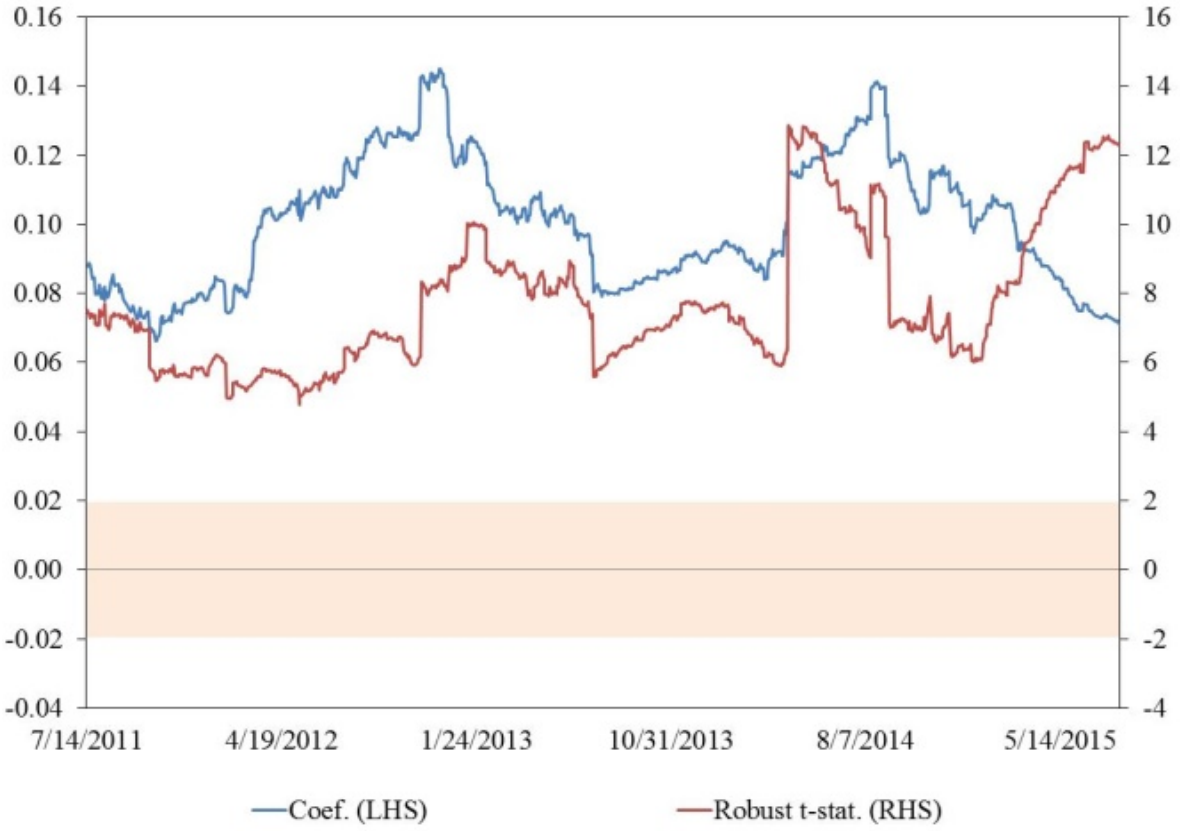
Model	VI	VIa-i	VIa-ii	VIa-iii	VIb	VIc
$(P_{t-1}-H_{t-1})$	-0.050	-0.050	-0.052	-0.044	-0.041	-0.051
	(-2.368)	(-2.452)	(-2.506)	(-2.117)	(-2.084)	(-2.514)
ΔH_{t-1}	0.132	0.088	0.134	0.113	0.058	
	(2.810)	(2.313)	(2.896)	(2.125)	(1.274)	
ΔY_{t-1}	0.258	0.261	0.257	0.342	0.358	0.416
	(1.776)	(1.725)	(1.751)	(3.124)	(3.481)	(4.318)
ΔU_{t-1}		0.078			0.088	0.089
		(4.234)			(4.374)	(4.408)
ΔVIX_{t-1}			-0.001		0.001	
			(-0.982)		(0.941)	
ΔFP_{t-1}				-0.020	-0.023	-0.026
				(-1.420)	(-1.666)	(-2.005)
Adj. R^2	0.373	0.447	0.372	0.392	0.473	0.466

