Is RMB a Safe Haven Currency?

Evidence from Conditional Coskewness and Cokurtosis

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Safe Haven Currencies

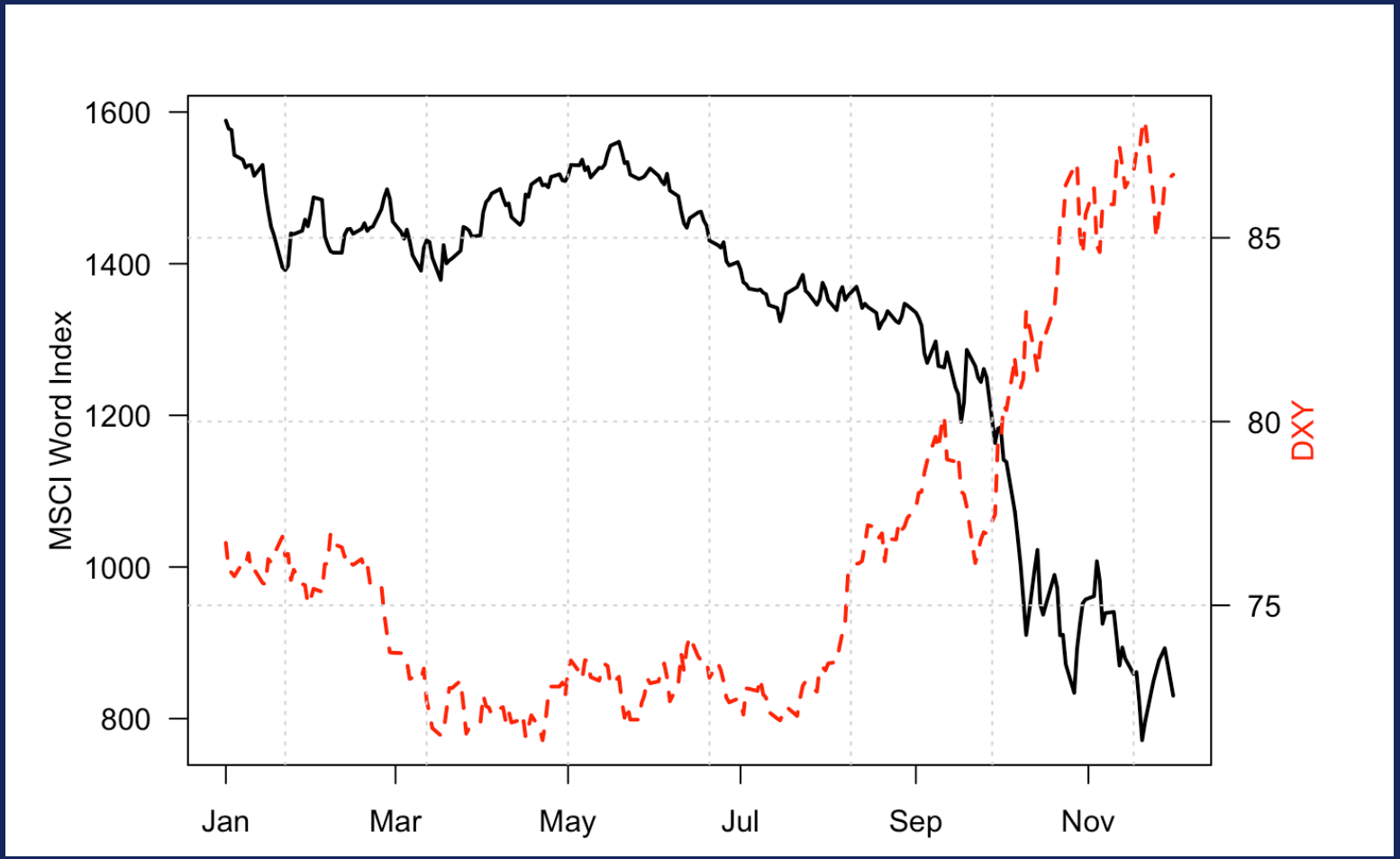
Habib and Stracca (2012)

- Safe-haven currencies are good hedge against financial stress

- Traditional safe haven currencies: US dollar, Japanese Yen.

