

The Shifting Drivers of Exchange Rates: Uncertainty, Interest Rate Parity, and Internationalization

Yuki Masujima

Bloomberg L.P.

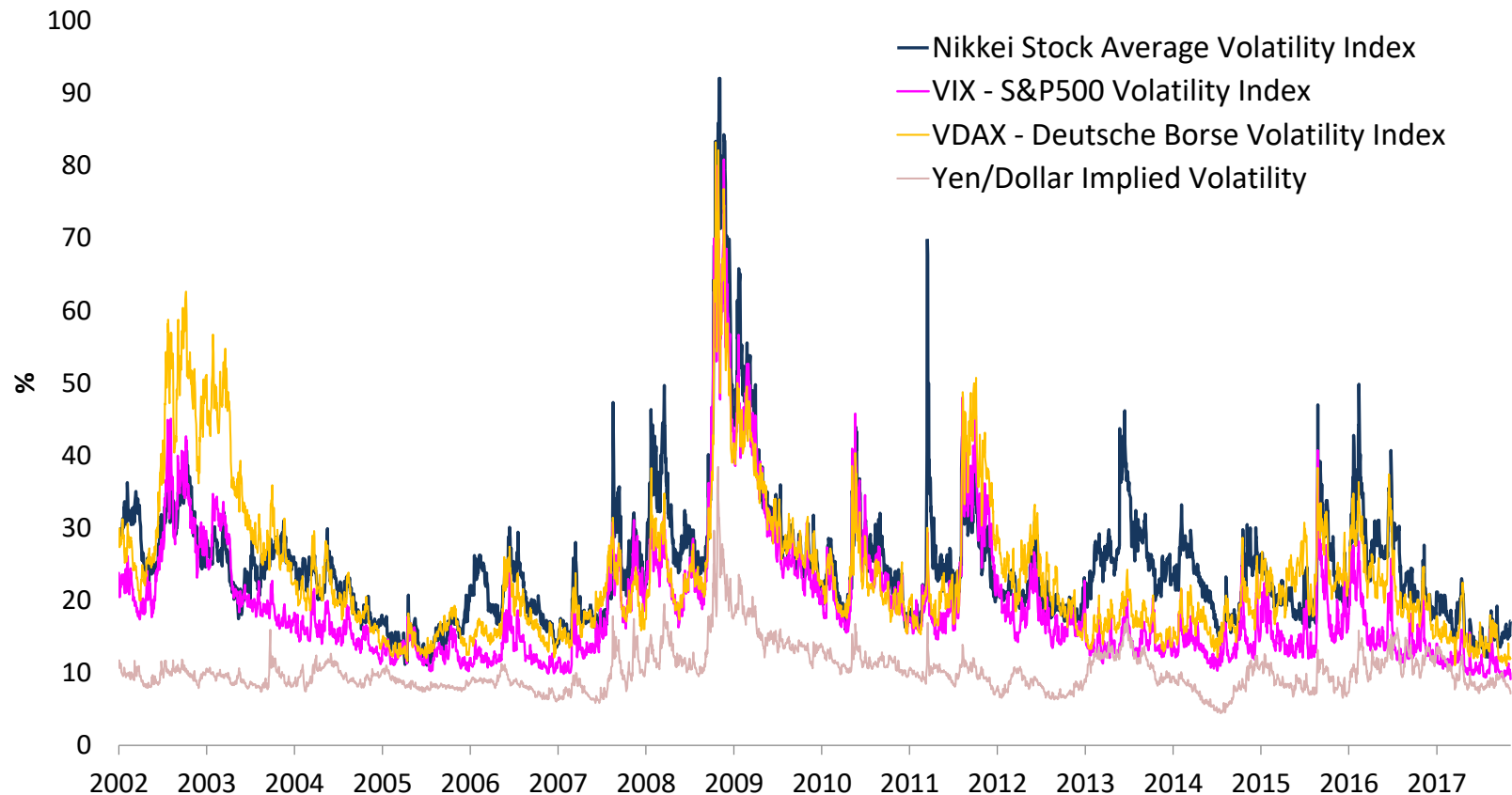
December 1st, 2018

MOTIVATION AND QUESTIONS

- Risk-off episodes have driven the FX move, safe haven currencies as well as fragile currencies
 - a safe-haven currency, which appreciates when global investors' behavior tends to be risk-averse
 - Masujima(2017) finds the safe-haven/vulnerable status is changing overtime
 - Uncovered Interest Parity and A Role of Interest Rate Differentials
1. What are determinants of the FX movement?
 2. How have the drivers of exchange rates been changing overtime?

EQUITY AND FX VOLATILITY INDEX: HIGHER CORRELATION AFTER 2007

Cross-asset co-movement matters for the FX moves



Source: Bloomberg

LITERATURE REVIEW

Verdelhan (2018) – Dollar and Carry Trade Risks Factors and FX Movements

Ismailov and Rossi (2017), Lustig and Verdelhan (2007) – Uncertainty, Growth Risk and UIP conditions
UIP is more likely to hold in low uncertainty environments, relative to high uncertainty ones, based on the assessment of a new exchange rate uncertainty index. Decomposing the uncertainty of a typical forecaster into common and idiosyncratic uncertainty.

Habib and Stracca (2012) – Safe Haven Determinants

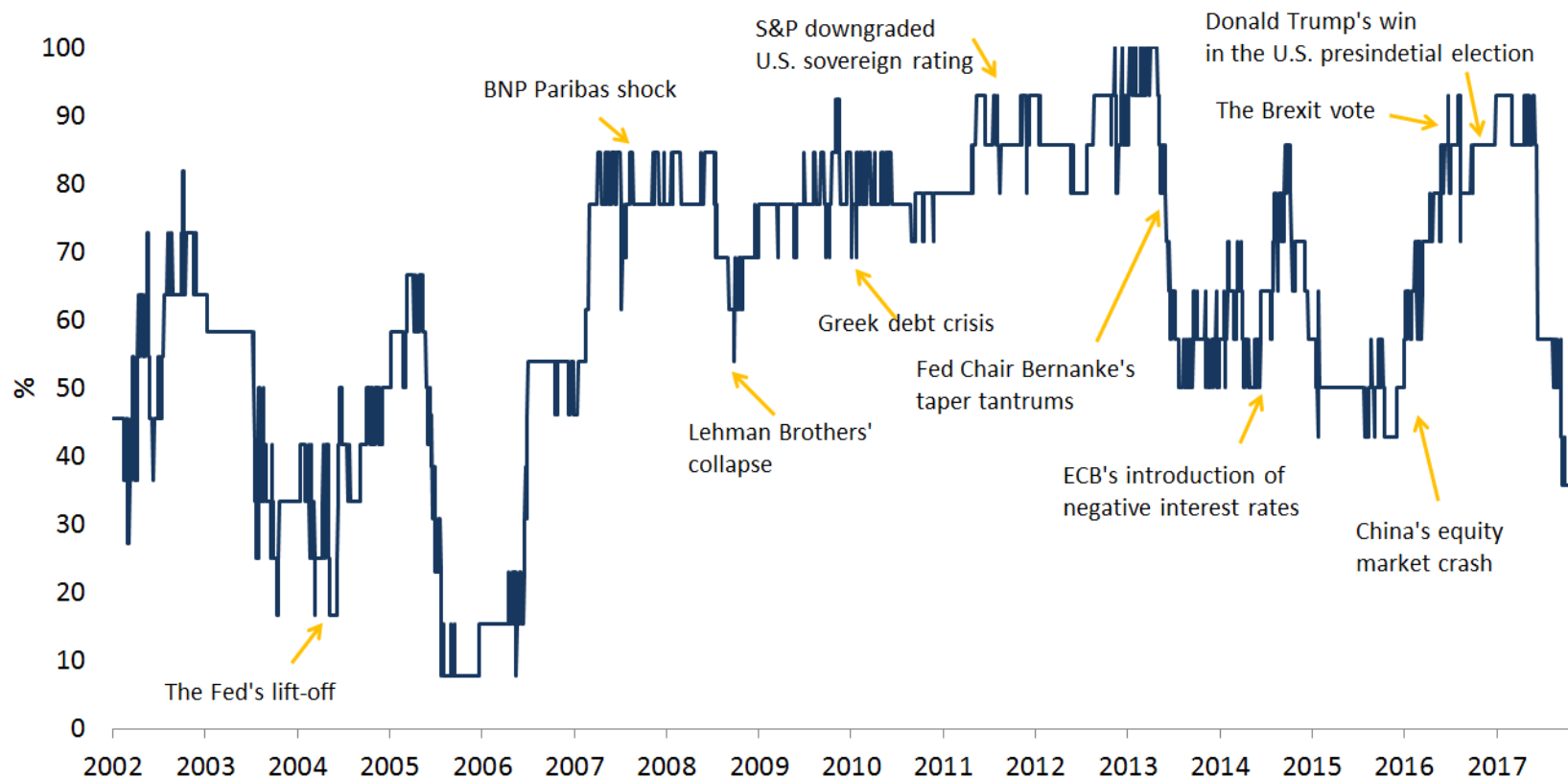
Safe haven status is robustly associated with stronger net foreign asset positions (an indicator of external vulnerability), and to a lesser extent with the absolute size of stock market (an indicator of market size and financial development). with safe haven status.

Ozturk and Sheng (2017), Baker, Bloom, and Davis (2016) – Uncertainty measurement

OS show persistent effects on economic activity from common uncertainty and short-lived effects from idiosyncratic uncertainty. BBD develop text-based uncertainty measurements.

A CRISIS TENDS TO STRENGTHEN SAFE HAVEN EFFECTS

Share of currencies statistically significant at the 10% level



Note: Share of currencies that are statistically significant at the 10% level on their safe haven indexes.

Source: Masujima (2019)

HOW DOES FX RATE RESPOND TO UNCERTAINTY?