Rolling Regressions: Pre-Change Period

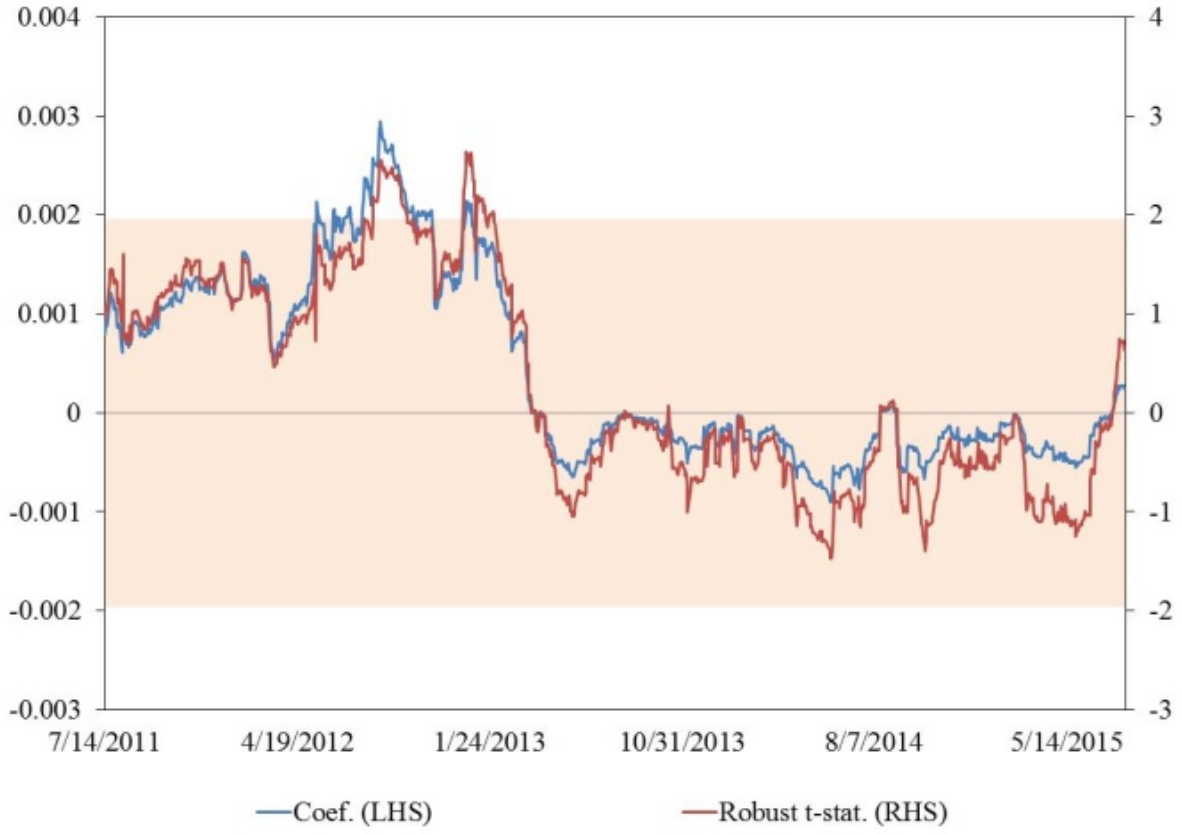
Coefficient of (P_{t-1}-H_{t-1})