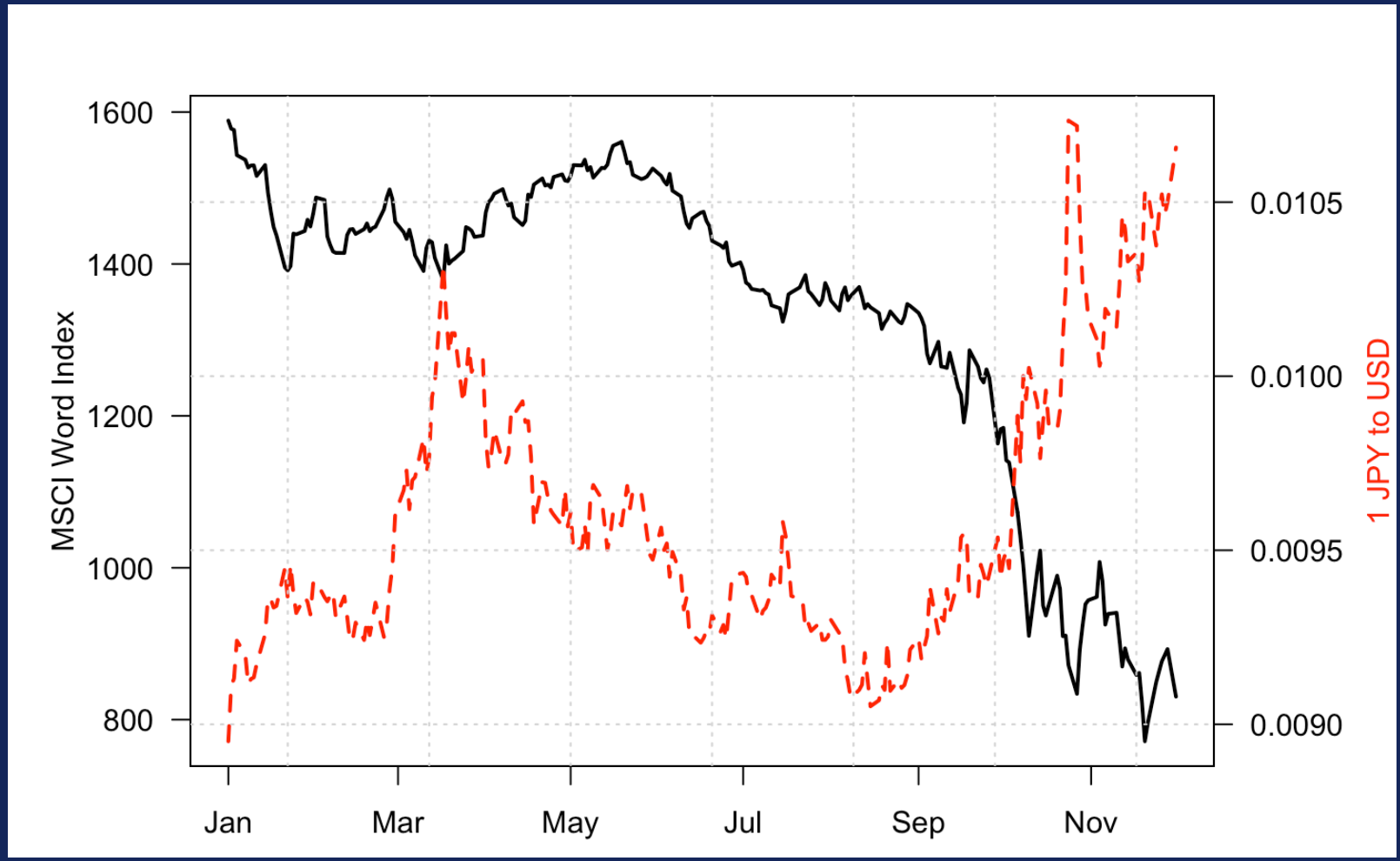
Motivation

US dollar's performance in the event of the crisis on Sep. 2008



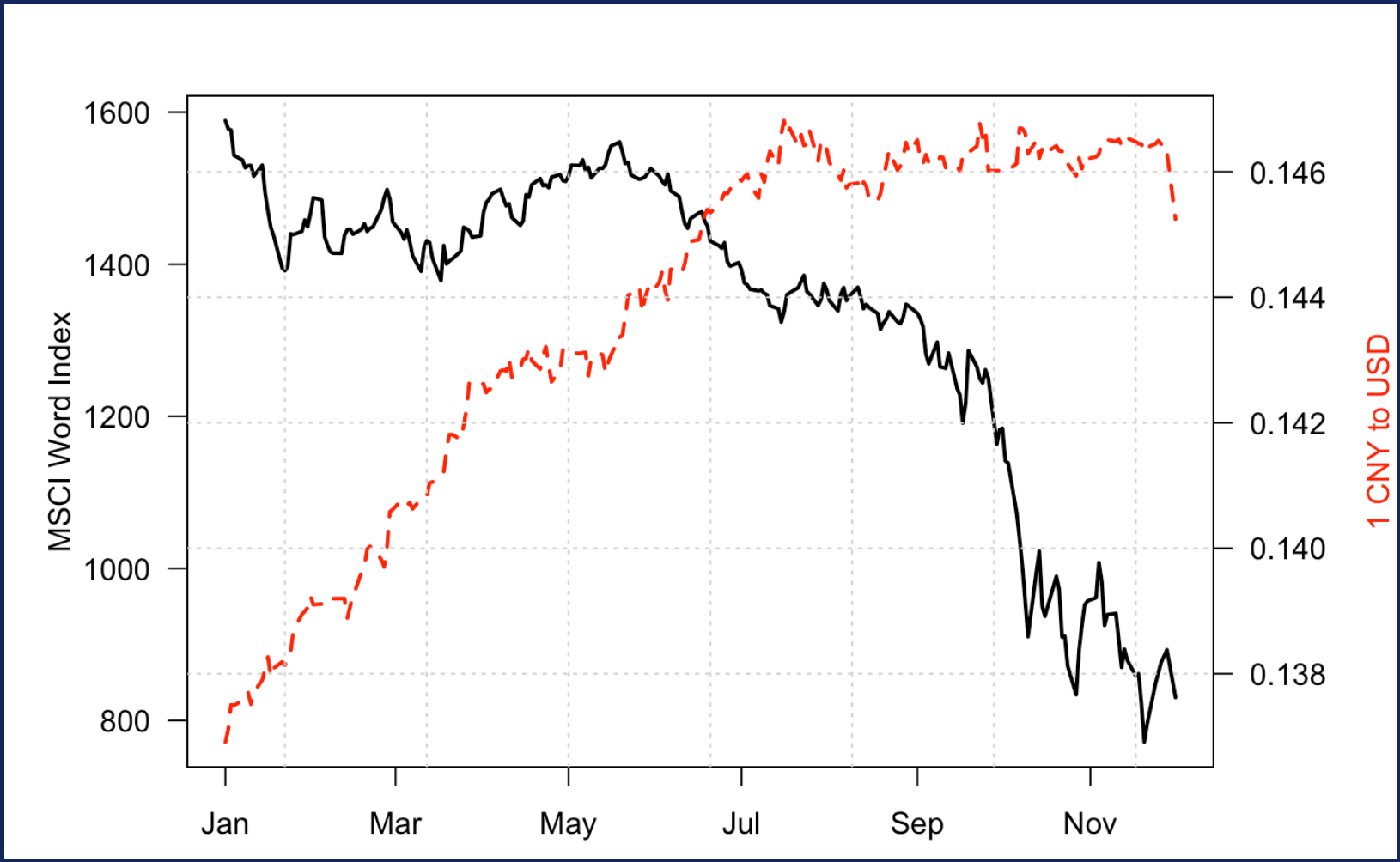
Motivation

Japanese Yen's performance in the event of the crisis on Sep. 2008



Motivation

RMB's performance in the event of the crisis on Sep. 2008



Motivation

Campbell, Medeiros and Viceira (2010)

- **US dollar, Euro and Swiss franc moved against world equity markets**
- **Their findings are based on correlation only**

Co-movement is not just correlation

- **Correlation is linear co-movement**

Asset returns have long (usually left tail) and fat tails, especially in the case of extreme events

- **Coskewness and Cokurtosis is nonlinear co-movement**

Motivation

Investors have preferences beyond mean & variance

- **Skewness preference** is about **"prudence"** (Kimball, 1990)
- A prudent investor will seek **higher (positive) skewness** (Rubinstein, 1973).