Safe Haven Ranking

Ranking	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	CHF	CHF	CHF	THB	CHF	CHF	JPY	JPY	JPY	USD	USD	JPY	JPY	JPY	JPY	JPY
2	EUR	GOLD	Crude Oil	HKD	THB	JPY	CHF	HKD	USD	JPY	JPY	Bitcoin	CHF	CHF	CHF	GOLD
3	SGD	EUR	HKD	Crude Oil	GBP	THB	THB	USD	THB	GOLD	GOLD	HKD	Bitcoin	HKD	Bitcoin	CNY
4	GOLD	THB	EUR	MYR	USD	USD	USD	CNY	CNY	Bitcoin	CNH	USD	CNY	GOLD	EUR	CHF
5	GBP	SGD	GOLD	USD	IDR	HKD	HKD	CHF	Bitcoin	CHF	CNY	IDR	USD	EUR	GOLD	Bitcoin
6	JPY	GBP	GBP	GBP	EUR	Crude Oil	Crude Oil	THB	IDR	CNH	IDR	CNY	GOLD	CNY	USD	USD
7	THB	Crude Oil	THB	CHF	Crude Oil	CNY	CNY	MYR	HKD	CNY	Bitcoin	CNH	EUR	USD	CNY	CNH
8	USD	JPY	USD	EUR	HKD	EUR	GOLD	GOLD	CNH	THB	HKD	GBP	HKD	GBP	MYR	EUR
9	HKD	USD	CAD	IDR	AUD	GBP	EUR	IDR	CHF	HKD	CHF	MYR	CNH	CNH	IDR	SGD
10	AUD	IDR	KRW	AUD	SGD	SGD	KRW	KRW	GOLD	IDR	THB	KRW	IDR	SGD	HKD	MYR
11	Crude Oil	HKD	SGD	SGD	CAD	CAD	SGD	GBP	MYR	MYR	MYR	THB	GBP	Bitcoin	SGD	IDR
12	KRW	KRW	IDR	GOLD	CNY	GOLD	GBP	EUR	KRW	Crude Oil	Crude Oil	CHF	Crude Oil	THB	CNH	THB
13	CAD	AUD	JPY	JPY	JPY	IDR	MYR	Crude Oil	EUR	GBP	KRW	GOLD	CAD	AUD	GBP	HKD
14		CAD	AUD	CAD	KRW	KRW	IDR	SGD	GBP	EUR	GBP	Crude Oil	THB	IDR	THB	GBP
15				KRW	MYR	MYR	CAD	CAD	Crude Oil	KRW	EUR	EUR	MYR	KRW	KRW	Crude O
16				CNY	GOLD	AUD	AUD	AUD	SGD	CAD	CAD	SGD	KRW	Crude Oil	Crude Oil	AUD
17									CAD	SGD	SGD	CAD	SGD	MYR	AUD	KRW
18									AUD	AUD	AUD	AUD	AUD	CAD	CAD	CAD

Source: Masujima (2019)

DATA, MODEL

DATA

- ❑ Foreign exchange rates of 21 currencies (10 advanced, 11 emerging economies)
- ❑ Two-year government bond yields of 21 economies plus the U.S.
- ❑ VIX - 30-day expected volatility of the U.S. S&P 500 volatility index

Sample period: daily data from the beginning of 2001 through Dec. 31, 2017

Sources: Bloomberg

THE MODEL (1)

Verdelhan (2018)

Uncovered Interest Parity Factor Model

$$\Delta s_{i,t+1} = \alpha_i + \beta_i(r_{i,t} - r_t) + \gamma_i(r_{i,t} - r_t)Carry_{t+1} + \delta_i Carry_{t+1} + \tau_i Dollar_{t+1} + v_i VIX_{t+1} + \varepsilon_{i,t+1}$$

Uncovered Interest Rate Parity Condition

Conditional Carry Trade Factor

Dollar Factor

Uncertainty Factor (Level)

$s_{i,t+1}$ denotes the bilateral exchange rate in foreign currency per U.S. dollar

$r_{i,t} - r_t$ is the two-year interest rate differential between the foreign country and the U.S.

$Carry_{t+1}$ denotes the dollar-neutral average change in exchange rates obtained by going long a basket of high interest rate currencies and short a basket of low interest rate currencies among 10 advanced economies and areas

$Dollar_{t+1}$ corresponds to the average change in exchange rates against the U.S. dollar

VIX_{t+1} reflects Chicago Board Options Exchange (CBOE) volatility index of S&P 500 index. The charts include the slope coefficients β , γ , δ , τ , and v , as well as the p-values of the regressions (in 0.01 percentage points). The sample period is the beginning of 2001 to end of 2017, which varies by currency.

$$Carry_{t+1} = \frac{1}{N_H} \sum_{i \in H} \Delta s_{i,t+1} - \frac{1}{N_L} \sum_{i \in L} \Delta s_{i,t+1}$$

$N_H = N_L = 2$ for advanced or EM portfolio

$N_H = N_L$ for advanced and EM portfolio

$$Dollar_{t+1} = \frac{1}{N} \sum_i \Delta s_{i,t+1}$$

$N = 10$ or 11 for advanced or EM portfolio

$N = 21$ for advanced and EM portfolio

CARRY TRADE – HIGH & LOW YIELD CCYS IN PORTFOLIO

Two-year Yield and Its Ranking in Advanced Economies

Year	USD		JPY		CHF		EUR		GBP		SEK		DKK		NOK		AUD		NZD		CAD	
	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield
2002	3	2.6	1	0.1	2	1.7	4	3.7	7	4.4	8	4.6	6	4.1	11	6.2	9	5.1	10	5.9	5	3.6
2003	3	1.6	1	0.1	2	0.6	3	2.5	8	3.8	7	3.5	5	2.8	9	4.0	10	4.8	11	5.3	6	3.3
2004	4	2.4	1	0.1	2	1.0	3	2.5	9	4.6	6	2.8	5	2.6	8	3.1	10	5.2	11	5.9	7	2.9
2005	9	3.8	1	0.2	2	1.1	4	2.4	8	4.4	3	2.2	5	2.4	6	2.7	10	5.3	11	6.1	7	3.2
2006	9	4.8	1	0.7	2	1.9	5	3.4	8	4.7	4	3.2	6	3.5	3	2.7	10	5.7	11	6.3	7	4.0
2007	7	4.4	1	0.9	2	2.6	4	4.1	9	5.3	3	4.0	6	4.2	8	4.5	10	6.4	11	7.1	5	4.2
2008	3	2.0	1	0.7	2	2.0	5	3.5	8	4.0	6	3.7	7	4.0	9	4.8	10	5.7	11	7.3	4	2.7
2009	3	0.9	1	0.3	2	0.5	7	1.3	6	1.2	4	1.1	8	1.9	9	2.6	10	3.7	11	6.5	5	1.2
2010	4	0.7	1	0.2	2	0.4	3	0.8	5	1.0	7	1.5	6	1.0	9	2.1	11	4.7	10	3.8	8	1.5
2011	3	0.4	1	0.2	2	0.3	5	1.1	4	0.9	8	1.8	6	1.2	9	1.9	11	4.3	10	3.3	7	1.4
2012	6	0.3	4	0.1	1	-0.1	3	0.1	5	0.3	7	0.9	2	0.0	9	1.4	11	2.9	10	2.6	8	1.1
2013	6	0.3	2	0.1	1	0.0	3	0.1	5	0.4	7	1.0	4	0.3	9	1.5	10	2.7	11	2.8	8	1.1
2014	6	0.4	3	0.1	1	-0.1	2	0.0	7	0.7	5	0.4	4	0.1	9	1.4	10	2.6	11	3.2	8	1.1
2015	9	0.7	5	0.0	1	-0.8	4	-0.2	7	0.5	3	-0.3	2	-0.3	8	0.9	10	1.9	11	2.9	6	0.6
2016	9	0.8	5	-0.2	1	-0.9	3	-0.6	6	0.3	2	-0.6	4	-0.4	8	0.6	10	1.7	11	2.1	7	0.6
2017	9	1.4	5	-0.2	1	-0.9	2	-0.7	6	0.3	3	-0.7	4	-0.6	7	0.6	10	1.8	11	2.1	8	1.1

Note: Yields are percent. The dollar's yield is excluded to estimate carry trade variables as it works as a base currency in bilateral exchange rates.

Source: Bloomberg, Author's Estimation

Two-year Yield and Its Ranking in Emerging Markets

Year	CNY		HKD		IDR		MYR		KRW		THB		SGD		MXN		TRY		ZAR		BRL	
	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield
2002			3	2.7					4	5.7	2	2.3	1	1.5	5	9.0			6	10.5		
2003			2	1.5	7	11.1			4	4.6	3	1.6	1	1.0	5	7.4			6	9.5		
2004			2	1.5	7	9.0			4	4.1	3	2.0	1	1.3	5	7.2			6	8.3		
2005	1	1.7	4	3.2	9	11.1	3	3.2	6	4.3	5	3.5	2	2.1	8	9.0	10	15.7	7	7.5		
2006	1	2.1	4	4.1	9	11.8	3	3.8	5	4.8	6	4.9	2	3.0	7	7.3	10	17.8	8	8.0		
2007	2	3.1	5	3.7	8	7.9	3	3.5	6	5.3	4	3.8	1	2.4	7	7.6	11	18.3	9	9.1	10	11.4
2008	3	3.4	2	1.7	9	11.2	4	3.6	6	5.3	5	3.6	1	1.1	7	7.9	11	19.3	8	9.9	10	14.1
2009	3	1.5	2	0.6	9	9.0	5	2.6	6	3.7	4	1.9	1	0.6	7	5.7	11	11.6	8	6.5	10	10.9
2010	4	2.3	2	0.6	8	6.8	5	3.0	6	3.6	3	2.2	1	0.5	7	5.0	10	8.4	9	7.1	11	11.9
2011	5	3.4	2	0.4	8	6.1	3	3.1	6	3.6	4	3.2	1	0.3	7	5.0	10	8.8	9	6.8	11	12.0
2012	3	2.8	2	0.2	8	5.0	4	3.0	5	3.1	6	3.1	1	0.2	7	4.7	10	8.3	9	5.4	11	8.7
2013	6	3.5	1	0.3	8	6.0	5	3.1	3	2.7	4	2.8	2	0.3	7	4.0	10	7.4	9	5.7	11	9.8
2014	7	3.7	1	0.4	9	7.5	5	3.3	4	2.5	3	2.3	2	0.5	6	3.7	10	9.3	8	6.4	11	12.1
2015	5	2.8	1	0.4	9	7.8	6	3.3	4	1.8	3	1.7	2	1.0	7	4.1	10	9.7	8	6.9	11	14.1
2016	5	2.5	1	0.6	8	7.2	6	3.0	4	1.4	3	1.4	2	1.0	7	4.9	10	9.7	9	7.9	11	12.9
2017	5	2.7	1	0.9	7	6.4	6	3.3	4	1.7	3	1.5	2	1.3	8	6.9	11	11.8	9	7.4	10	9.0

Note: Yields are two-year rates (percent).