Coefficient of ΔU_{t-1}

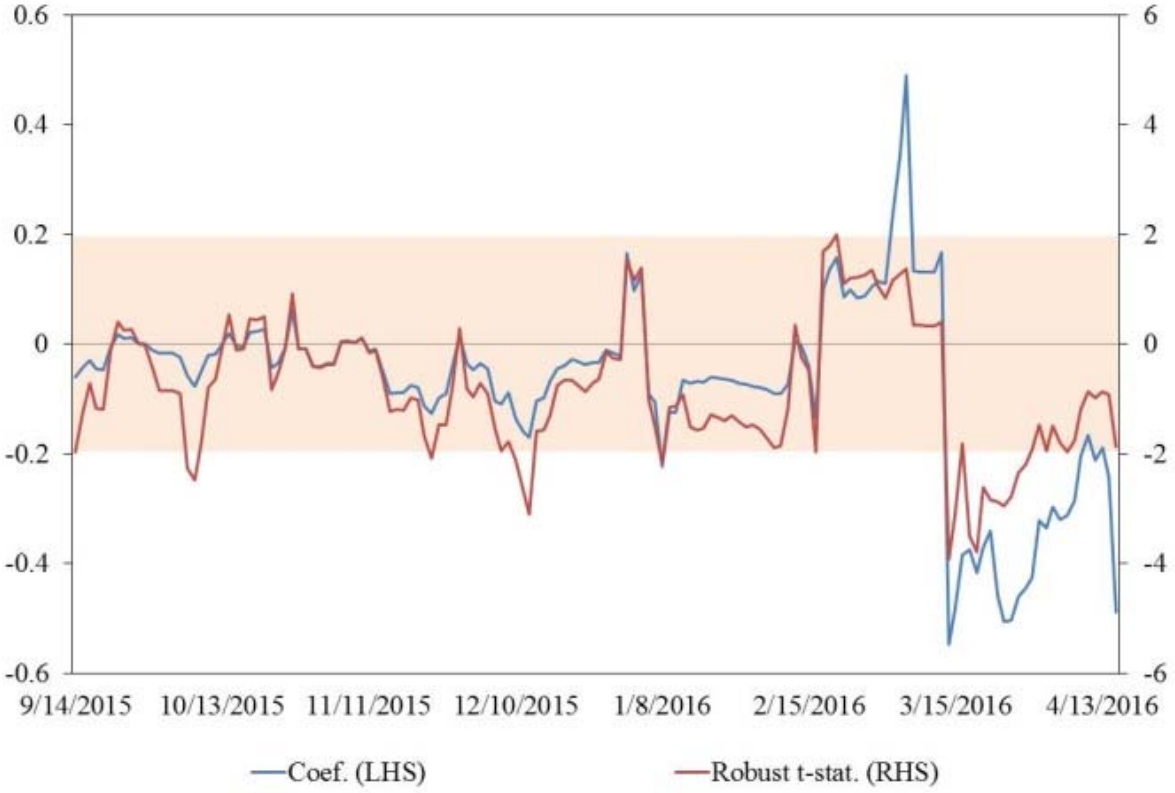


Coefficient of ΔVIX_{t-1}

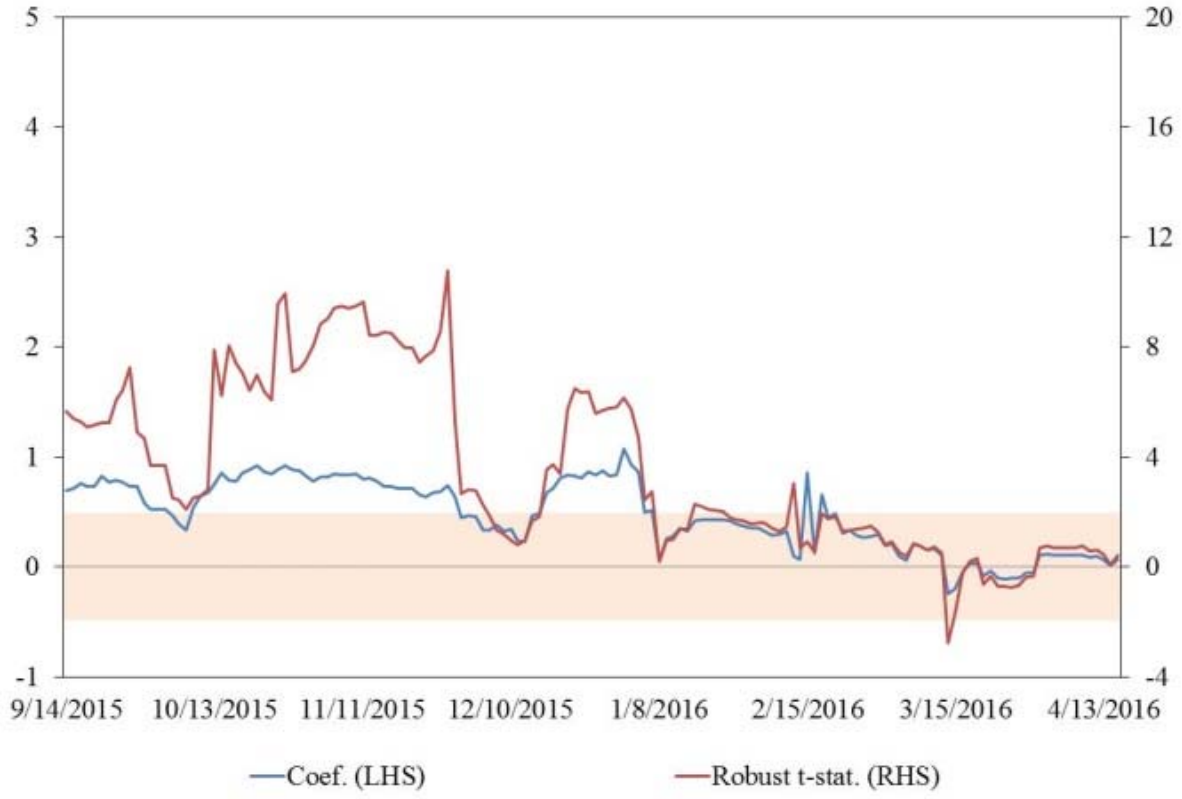


Rolling Regressions: Post-Change Period

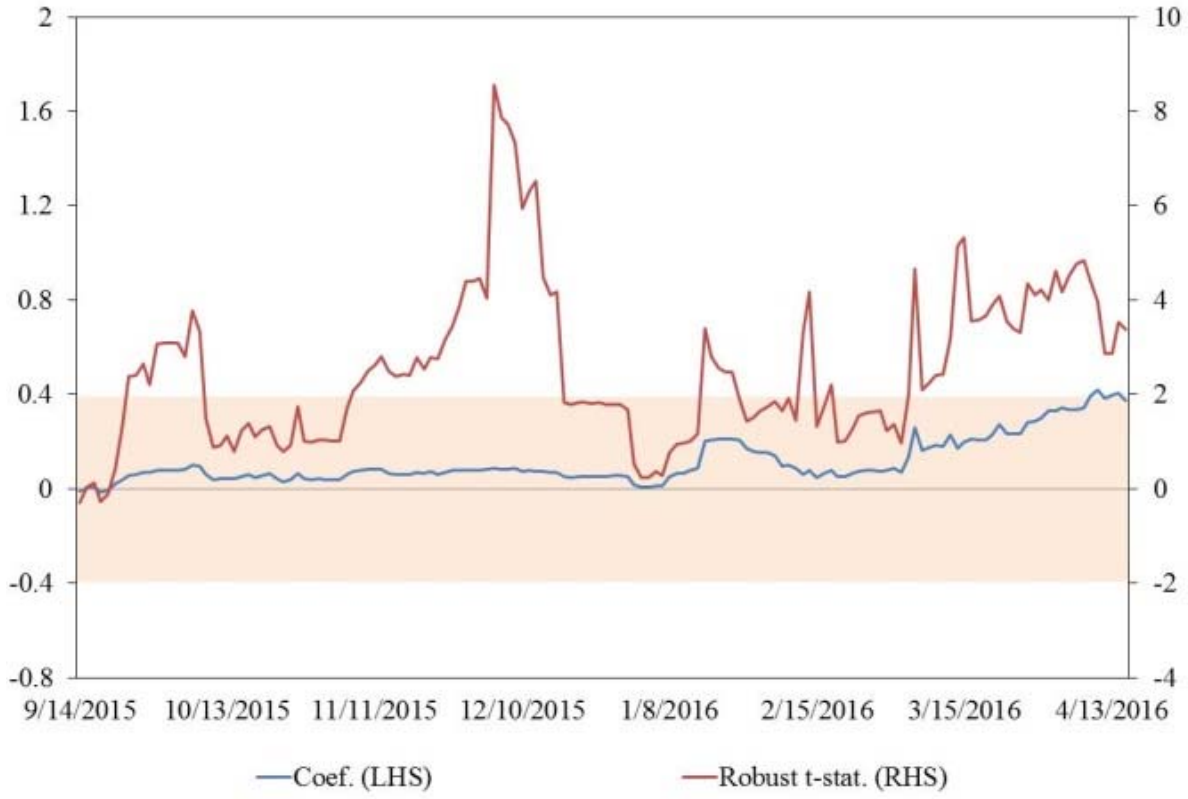
Coefficient of (P_{t-1}-H_{t-1})



Coefficient of ΔY_{t-1}



Coefficient of ΔU_{t-1}



Coefficient of ΔFP_{t-1}

Forecast Results: Pre-Change Period with augmented variables

	RMSE	MAE	DoC
Model IVc	0.396	0.266	0.717
	(8.774)	(14.159)	(13.724)
Model IVb	0.399	0.270	0.728
	(8.427)	(13.565)	(14.420)
Model IVa-iii	0.477	0.350	0.520
	(0.196)	(2.423)	(1.265)
Model IVa-ii	0.459	0.335	0.533
	(2.873)	(4.920)	(2.087)