- **Kurtosis preference** is about **"Temperance"** (Denuit and Eeckhoudt, 2010)
- A temperate investor will seek **lower (negative) kurtosis** (Kraus and Litzenberger, 1976)

Motivation

- Higher-order-moment CAPM for stock market
  - Rubinstein (1973) , Kraus and Litzenberger (1976)
  - Harvey and Siddque (2000), Dittmar (2002)
- Recent renewed interest and extension to (international) stock, bond and/or option markets
  - Vanden (2006)
  - Guidolin and Timmermann (2008)
  - Yang, Zhou and Wang (2010)
  - Conrad, Dittmar and Ghysels (2013)

Motivation

Coskewness and cokurtosis are the contribution of an asset to the skewness and kurtosis of a stock market index

- **Coskewness** is the correlation between currency and volatility of stock market
- A safe haven currency has **positive** coskewness

- **Cokurtosis** is the correlation between currency and skewness of stock market
- A safe haven currency has **negative** cokurtosis

Contributions

Study currency coskewness and cokurtosis with world stock market

- **Currency coskewness is the relation between currency return and stock volatility.**
- **Currency coskurtosis is the relation between currency return and stock skewness.**

CNY have positive coskewness during a certain time period

- **A good hedge in the volatile stock market.**

Currency coskewness is priced in JPY!

- **Coskewness is neither priced in CNY nor CNH.**

Data (2005-2018, monthly)

Stock market index

- Datastream
- MSCI Stock indices
- USD-denominated

Exchange rates

- JPY, CNY, CNH
- IFS of IMF
- Domestic Currency per SDR

Interest Rate

- 3 month Treasury bill rate
- IFS of IMF
- Datastream

Data

Stock premiums = (log excess return of MSCI indices) – (US interest rate)

Currency premiums = (foreign interest rate-US interest rate)+ foreign currency appreciation rate

- Excess returns to a US investor who borrowing in US dollars to hold foreign currencies

All measures are annualized

Summary statistics

Stock premiums

Statistics (monthly Aug.2005 - Dec.2018)	World Stock Premium (USD)	Asian Market Stock Premium (USD)	Emerging Market Stock Premium (USD)	Asian Emerging Market Stock Premium (USD)
mean	0.022	0.0147	0.023	0.039
std.	0.532	0.591	0.773	0.757
Skewness	-1.095***	-0.905***	-0.913***	-0.729***
Exc.kurtosis	3.374***	2.536***	3.723***	2.250***

Remarks: (1)left long tail; (2) fat tail

Summary statistics

Currency premiums

Currency Premium	JPY (05–18)	CNY (05–18)	CNH (10–18)
Mean	-0.015	0.024***	0.016
Std dev.	0.323	0.100	0.146
Skewness	-0.260	-1.455***	-1.045***
Excess kurtosis	0.721*	9.036***	8.603***

Methodology

- Estimate a bivariate regime switching model for stock and currency premiums
- Derive conditional moments from the regime switching model
- Time series regressions

  future currency premium =intercept + slope * controlling variables

  + slope * expected currency coskewness

  + slope * expected currency cokurtosis

  + error

Why regime switching model?

Regimes are present

- likelihood values and standardized LR test (Hansen, 1992) suggest that two-regime models are better than single-regime models

Hard to estimate expected coskewness

- We may not have extreme observations within a rather short period

A solution: regime switching model

- The mixture of two (normal) distributions is not normal so that higher order moments exist

1st step: the regime-switching model

Two variables

- Stock premium=drift+slope*first lagged US short rate + e
- Currency premium=drift+slope*first lagged interest differential+e
- (Lustig and Verdelhan, 2007, Campbell et al, 2010)

Two regimes

- Regime 1: less volatile; Regime 2: more volatile

In each regime

- Errors are i.i.d. bivariate normally distributed
- Variances and correlation are constant

Switch between regimes

- First-order Markov process with transition probability depends on first lag of instruments such as interest differential (Lustig et al., 2011; Menkhoff et al., 2012)

1st step: The regime switching model for foreign currencies

- **Conditional mean**

$$\begin{pmatrix} r_t^s \\ r_t^c \end{pmatrix} = \begin{pmatrix} \mu_i^s \\ \mu_i^c \end{pmatrix} + \begin{pmatrix} \lambda_i^s & 0 \\ 0 & \lambda_i^c \end{pmatrix} \begin{pmatrix} RF_{t-1} \\ RD_{t-1} \end{pmatrix} + \begin{pmatrix} \varepsilon_{it}^s \\ \varepsilon_{it}^c \end{pmatrix}$$

- **Conditional variance-covariance**

$$\boldsymbol{H_{it}} = \boldsymbol{D_{it}} \boldsymbol{R_{it}} \boldsymbol{D_{it}}, \boldsymbol{D_{it}} = \begin{bmatrix} \sqrt{h_i^s} & 0 \\ 0 & \sqrt{h_i^c} \end{bmatrix}, \boldsymbol{R_{it}} = \begin{bmatrix} 1 & 0 \\ \rho_i & 1 \end{bmatrix}, i \in \{1,2\}$$

- **Transition probability**

$$p_{ii,t} = p(S_t = i | S_{t-1} = i, \mathbf{F}_{t-1}) = \Phi(a_i + b_i RD_{t-1}), i \in \{1,2\}$$

2st step: Derive high order moments

General formula

$$E[(r_t^s - \mu_t^s)^k (r_t^c - \mu_t^c)^l | \mathbf{F}_{t-1}, \theta]$$

$$= \sum_{i=1}^{2} p_{it} \{ \sum_{m=0}^{k} \sum_{n=0}^{l} [C_k^m C_l^n (\mu_{it}^s - \mu_t^s)^{k-m} (\mu_{it}^c - \mu_t^c)^{l-n} \varphi(m, n; i)] \}$$

Partial moments

- **Conditional currency premiums**
- **Conditional currency variance (volatility)**
- **Conditional covariance**
- **Conditional currency skewnesses**
- **Conditional currency coskewnesses**

2st step: Derive high order moments

- **Expected currency covariance**

$$p_{1t}\mathrm{cov}_1 + p_{2t}\mathrm{cov}_2 + p_{1t}p_{2t}[(\mu_{1t}^s - \mu_{2t}^s)(\mu_{1t}^c - \mu_{2t}^c)]$$

- **Expected currency correlation**

$$\frac{p_{1t}\mathrm{cov}_1 + p_{2t}\mathrm{cov}_2 + p_{1t}p_{2t}[(\mu_{1t}^s - \mu_{2t}^s)(\mu_{1t}^c - \mu_{2t}^c)]}{[p_{1t}h_1^s + p_{2t}h_2^s + p_{1t}p_{2t}(\mu_{1t}^s - \mu_{2t}^s)^2]^{1/2}[p_{1t}h_1^c + p_{2t}h_2^c + p_{1t}p_{2t}(\mu_{1t}^c - \mu_{2t}^c)^2]^{1/2}}$$