Source: Bloomberg, Author's Estimation

THE MODEL (2)

Verdelhan (2018)

Contemporaneous Adjustment Factor Model

$$\begin{aligned}\Delta s_{i,t} = & \alpha_i + \beta_i \Delta(r_{i,t} - r_t) \\ & + \gamma_i (r_{i,t} - r_t) Carry_t + \delta_i Carry_t \\ & + \tau_i Dollar_t \\ & + v_i \Delta(VIX_t) \\ & + \varepsilon_i\end{aligned}$$

Relative Interest Rate Adjustment

Conditional Carry Trade Factor

Dollar Factor

Uncertainty Factor (Change)

$s_{i,t+1}$ denotes the bilateral exchange rate in foreign currency per U.S. dollar

$r_{i,t} - r_t$ is the two-year interest rate differential between the foreign country and the U.S.

$Carry_{t+1}$ denotes the dollar-neutral average change in exchange rates obtained by going long a basket of high interest rate currencies and short a basket of low interest rate currencies among 10 advanced economies and areas

$Dollar_{t+1}$ corresponds to the average change in exchange rates against the U.S. dollar

VIX_{t+1} reflects Chicago Board Options Exchange (CBOE) volatility index of S&P 500 index. The charts include the slope coefficients β , γ , δ , τ , and v , as well as the p-values of the regressions (in 0.01 percentage points). The sample period is the beginning of 2001 to end of 2017, which varies by currency.

$$Carry_{t+1} = \frac{1}{N_H} \sum_{i \in H} \Delta s_{i,t+1} - \frac{1}{N_L} \sum_{i \in L} \Delta s_{i,t+1}$$

$N_H = N_L = 2$ for advanced or EM portfolio

$N_H = N_L$ for advanced and EM portfolio

$$Dollar_{t+1} = \frac{1}{N} \sum_i \Delta s_{i,t+1}$$

$N = 10$ or 11 for advanced or EM portfolio

$N = 21$ for advanced and EM portfolio

WHAT DETERMINES THE FX MOVES

--FULL SAMPLE ANALYSIS

OLS REGRESSION (ADVANCED ECONOMIES – ADV. CARRY)

Uncovered Interest Parity Factor Model

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependant Variable		<i>dlog(bilateral exchange rate against the U.S. dollar) [t+1]</i>									
Country		AUD	CAD	CHF	DKK	EUR	GBP	JPY	NOK	NZD	SEK
Constant [t]	α	0.020	-0.019	-0.016	0.036**	0.032**	-0.026	0.088***	0.027	0.034	0.006
Two-year yield spreads [t]	β	-0.001	-0.002	0.009	-0.009	-0.008	0.002	-0.008	-0.015	0.003	0.002
Yield spreads [t] * Carry [t+1]	γ	0.011	-0.010	0.067***	-0.039***	-0.052***	-0.016*	-0.003	-0.089***	0.021*	-0.073***
Carry [t+1]	δ	0.466***	0.152***	-0.614***	-0.260***	-0.249***	-0.069***	-0.515***	-0.165***	0.583***	-0.152***
Dollar [t+1]	τ	1.337***	0.948***	1.602***	1.449***	1.453***	1.065***	0.769***	1.688***	1.285***	1.660***
VIX [t+1]	υ	-0.001**	0.001	0.000	-0.002***	-0.002***	0.001*	-0.004***	-0.001	-0.002	-0.001
R-squared		0.794	0.531	0.645	0.715	0.716	0.459	0.376	0.679	0.744	0.655
Durbin-Watson		2.299	2.093	2.136	1.968	1.965	1.888	2.015	2.167	2.020	2.085
Observations		4025	4024	3987	4026	4027	4025	4023	1669	2740	4024

Note: *, **, *** indicate the 10%, 5%, 1% significant level.

Contemporaneous Adjustment Factor Model

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependant Variable		<i>dlog(bilateral exchange rate against the U.S. dollar) [t]</i>									
Currency		AUD	CAD	CHF	DKK	EUR	GBP	JPY	NOK	NZD	SEK
Constant [t]	α	-0.004	-0.003	-0.011	-0.005	-0.005	0.000	-0.006	0.017	-0.008	-0.002
d(Two-year yield spreads) [t]	β	1.036***	2.015***	0.097	0.716***	0.745***	1.556***	2.155***	1.025***	0.588***	0.490***
Yield spreads [t] * Carry [t]	γ	0.004	0.008	0.039***	-0.049***	-0.062***	-0.028***	-0.004	-0.088***	0.014	-0.074***
Carry [t]	δ	0.461***	0.128***	-0.542***	-0.228***	-0.214***	-0.035***	-0.395***	-0.147***	0.612***	-0.140***
Dollar [t]	τ	1.306***	0.882***	1.616***	1.457***	1.461***	1.040***	0.783***	1.676***	1.292***	1.656***
d(VIX) [t]	υ	0.001	0.044***	-0.039***	-0.033***	-0.033***	-0.022***	-0.080***	-0.008	-0.041***	-0.010*
R-squared		0.803	0.555	0.649	0.725	0.725	0.481	0.445	0.686	0.753	0.655
Durbin-Watson		2.330	2.101	2.186	1.994	1.993	1.925	2.025	2.196	2.071	2.090
Observations		3882	3882	3845	3884	3884	3882	3879	1607	2630	3882

Note: *, **, *** indicate the 10%, 5%, 1% significant level.

OLS REGRESSION (ADVANCED ECONOMIES-GLOBAL CARRY)

Uncovered Interest Parity Factor Model

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependant Variable		<i>dlog(bilateral exchange rate against the U.S. dollar) [t+1]</i>									
Country		AUD	CAD	CHF	DKK	EUR	GBP	JPY	NOK	NZD	SEK
Constant [t]	α	-0.011	-0.031*	0.007	0.041***	0.036**	-0.032**	0.109***	0.023	0.000	-0.003
Two-year yield spreads [t]	β	0.003	0.000	0.002	-0.012**	-0.010*	0.003	-0.011	-0.015	0.022*	0.002
Yield spreads [t] * Carry [t+1]	γ	-0.026***	0.013	0.091***	-0.053***	-0.068***	-0.035***	0.083***	-0.046***	-0.019*	-0.055***
Carry [t+1]	δ	-0.031	0.040***	-0.496***	-0.270***	-0.258***	-0.157***	-0.487***	-0.199***	-0.082**	-0.226***
Dollar [t+1]	τ	1.675***	1.058***	1.386***	1.402***	1.410***	1.101***	0.585***	1.723***	1.609***	1.693***
VIX [t+1]	υ	0.000	0.001*	-0.001	-0.002***	-0.002***	0.002**	-0.004***	-0.001	0.003	0.000
R-squared		0.652	0.499	0.570	0.750	0.752	0.486	0.278	0.692	0.540	0.684
Durbin-Watson		2.241	2.080	2.026	1.933	1.927	1.868	2.055	2.194	2.042	2.090
Observations		4025	4024	3987	4026	4027	4025	4023	1669	2740	4024

Note: *, **, *** indicate the 10%, 5%, 1% significant level.

Contemporaneous Adjustment Factor Model

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependant Variable		<i>dlog(bilateral exchange rate against the U.S. dollar) [t]</i>									
Currency		AUD	CAD	CHF	DKK	EUR	GBP	JPY	NOK	NZD	SEK
Constant [t]	α	-0.001	-0.002	-0.001	0.000	-0.001	0.004	0.000	0.017	-0.005	0.002
d(Two-year yield spreads) [t]	β	0.926***	1.878***	0.470***	0.779***	0.819***	1.486***	2.653***	0.847***	0.270	0.406***
Yield spreads [t] * Carry [t]	γ	-0.023***	0.008	0.053***	-0.056***	-0.070***	-0.037***	0.055***	-0.043***	-0.028**	-0.054***
Carry [t]	δ	-0.067***	0.004	-0.413***	-0.247***	-0.235***	-0.143***	-0.340***	-0.203***	-0.137***	-0.231***
Dollar [t]	τ	1.544***	0.947***	1.449***	1.422***	1.429***	1.075***	0.658***	1.701***	1.540***	1.674***
d(VIX) [t]	υ	0.091***	0.068***	-0.065***	-0.030***	-0.030***	-0.005	-0.101***	0.012	0.072***	0.010**
R-squared		0.680	0.537	0.598	0.760	0.762	0.503	0.393	0.700	0.551	0.685
Durbin-Watson		2.263	2.097	2.096	1.955	1.951	1.906	2.051	2.227	2.018	2.100
Observations		3882	3882	3845	3884	3884	3882	3879	1607	2630	3882

Note: *, **, *** indicate the 10%, 5%, 1% significant level.