Model IVa-i	0.397	0.266	0.719
	(8.385)	(14.206)	(13.851)
Model IV (Parsimonious model)	0.474	0.348	0.514
	(0.906)	(3.251)	(0.885)
RW	0.478	0.359	0.473

Forecast Results: Post-Change Period with augmented variables

	RMSE	MAE	DoC
Model VIc	0.890	0.544	0.734
	(0.717)	(2.895)	(5.603)
Model VIb	0.920	0.590	0.678
	(0.586)	(2.286)	(4.265)
Model VIa-iii	1.026	0.651	0.664
	(-0.078)	(1.472)	(3.930)
Model VIa-ii	0.999	0.631	0.615
	(0.063)	(1.746)	(2.760)
Model VIa-i	0.990	0.567	0.734
	(0.098)	(2.385)	(5.603)
Model VI (Parsimonious model)	1.020	0.624	0.685
	(-0.044)	(1.800)	(4.432)
RW	1.011	0.759	0.573

5. Concluding Remarks

Limited degree of financial linkages
- But increasing influences

Empirical behavior of central parity
- Hints of policy changes/intentions

Our results
- Differences before and after August 2015
  - Both periods: $(P_{t-1}-H_{t-1})$, US$
  - Before: VIX
  - After: ΔY_{t-1}, ΔFP_{t-1}
- After policy changed
  - Ability to explain and predict enhanced
- Limited role of RMB index revealed

Caveats

- Difficulty of modelling exchange rates
- Interpretation
  - Ability to predict the central parity
  - Policy manipulations or empirical artifacts

Tricky to maintain a stable RMB value against a currency basket

THANK YOU

Epilogue

RMB Fixing & CFETS Index