- **Expected currency beta**

$$\frac{E[(r_t^s - \mu_t^s)(r_t^c - \mu_t^c)|\mathbf{F}_{t-1}, \theta]}{E[(r_t^s - \mu_t^s)^2|F_{t-1}, \theta]}$$

2st step: Derive high order moments

- **Expected currency skewness**

$$\frac{E[(r_t^c - \mu_t^c)^3 | F_{t-1}, \theta]}{\left(\sqrt{E[(r_t^c - \mu_t^c)^2 | F_{t-1}, \theta)^3}\right.}$$

- **Expected currency coskewness**

$$E[(r_t^s - \mu^s)^2 (r_t^c - \mu^c) | \mathbf{F}_{t-1}, \boldsymbol{\theta}]$$

- **Expected currency standardized coskewness**

$$\frac{E[(r_t^s - \mu_t^s)^2 (r_t^c - \mu_t^c) | F_{t-1}, \theta]}{E[(r_t^s - \mu_t^s)^2 | F_{t-1}, \theta]\{E[(r_t^c - \mu_t^c) | F_{t-1}, \theta]\}^{1/2}}$$

2st step: Derive high order moments

- **Expected currency kurtosis**

$$\frac{E[(r_t^c - \mu_t^c)^3 | F_{t-1}, \theta]}{\left(\sqrt{E[(r_t^c - \mu_t^c)^2 | F_{t-1}, \theta)^3}\right.}$$

- **Expected currency cokurotosis**

$$E[(r_t^s - \mu^s)^2 (r_t^c - \mu^c) | \mathbf{F}_{t-1}, \boldsymbol{\theta}]$$

- **Expected currency standardized cokurtosis**

$$\frac{E[(r_t^s - \mu_t^s)^3 (r_t^c - \mu_t^c) | F_{t-1}, \theta]}{\{E[(r_t^s - \mu_t^s)^2 | F_{t-1}, \theta]\}^{3/2} \{E[(r_t^c - \mu_t^c) | F_{t-1}, \theta]\}^{1/2}}$$

3nd step results Time series regressions

Regressions guided by SDF framework

future currency excess return = a +b1*expected covariance (beta)+b2*expected currency (standardized) co-skewness + b3* expected currency (standardized) co-kurtosis

Additional regressions include other risk factors and orthogonalize them by the order of moments (Menkhoff, 2012)

- expected currency beta
- expected currency idiosyncratic volatility
- expected currency (standardized) co-skewness
- epxected currency idiosyncratic skewness
- expected currency (standardized) co-kurtosis
- epxected currency idiosyncratic kurtosis

1st step results (continued)

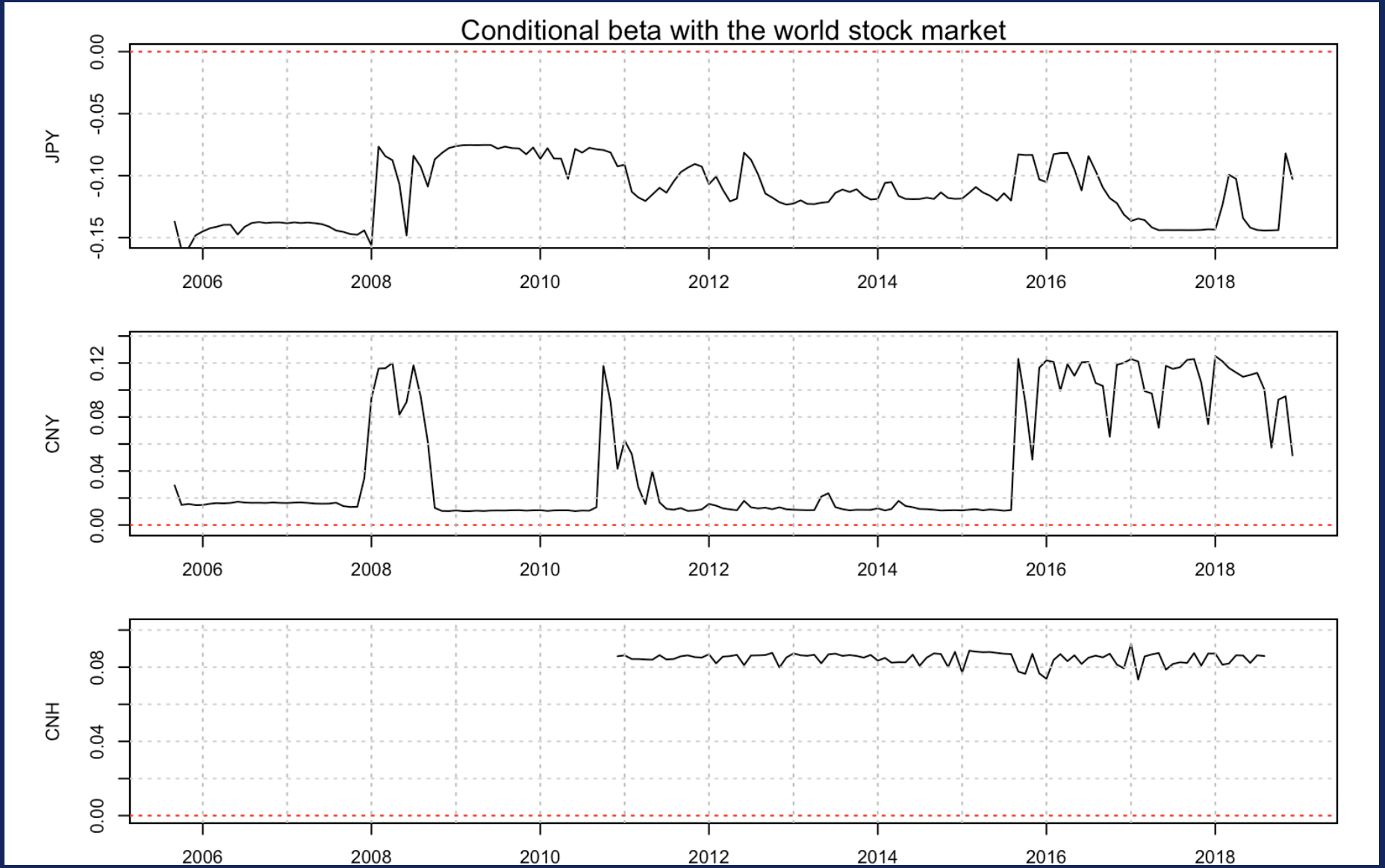
	CNY (2005-2018)		CNH (2010-2018)		JPY (2005-2018)	
	Regime 1	Regime 2	Regime 1	Regime 2	Regime 1	Regime 2
m_i^s	0.038**	0.208	0.131	0.018**	0.13	0.011**
t-stat.	(0.718)	(3.422)	(2.867)	(0.235)	(4.509)	(0.129)
m_i^c	0.023**	-0.02***	0.012**	-0.024***	-0.087***	0.12
t-stat.	(7.044)	(-0.925)	(3.498)	(-0.811)	(-2.842)	(2.619)
l_i^s	-0.003***	-0.203***	-0.026***	-0.056***	-0.005***	-0.217***
t-stat.	(-0.071)	(-5.26)	(-0.352)	(-1.037)	(-0.469)	(-2.098)
l_i^c	0.708	1.748	0.731	1.253	-1.2***	-1.356***
t-stat.	(5.457)	(1.265)	(5.361)	(0.94)	(-1.036)	(-0.471)
h_i^s	0.318	0.178	0.089*	0.263	0.064*	0.498
t-stat.	(12.291)	(4.968)	(4.42)	(4.647)	(5.515)	(5.633)
h_i^c	0.001***	0.028**	0***	0.043**	0.071*	0.123
t-stat.	(8.656)	(6.397)	(4.096)	(7.654)	(6.197)	(7.353)
r_i	0.139	0.331	0.037**	0.277	-0.123***	-0.148***
t-stat.	(1.567)	(3.624)	(0.179)	(2.804)	(-1.149)	(-1.616)
a_i	1.876	-0.828***	0.151	0.06*	1.607	-2.464***
t-stat.	(7.173)	(-2.766)	(0.68)	(0.247)	(6.824)	(-9.004)
b_i	1.818	-48.161***	-8.058***	4.507	-16.95***	64.158
t-stat.	(0.119)	(-2.727)	(-0.857)	(0.403)	(-1.544)	(4.899)