OLS REGRESSION (EMERGING MARKETS – EM CARRY)

Uncovered Interest Parity Factor Model

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependant Variable		<i>dlog(bilateral exchange rate against the U.S. dollar) [t+1]</i>											
Country		BRL	CNH	CNY	HKD	IDR	KRW	MXN	MYR	SGD	THB	TRY	ZAR
Constant [t]	α	0.078	0.032	-0.008	-0.001	-0.022	-0.066***	0.015	-0.026	-0.006	-0.007	0.100***	0.148**
Two-year yield spreads [t]	β	0.005	0.008	-0.001	0.005***	0.008	0.008	0.016*	-0.005	0.004	-0.002	0.007**	0.020*
Yield spreads [t] * Carry [t+1]	γ	-0.021***	0.044***	0.000	-0.004**	-0.008*	-0.019*	0.033***	0.028***	0.000	0.004	-0.013***	-0.007
Carry [t+1]	δ	0.889***	0.053*	-0.029***	-0.004***	-0.087**	-0.142***	0.395***	-0.048**	-0.089***	-0.043***	0.567***	0.209**
Dollar [t+1]	τ	0.414***	0.277***	0.096***	0.020***	0.373***	0.668***	0.876***	0.484***	0.775***	0.398***	0.614***	1.947***
VIX [t+1]	υ	-0.002**	-0.001	0.000	0.000	0.005***	0.004***	0.004***	0.001	0.000	0.000	-0.001	-0.002
R-squared		0.781	0.181	0.055	0.045	0.074	0.116	0.402	0.143	0.642	0.199	0.678	0.521
Durbin-Watson		2.108	1.698	1.906	2.056	2.337	2.248	2.072	2.257	2.265	2.087	2.187	2.101
Observations		2529	1515	2684	3624	3406	3823	3781	2921	3868	3582	3135	2805

Note: *, **, *** indicate the 10%, 5%, 1% significant level.

Contemporaneous Adjustment Factor Model

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependant Variable		<i>dlog(bilateral exchange rate against the U.S. dollar) [t]</i>											
Country		BRL	CNH	CNY	HKD	IDR	KRW	MXN	MYR	SGD	THB	TRY	ZAR
Constant [t]	α	-0.010	-0.002	-0.010***	0.000	0.015*	-0.006	0.017*	0.000	-0.006*	-0.002	0.004	0.005
d(Two-year yield spreads) [t]	β	-0.713***	0.213**	0.220***	-0.002	-0.229***	-0.299*	-0.759***	0.120	0.244***	0.079	-0.706***	-1.509***
Yield spreads [t] * Carry [t]	γ	0.172***	-0.393**	0.006	0.009	-0.168***	0.307*	-0.069	-0.366***	0.050***	-0.131**	-0.084***	-0.226*
Carry [t]	δ	1.073***	-0.043***	-0.026***	-0.004***	-0.020	-0.077***	0.141***	-0.092***	-0.149***	-0.048***	0.667***	0.163***
Dollar [t]	τ	0.393***	0.266***	0.086***	0.020***	0.368***	0.651***	0.765***	0.498***	0.755***	0.400***	0.589***	1.765***
d(VIX) [t]	υ	0.017***	-0.012***	0.003**	0.000	0.053***	0.093***	0.113***	0.050***	0.008***	0.002	-0.006	0.072***
R-squared		0.788	0.184	0.058	0.041	0.108	0.167	0.469	0.191	0.659	0.198	0.702	0.547
Durbin-Watson		2.090	1.914	2.004	2.052	2.350	2.284	2.067	2.291	2.255	2.093	2.154	2.136
Observations		2439	1327	2424	3380	3191	3560	3581	2676	3627	3225	2992	2699

Note: *, **, *** indicate the 10%, 5%, 1% significant level.

OLS REGRESSION (EMERGING MARKETS-GLOBAL CARRY)

Uncovered Interest Parity Factor Model

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependant Variable		$d\log(\text{bilateral exchange rate against the U.S. dollar}) [t+1]$											
Country		BRL	CNH	CNY	HKD	IDR	KRW	MXN	MYR	SGD	THB	TRY	ZAR
Constant [t]	α	0.093	0.037*	-0.008	-0.001	-0.020	-0.060**	0.019	-0.022	-0.008	-0.007	0.146***	0.141**
Two-year yield spreads [t]	β	0.003	0.010	-0.001	0.005***	0.005	0.007	0.014*	-0.005	0.005	-0.002	0.008***	0.016
Yield spreads [t] * Carry [t+1]	γ	-0.027***	0.014	-0.002	-0.005**	-0.004	-0.014	0.037***	-0.012	-0.016***	-0.002	-0.028***	0.029**
Carry [t+1]	δ	0.398***	0.013	-0.014***	0.000	0.083**	-0.020	0.442***	0.011	-0.037***	-0.026***	0.171***	0.544***
Dollar [t+1]	τ	1.140***	0.235***	0.074***	0.016***	0.277***	0.559***	0.959***	0.349***	0.709***	0.363***	1.020***	1.928***
VIX [t+1]	υ	-0.003**	-0.001	0.000	0.000	0.004***	0.003**	0.003**	0.001	0.000	0.000	-0.002**	-0.003
R-squared		0.635	0.163	0.044	0.038	0.096	0.106	0.440	0.128	0.620	0.192	0.618	0.562
Durbin-Watson		2.255	1.695	1.900	2.059	2.343	2.263	2.104	2.292	2.271	2.085	2.219	2.127
Observations		2529	1515	2684	3624	3406	3823	3781	2921	3868	3582	3135	2805

Note: *, **, *** indicate the 10%, 5%, 1% significant level.

Contemporaneous Adjustment Factor Model

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependant Variable		$d\log(\text{bilateral exchange rate against the U.S. dollar}) [t]$											
Country		BRL	CNH	CNY	HKD	IDR	KRW	MXN	MYR	SGD	THB	TRY	ZAR
Constant [t]	α	-0.007	-0.003	-0.011***	0.000	0.015	-0.009	0.016*	-0.003	-0.006*	-0.003	0.012	0.007
$d(\text{Two-year yield spreads}) [t]$	β	-1.256***	0.192*	0.223***	0.012	-0.208***	-0.317*	-0.614***	0.141	-0.202***	0.084	-0.680***	-1.189***
Yield spreads [t] * Carry [t]	γ	-0.019***	0.011	-0.002	-0.005**	-0.002	-0.020**	0.031***	-0.015*	-0.012**	-0.001	-0.022***	0.032***
Carry [t]	δ	0.438***	0.009	-0.015***	0.000	0.101***	-0.021	0.335***	0.015	-0.045***	-0.029***	0.219***	0.501***
Dollar [t]	τ	1.140***	0.237***	0.068***	0.016***	0.275***	0.553***	0.837***	0.360***	0.701***	0.365***	1.032***	1.853***
$d(\text{VIX}) [t]$	υ	-0.029***	-0.011***	0.003**	0.000	0.051***	0.096***	0.095***	0.050***	0.006**	0.002	-0.036***	0.041***
R-squared		0.657	0.173	0.050	0.033	0.127	0.161	0.486	0.180	0.619	0.190	0.637	0.571
Durbin-Watson		2.236	1.912	2.005	2.025	2.348	2.280	2.097	2.293	2.256	2.093	2.155	0.000
Observations		2439	1327	2424	3380	3191	3560	3581	2676	3627	3225	2992	2699

Note: *, **, *** indicate the 10%, 5%, 1% significant level.

R² COMPARISON –

BASELINE, UIP, CONTEMPORANEOUS ADJUSTMENT MODELS

Overall results shows a change in yield differentials and VIX explain the FX movement of Asian currencies more than non-Asian currencies

Verdelhan (2018)
UIP
Contemp. Adj.

Country	AUD	CAD	CHF	DKK	EUR	GBP	JPY	NOK	NZD	SEK
R-squared	0.793	0.529	0.645	0.714	0.715	0.458	0.372	0.678	0.745	0.654
R-squared	0.794	0.531	0.645	0.715	0.716	0.459	0.376	0.679	0.744	0.655
R-squared	0.803	0.555	0.649	0.725	0.725	0.481	0.445	0.686	0.753	0.655

Verdelhan (2018)
UIP
Contemp. Adj.

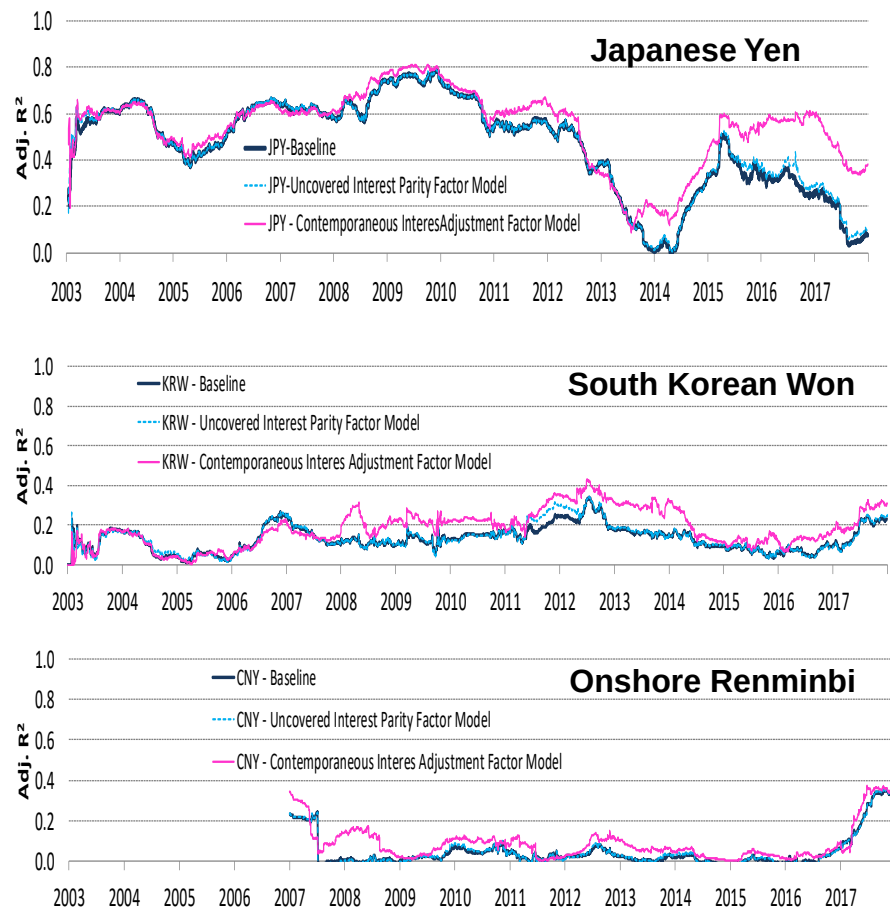
BRL	CNH	CNY	HKD	IDR	KRW	MXN	MYR	SGD	THB	TRY	ZAR
0.779	0.176	0.052	0.044	0.067	0.115	0.398	0.143	0.640	0.196	0.678	0.521
0.781	0.181	0.055	0.045	0.074	0.116	0.402	0.143	0.642	0.199	0.678	0.521
0.788	0.184	0.058	0.041	0.108	0.167	0.469	0.191	0.659	0.198	0.702	0.547