Summary of conditional moments

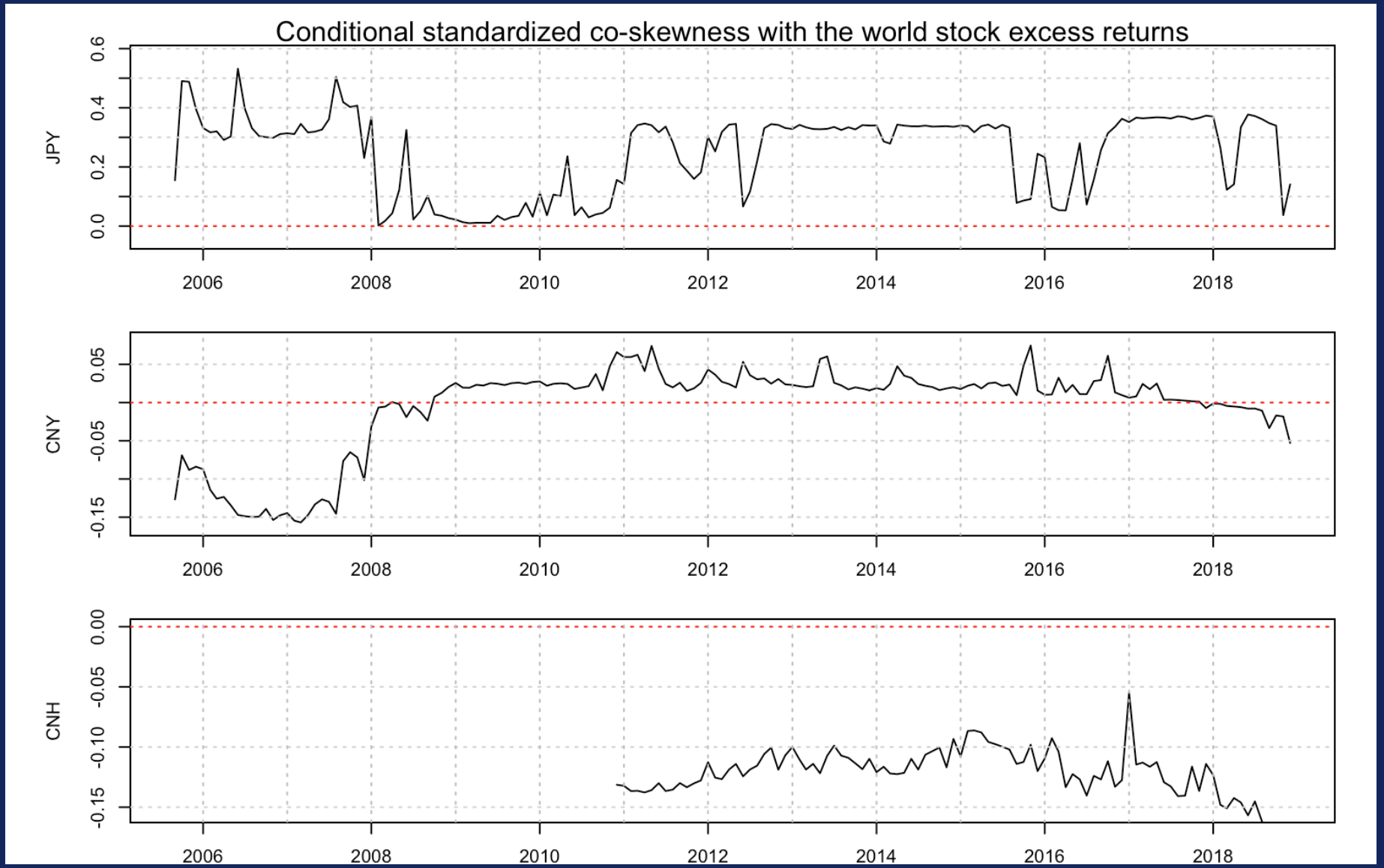
The average of conditional moment estimates（World）

Variable name	JPY	CNY	CNH
Conditional beta	-0.112	0.043	0.086
Conditional standard deviation	0.314	0.086	0.144
Conditional skewness	0.136	-0.582	-0.234
Conditional correlation with the world stock excess returns	-0.170	0.197	0.251
Conditional covariance with the world stock excess returns	-0.028	0.010	0.015
Conditional standardized co-skewness with the world stock excess returns	0.236	-0.006	-0.119
Conditional co-skewness with the world stock excess returns	0.015	0.000	-0.003
Conditional standardized co-kurtosis with the world stock excess returns	-0.997	0.564	1.121
Conditional co-kurtosis with the world stock excess returns	-0.036	0.006	0.012

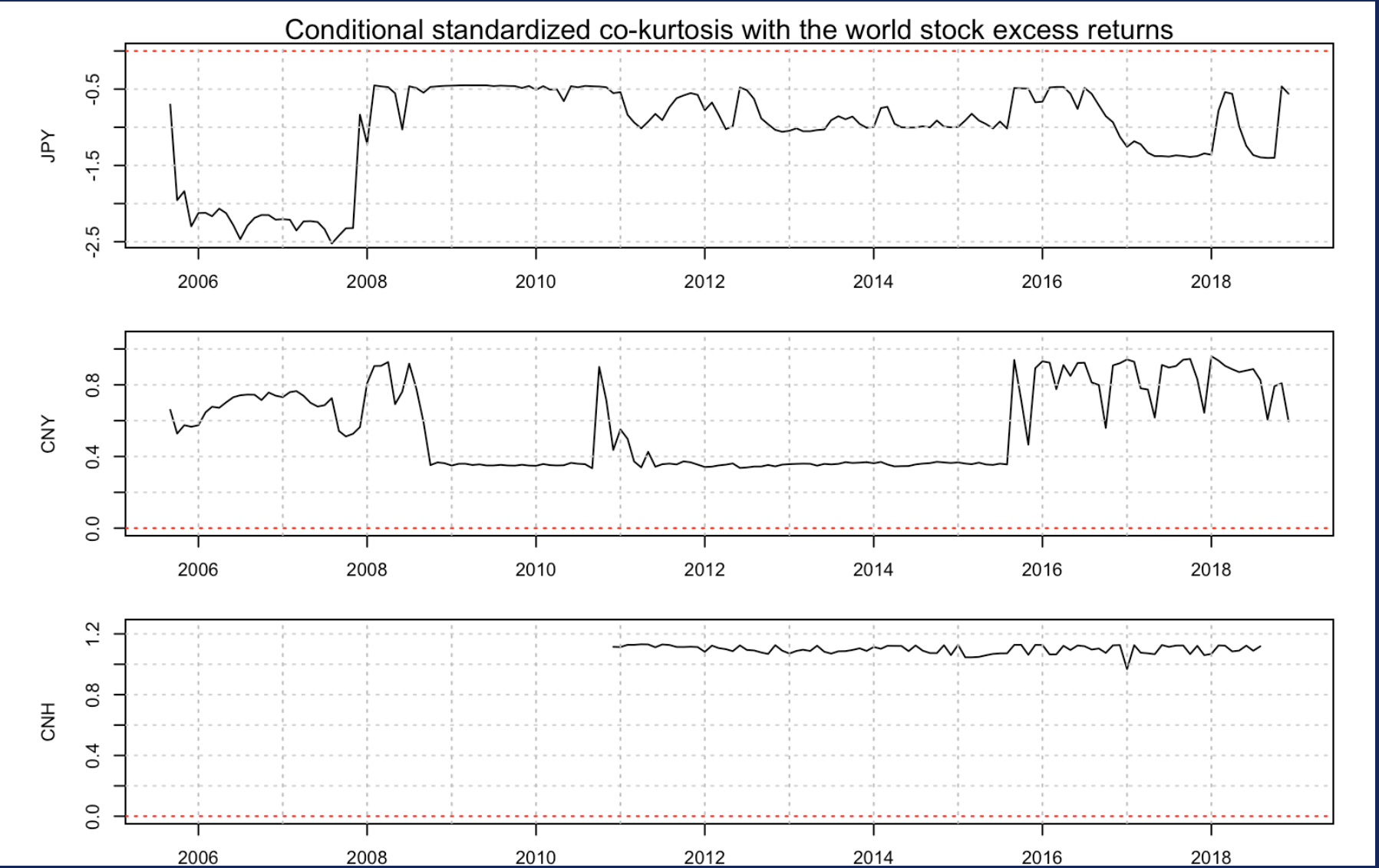
2nd step results (continued)



2nd step results (continued)



2nd step results (continued)



3nd step results : Regressions of 1-month future currency excess return on orthogonal factors

Currency	Intercept	Conditional beta	Orthogonal standardized co-skewness	Orthogonal standardized co-kurtosis	R2	economic impact of conditional standarized	
						co-skewness	co-skewness
JPY	0.15* (1.884)	1.436** (2.016)	-1.018** (-2.445)	0.028 (0.493)	4.8%	-2.4%	0.0%
CNY	0.032*** (2.847)	-0.176 (-0.633)	-0.039 (-0.251)	-0.441 (-0.798)	1.5%	0.0%	0.0%
CNH	-0.079 (-0.32)	1.121 (0.389)	1.517 (0.788)	-24.13** (-2.579)	4.5%	0.0%	-2.6%

Currency	Intercept	Conditional beta	Idiosyncratic volatility	Orthogonal standardized co-skewness	Idiosyncratic skewness	Orthogonal standardized co-kurtosis	Idiosyncratic kurtosis	R2	economic impact of conditional standarized	
									co-skewness	co-kurtosis
JPY	0.151** (2.11)	1.444** (2.196)	3.768* (1.914)	-0.846** (-2.421)	-0.364 (-0.869)	0.007 (0.027)	-1.077 (-0.814)	5.9%	-2.4%	0.0%
CNY	0.032*** (3.165)	-0.175 (-0.631)	0.85 (0.774)	-0.047 (-0.365)	0.077** (2.514)	-0.471 (-1.004)	0.009 (0.679)	5.4%	0.0%	0.0%
CNH	-0.075 (-0.258)	1.076 (0.313)	7.797** (2.026)	1.639 (1.011)	-0.404 (-0.968)	-24.067*** (-2.92)	-1.14 (-1.273)	7.6%	0.0%	-2.9%

3nd step results: Regressions of 3-month future currency excess return on orthogonal factors

Currency	Intercept	Conditional beta	Orthogonal standardized co-skewness	Orthogonal standardized co-kurtosis	R2	economic impact of conditional standarized	
						co-skewness	co-skewness
JPY	0.037 (0.364)	0.399 (0.468)	-0.81** (-2.184)	0.006 (0.084)	2.4%	-2.2%	0.0%
CNY	0.039*** (3.557)	-0.341 (-1.142)	-0.102 (-0.622)	0.004 (0.008)	2.5%	0.0%	0.0%
CNH	0.174 (0.772)	-1.89 (-0.689)	2.213 (1.138)	-0.056 (-0.002)	2.1%	0.0%	0.0%