A SHIFT IN THE FX DRIVERS

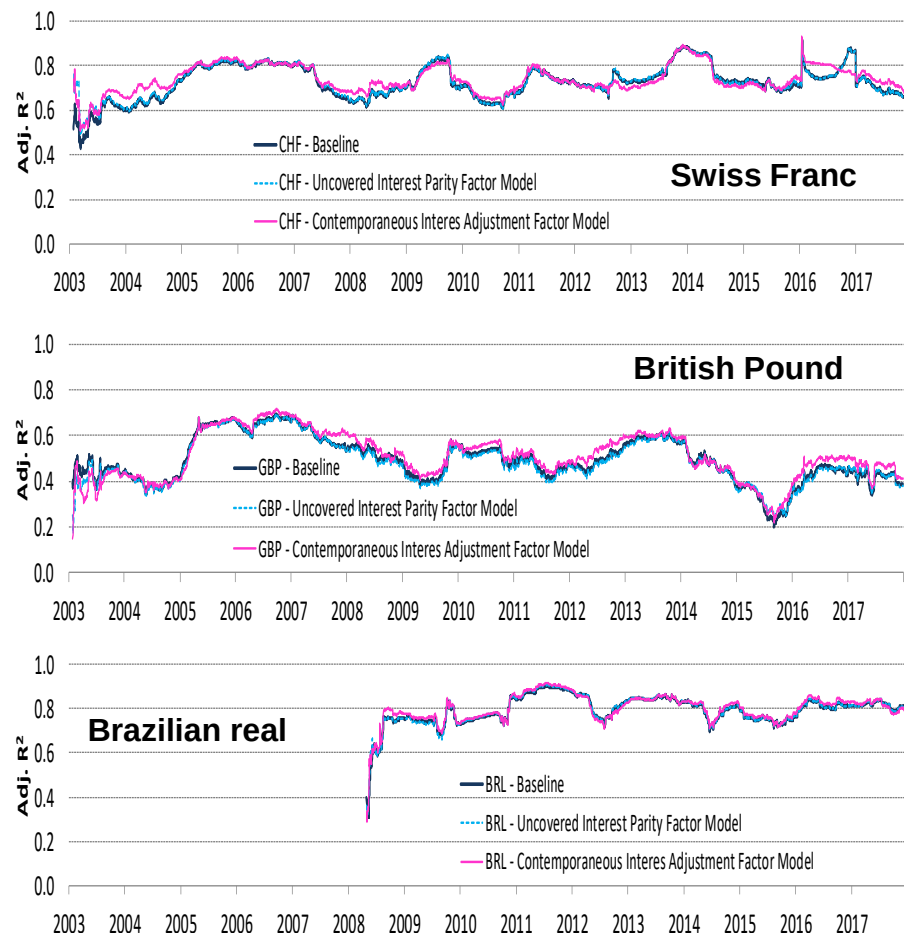
--ROLLING REGRESSION

R² COMPARISON – BASELINE, UIP, CONTEMPORANEOUS ADJUSTMENT MODELS

Asian Currencies



Non-Asian Currencies

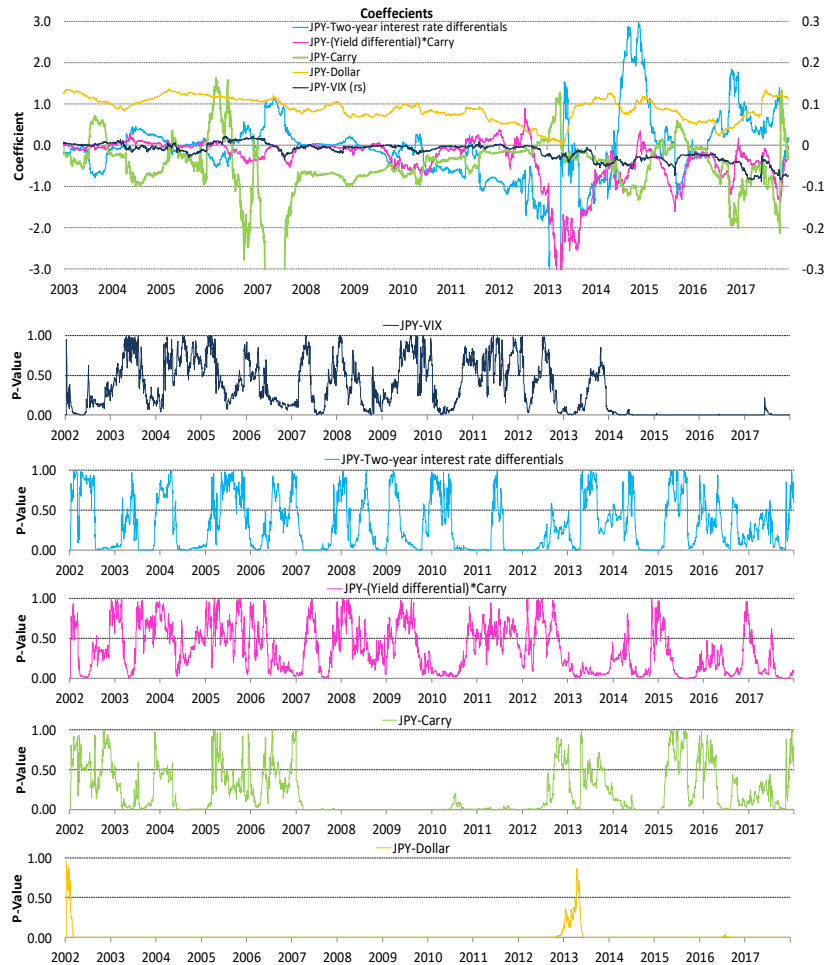


Source: Bloomberg Economics, author's estimation

YEN – ΔVIX AND $\Delta YIELD$ DIFFERENTIAL WORK WELL

UIP-Factor Model

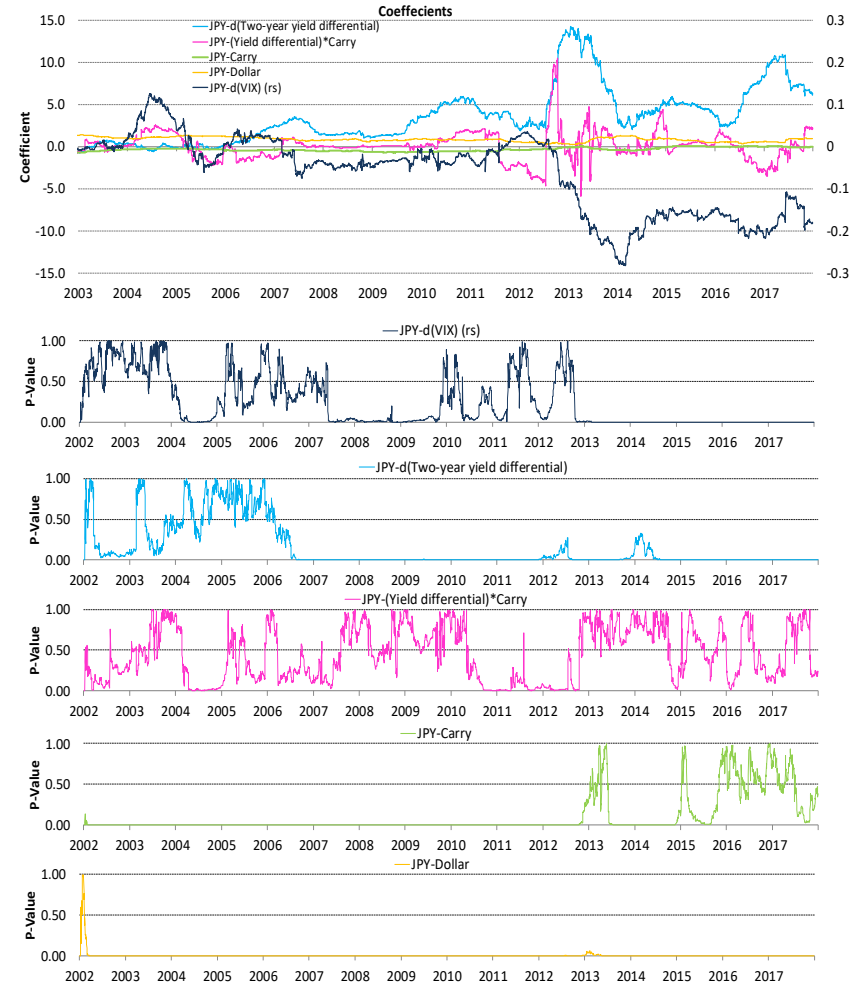
$$\Delta S_{i,t+1} = \alpha_i + \beta_i(r_{i,t} - r_c) + \gamma_i(r_{i,t} - r_c)Carry_{t+1} + \delta_i Carry_{t+1} + \tau_i Dollar_{t+1} + v_i VIX_{t+1} + \varepsilon_{i,t+1}$$