Currency	Intercept	Conditional beta	Idiosyncratic volatility	Orthogonal standardized co-skewness	Idiosyncratic skewness	Orthogonal standardized co-kurtosis	Idiosyncratic kurtosis	R2	economic impact of conditional standarized	
									co-skewness	co-kurtosis
JPY	0.039 (0.41)	0.423 (0.545)	3.591** (2.453)	-0.599* (-1.903)	-0.708 (-1.479)	-0.118 (-0.588)	0.747 (0.63)	4.0%	-1.9%	0.0%
CNY	0.04*** (4.11)	-0.334 (-1.138)	1.879*** (3.509)	-0.118 (-0.901)	0.016 (0.92)	-0.053 (-0.153)	-0.016 (-1.319)	5.9%	0.0%	0.0%
CNH	0.174 (0.71)	-1.901 (-0.642)	1.058 (0.184)	2.219 (1.257)	-0.644 (-0.949)	0.277 (0.011)	1.455*** (2.669)	5.7%	0.0%	0.0%

3nd step results: Regressions of 6-month future currency excess return on orthogonal factors

Currency	Intercept	Conditional beta	Orthogonal standardized co-skewness	Orthogonal standardized co-kurtosis	R2	economic impact of conditional standarized	
						co-skewness	co-skewness
JPY	0.086 (0.921)	0.853 (1.158)	-0.518 (-1.631)	-0.053 (-0.773)	1.6%	0.0%	0.0%
CNY	0.033** (2.369)	-0.185 (-0.609)	-0.117 (-0.55)	0.21 (0.42)	1.2%	0.0%	0.0%
CNH	0.686*** (3.072)	-7.946*** (-3.017)	1.14 (0.561)	25.105** (2.089)	6.3%	0.0%	2.1%

Currency	Intercept	Conditional beta	Idiosyncratic volatility	Orthogonal standardized co-skewness	Idiosyncratic skewness	Orthogonal standardized co-kurtosis	Idiosyncratic kurtosis	R2	economic impact of conditional standarized	
									co-skewness	co-kurtosis
JPY	0.086 (0.954)	0.858 (1.2)	0.87 (0.615)	-0.527* (-1.677)	-0.757 (-1.264)	0.059 (0.3)	0.777 (0.869)	2.3%	-1.7%	0.0%
CNY	0.033** (2.406)	-0.19 (-0.625)	-0.425 (-0.47)	-0.118 (-0.548)	-0.017 (-0.502)	0.203 (0.393)	-0.024* (-1.889)	2.8%	0.0%	0.0%
CNH	0.693*** (2.685)	-8.037*** (-2.655)	-3.076 (-0.615)	1.33 (0.819)	-1.417*** (-3.578)	25.283** (2.178)	0.176 (0.264)	8.8%	0.0%	2.2%

3nd step results: Regressions of 12-month future currency excess return on orthogonal factors

Currency	Intercept	Conditional beta	Orthogonal standardized co-skewness	Orthogonal standardized co-kurtosis	R2	economic impact of conditional standarized	
						co-skewness	co-skewness
JPY	-0.108 (-0.712)	-0.896 (-0.663)	-0.906* (-1.853)	-0.036 (-0.698)	3.4%	-1.9%	0.0%
CNY	0.037** (2.396)	-0.255 (-0.677)	-0.202 (-1.143)	0.168 (0.445)	2.3%	0.0%	0.0%
CNH	-0.475 (-1.049)	5.853 (1.095)	-2.378 (-0.567)	-5.068 (-0.287)	2.6%	0.0%	0.0%

Currency	Intercept	Conditional beta	Idiosyncratic volatility	Orthogonal standardized co-skewness	Idiosyncratic skewness	Orthogonal standardized co-kurtosis	Idiosyncratic kurtosis	R2	economic impact of conditional standarized	
									co-skewness	co-kurtosis
JPY	-0.111 (-0.742)	-0.935 (-0.682)	1.105 (0.491)	-0.987** (-2.249)	-0.398 (-0.727)	0.231 (0.841)	-0.155 (-0.103)	4.0%	-2.2%	0.0%
CNY	0.036*** (2.611)	-0.265 (-0.74)	-1.366 (-1.368)	-0.178 (-1.088)	-0.058 (-1.531)	0.24 (0.771)	-0.01 (-0.926)	5.6%	0.0%	0.0%
CNH	-0.447* (-1.82)	5.379* (1.891)	9.381* (1.775)	0.393 (0.112)	-3.09*** (-3.372)	1.555 (0.123)	2.194*** (3.089)	21.9%	0.0%	0.0%

Comments

- **JPY coskewness is priced while RMB counterparts are not**

"Prudent" equity investors use JPY but not RMB to hedge against global stock market volatility

Why is that?

Probably because there is still capital control in the CNY market and there is not liquid CNH treasury market

- **All cokurtosises are not priced**

Robustness

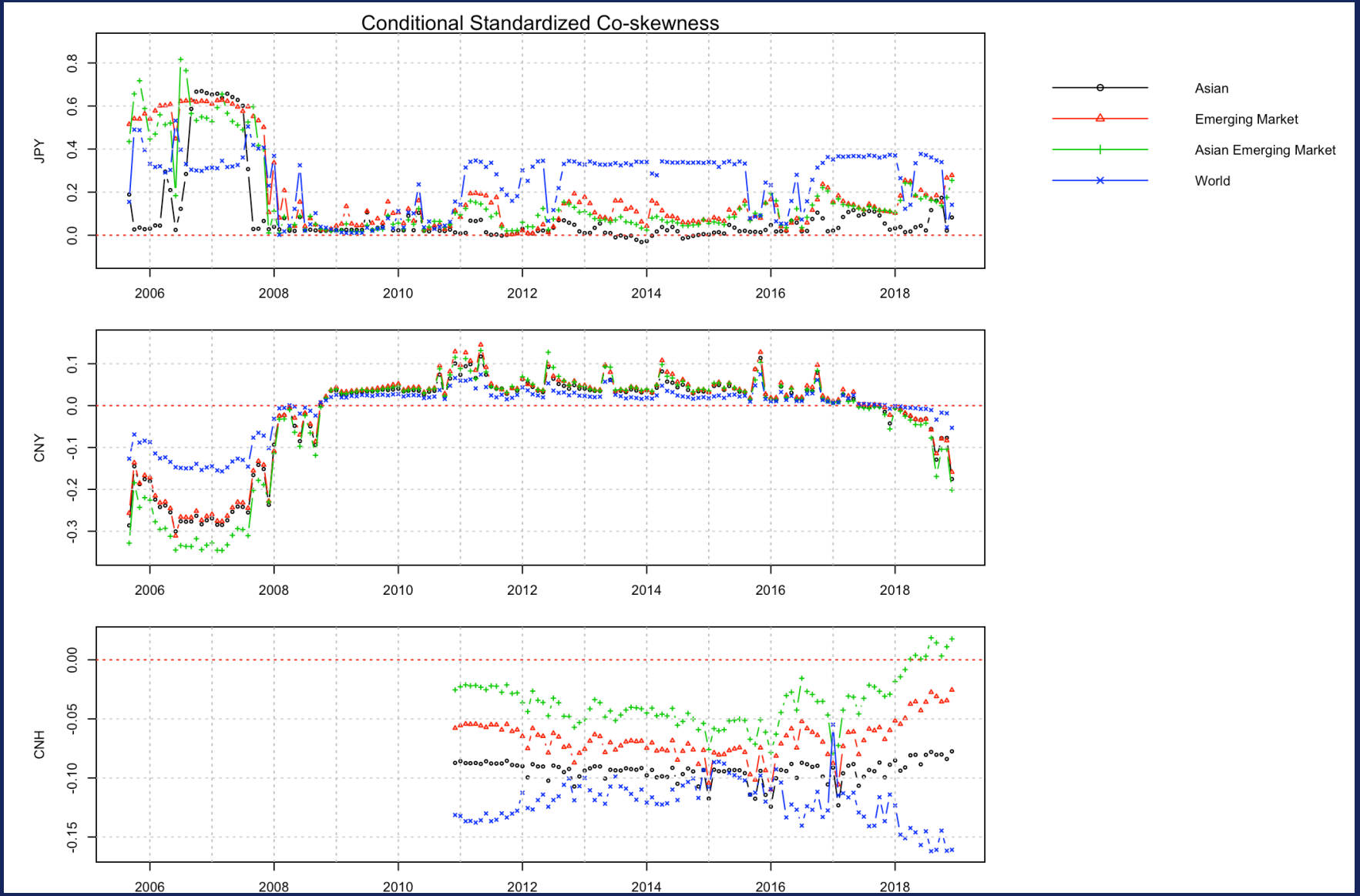
Use Asian, emerging market, and Asian emerging market indices to replace the world stock market index