Source: Bloomberg Economics, author's estimation

Contemporaneous Interest Adjustment Model

$$\Delta S_{i,t+1} = \alpha_i + \beta_i(r_{i,t} - r_t) + \gamma_i(r_{i,t} - r_t)Carry_{t+1} + \delta_i Carry_{t+1} + \tau_i Dollar_{t+1} + v_i VIX_{t+1} + \varepsilon_{i,t+1}$$

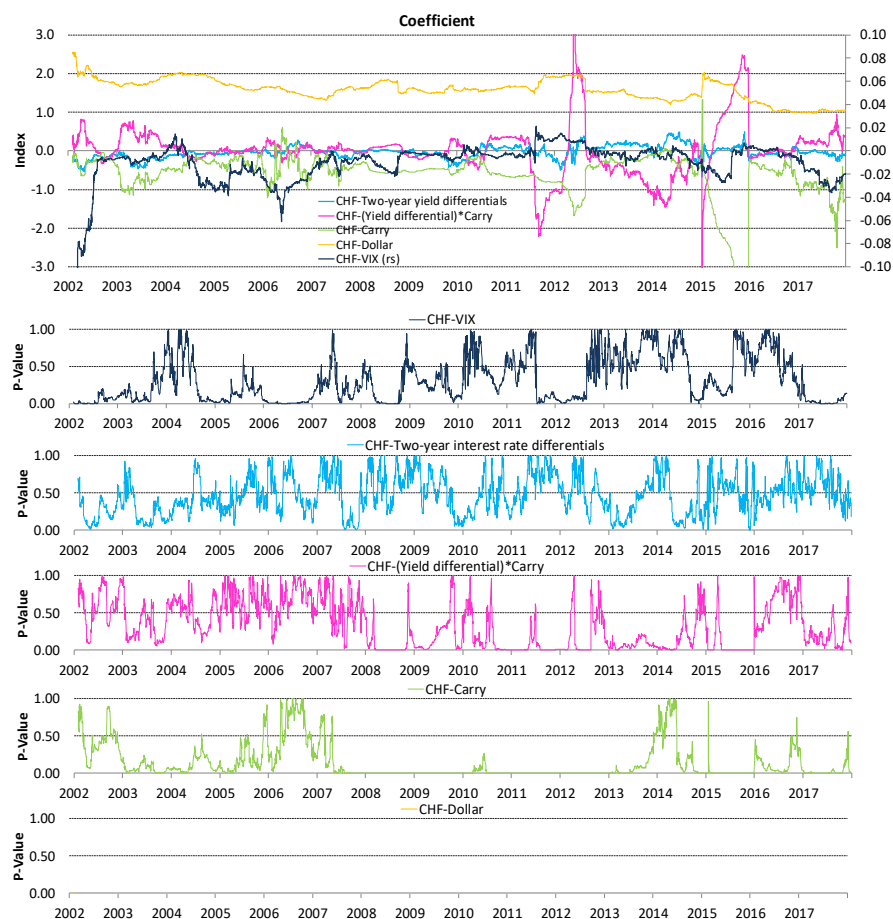


Source: Bloomberg Economics, author's estimation

SWISS FRANC - ΔVIX AND $\Delta YIELD$ DIFFERENTIAL WORK TIME TO TIME

UIP-Factor Model

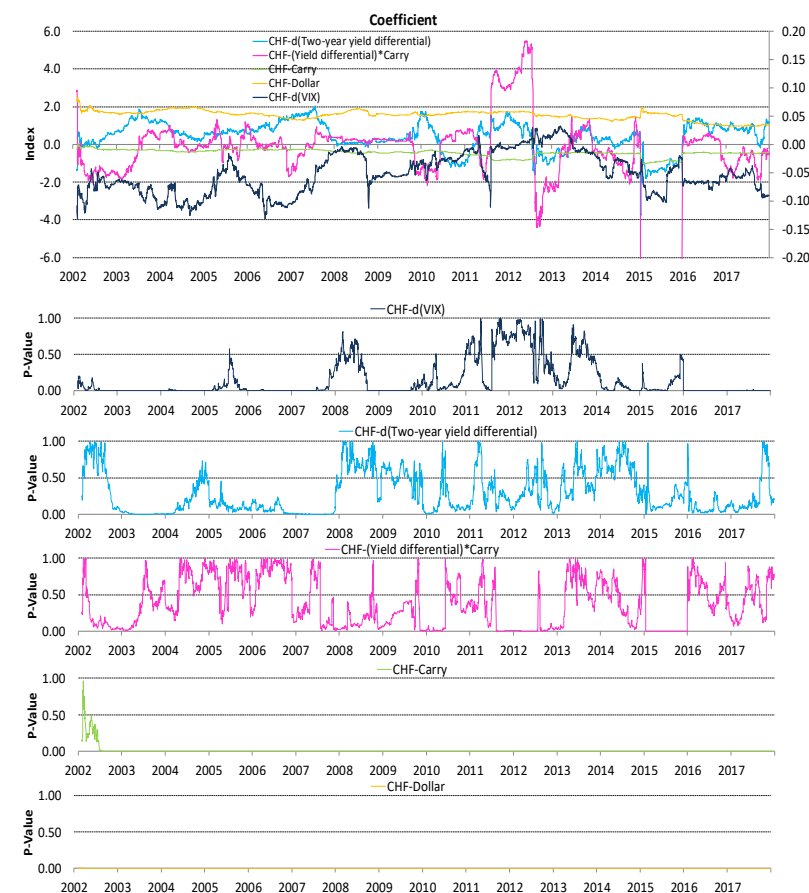
$$\Delta s_{i,t+1} = \alpha_i + \beta_i(r_{i,t} - r_t) + \gamma_i(r_{i,t} - r_t)Carry_{t+1} + \delta_i Carry_{t+1} + \tau_i Dollar_{t+1} + v_i VIX_{t+1} + \varepsilon_{i,t+1}$$



Source: Bloomberg Economics, author's estimation

Contemporaneous Interest Adjustment Model

$$\Delta s_{i,t+1} = \alpha_i + \beta_i(r_{i,t} - r_t) + \gamma_i(r_{i,t} - r_t)Carry_{t+1} + \delta_i Carry_{t+1} + \tau_i Dollar_{t+1} + v_i VIX_{t+1} + \varepsilon_{i,t+1}$$

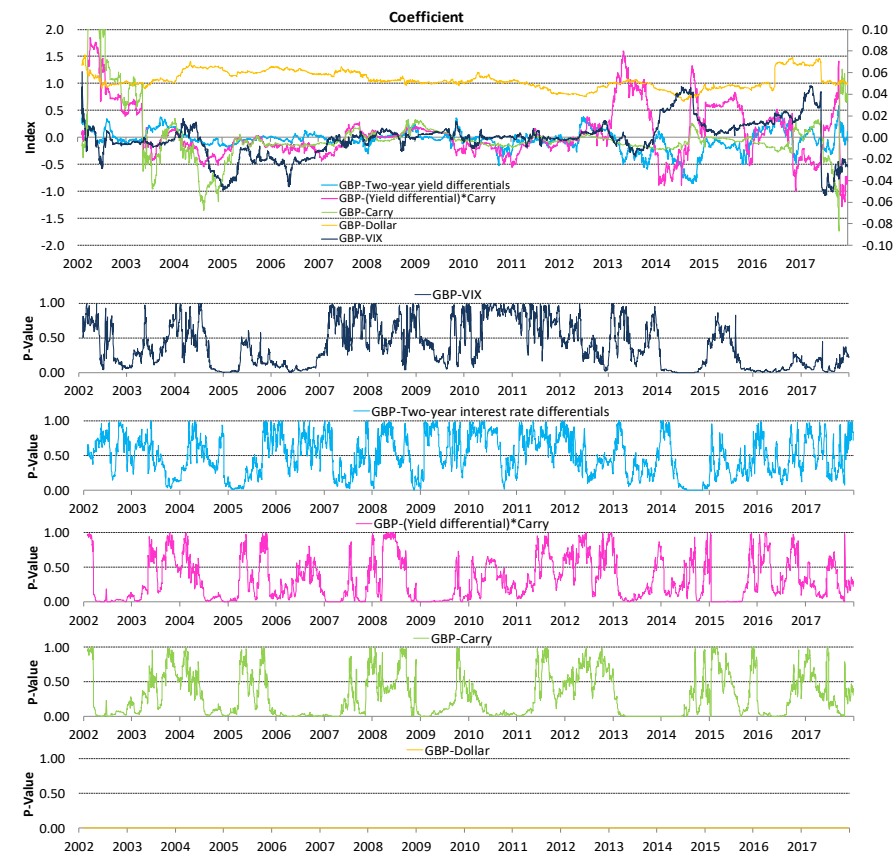


Source: Bloomberg Economics, author's estimation

BRITISH POUND - Δ YIELD DIFFERENTIAL WORK WELL

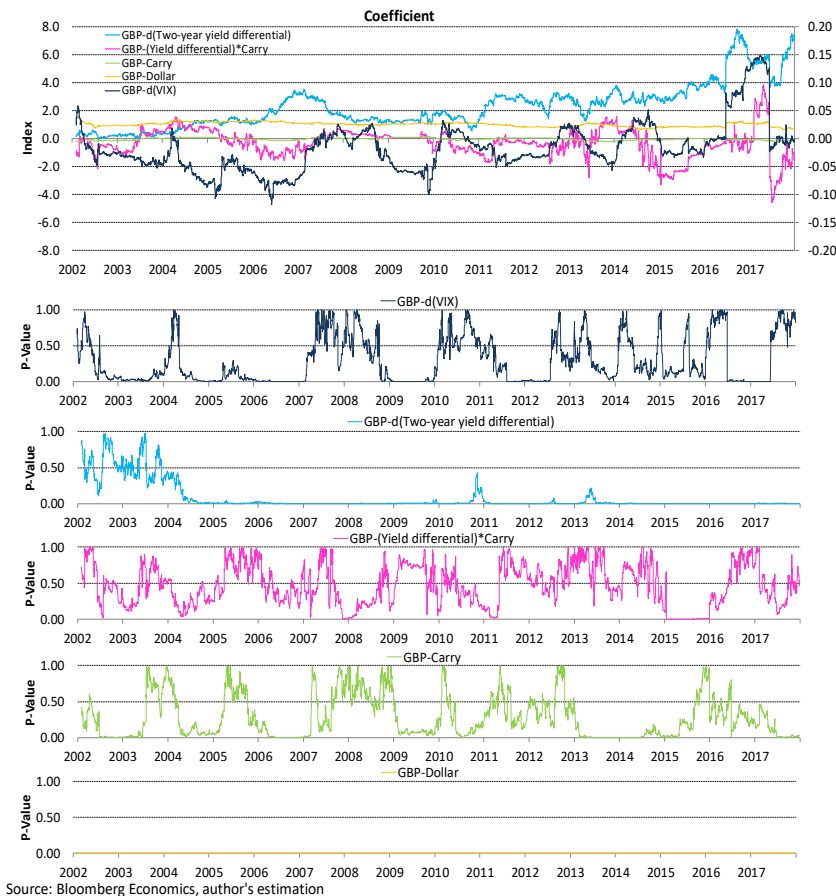
UIP-Factor Model

$$\Delta s_{i,t+1} = \alpha_i + \beta_i(r_{i,t} - r_t) + \gamma_i(r_{i,t} - r_t)Carry_{t+1} + \delta_i Carry_{t+1} + \tau_i Dollar_{t+1} + v_i VIX_{t+1} + \varepsilon_{i,t+1}$$



Contemporaneous Interest Adjustment Model

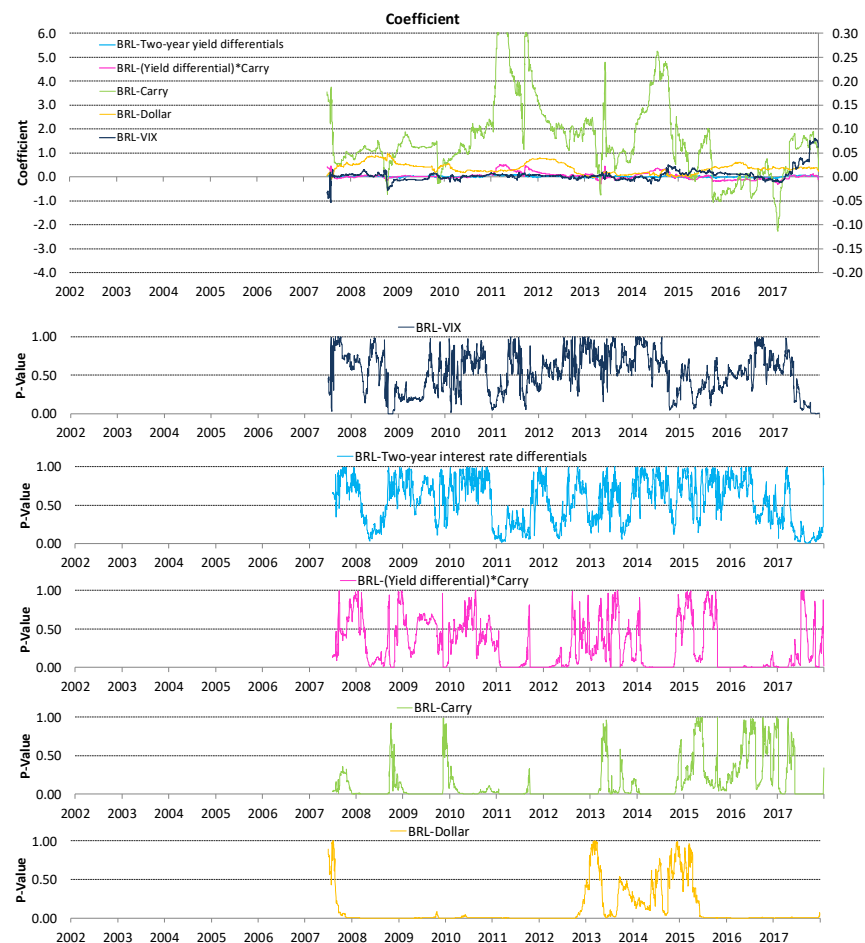
$$\Delta s_{i,t+1} = \alpha_i + \beta_i(r_{i,t} - r_t) + \gamma_i(r_{i,t} - r_t)Carry_{t+1} + \delta_i Carry_{t+1} + \tau_i Dollar_{t+1} + v_i VIX_{t+1} + \varepsilon_{i,t+1}$$



BRAZILIAN REAL - CARRY & DOLLAR FACTORS DOMINATE MOVES

UIP-Factor Model

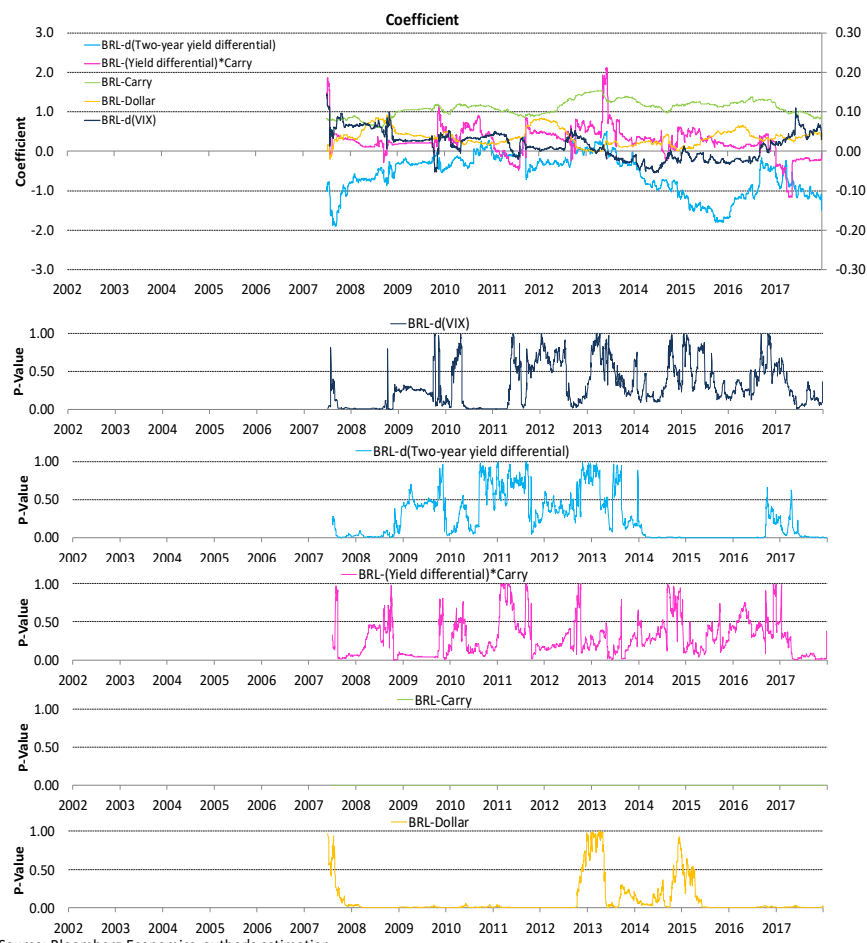
$$\Delta s_{i,t+1} = \alpha_i + \beta_i(r_{i,t} - r_t) + \gamma_i(r_{i,t} - r_t)Carry_{t+1} + \delta_i Carry_{t+1} + \tau_i Dollar_{t+1} + v_i VIX_{t+1} + \varepsilon_{i,t+1}$$



Source: Bloomberg Economics, author's estimation

Contemporaneous Interest Adjustment Model

$$\Delta s_{i,t+1} = \alpha_i + \beta_i(r_{i,t} - r_t) + \gamma_i(r_{i,t} - r_t)Carry_{t+1} + \delta_i Carry_{t+1} + \tau_i Dollar_{t+1} + v_i VIX_{t+1} + \varepsilon_{i,t+1}$$