The results are similar

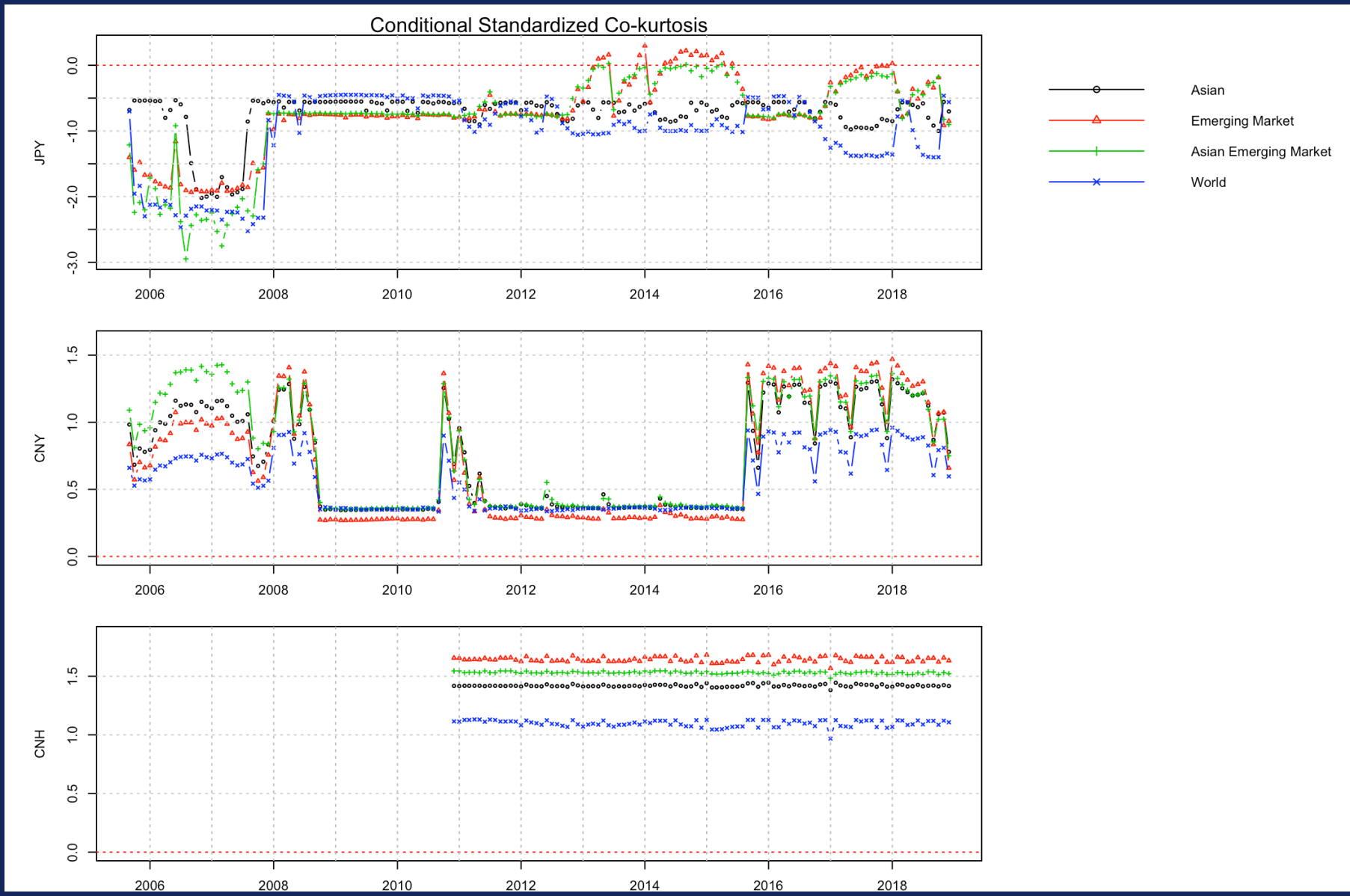
- **CNY can hedge against stock volatility in some period but no crash**
- **CNH can't hedge against stock volatility and crash**
- **In contrast, JPY can hedge against both**

RMB coskewness and cokurtosis effects are not priced while JPY coskewness are priced

Robustness: conditional coskewness



Robustness: conditional cokurtosis



Conclusions

- JPY can hedge against stock market volatility and CNY can do it sometimes while CNH can't
- RMB' capacity to hedge against volatility is not priced while JPY's counterpart is priced
- RMB can't hedge against stock market crash but JPY can
- Neither JPY nor RMB's capacity to hedge against crash is priced
- RMB is not a safe haven currency yet

Thank you!