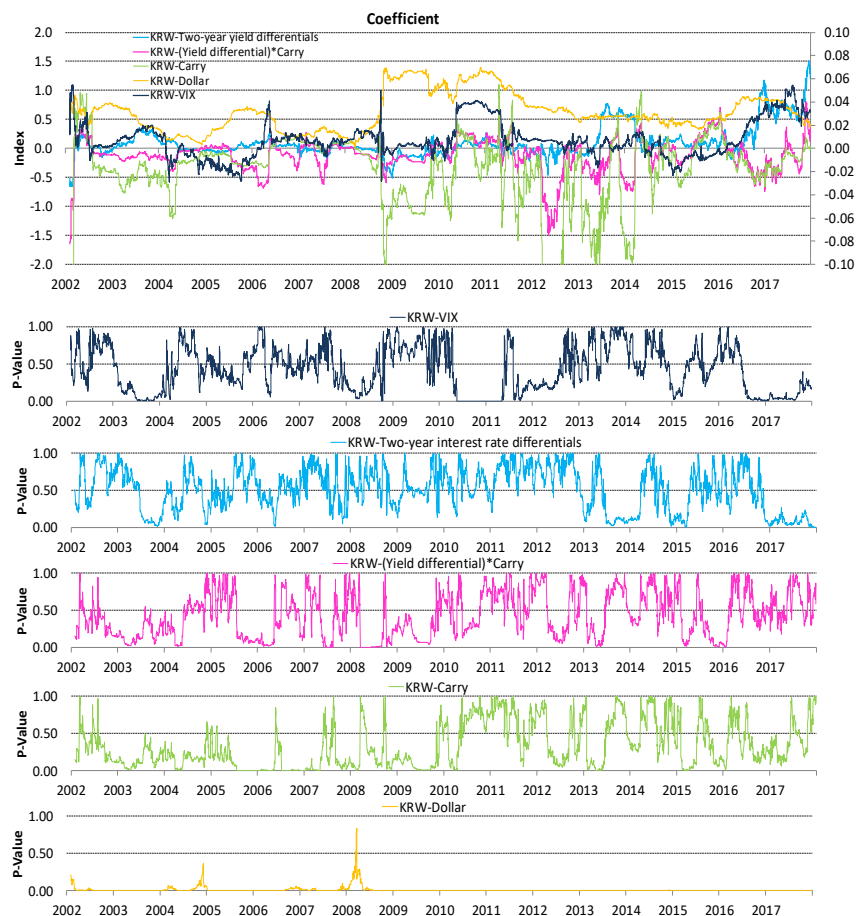


Source: Bloomberg Economics, author's estimation

SOUTH KOREAN WON – VIX WORKS WELL

UIP-Factor Model

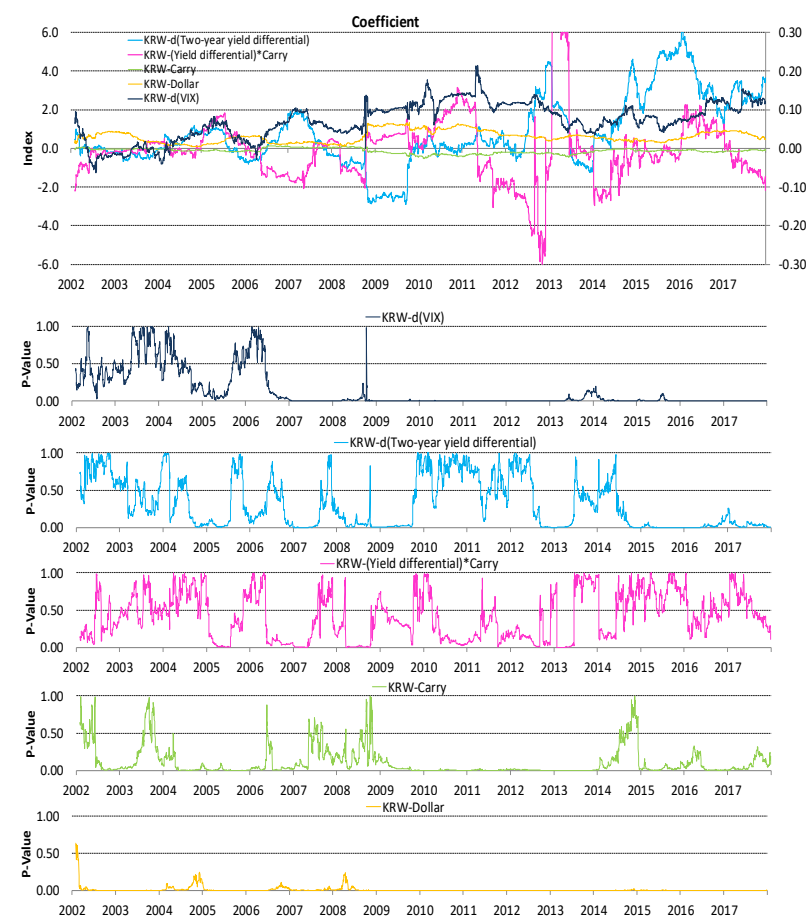
$$\Delta s_{i,t+1} = \alpha_i + \beta_i(r_{i,t} - r_t) + \gamma_i(r_{i,t} - r_t)Carry_{t+1} + \delta_i Carry_{t+1} + \tau_i Dollar_{t+1} + v_i VIX_{t+1} + \varepsilon_{i,t+1}$$



Source: Bloomberg Economics, author's estimation

Contemporaneous Interest Adjustment Model

$$\Delta s_{i,t+1} = \alpha_i + \beta_i(r_{i,t} - r_t) + \gamma_i(r_{i,t} - r_t)Carry_{t+1} + \delta_i Carry_{t+1} + \tau_i Dollar_{t+1} + v_i VIX_{t+1} + \varepsilon_{i,t+1}$$

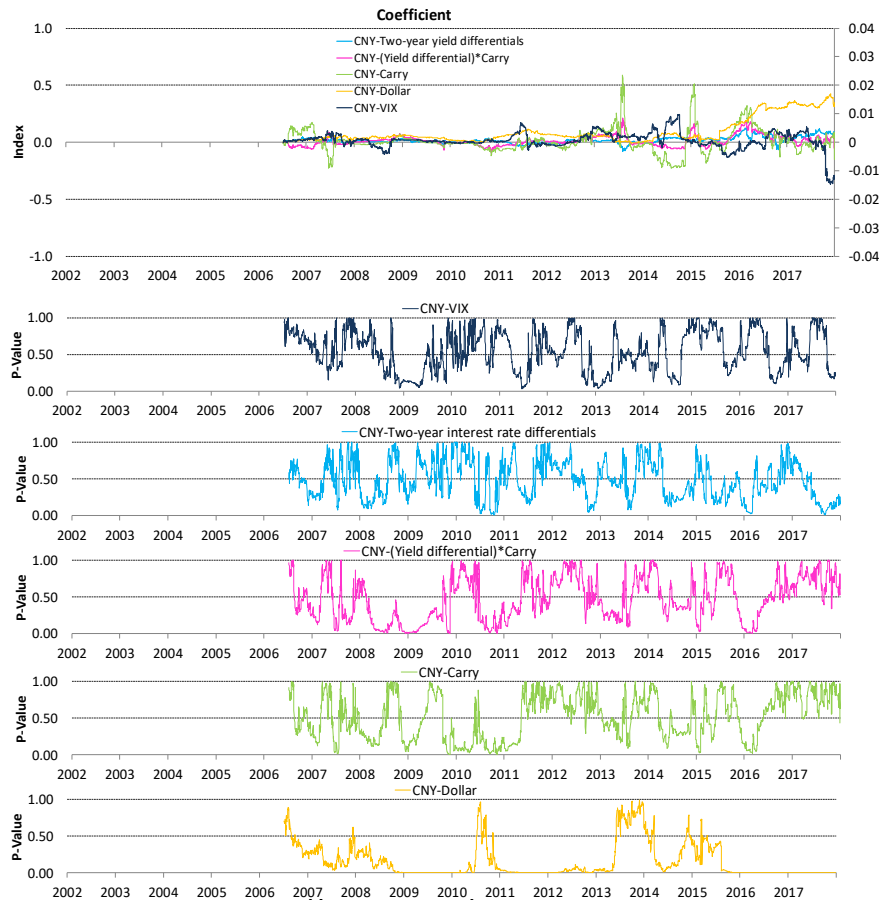


Source: Bloomberg Economics, author's estimation

ONSHORE RMB - DOLLAR FACTOR STARTED TO WORK, ASSOCIATED WITH RMB POLICY CHANGES

UIP-Factor Model

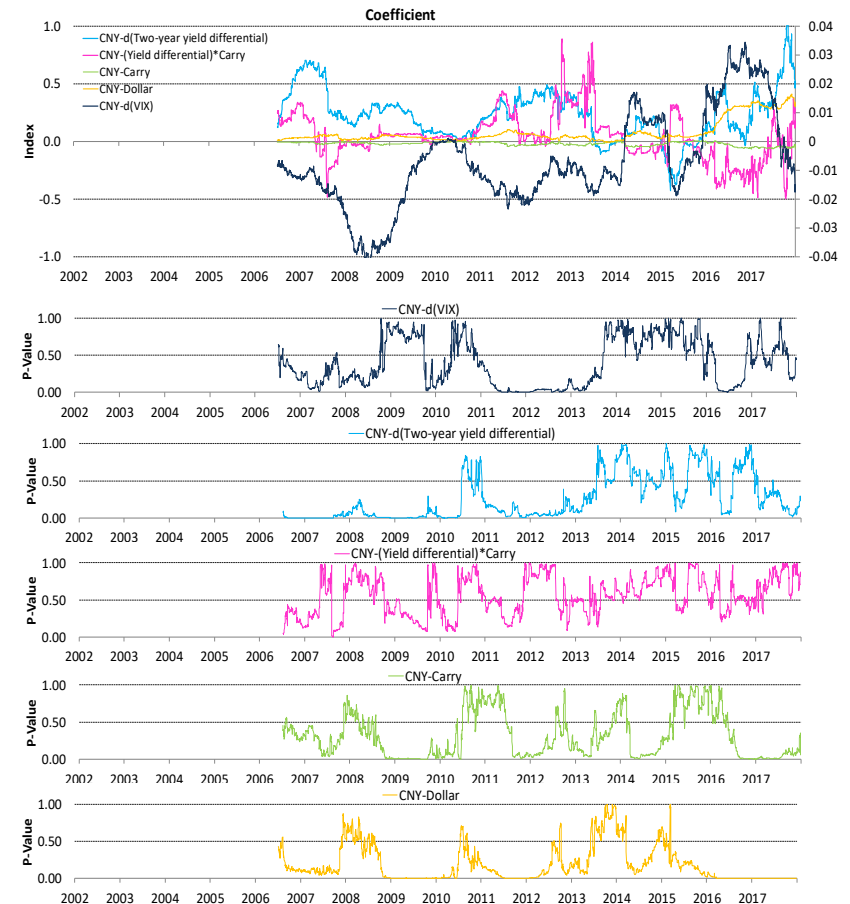
$$\Delta s_{i,t+1} = \alpha_i + \beta_i(r_{i,t} - r_t) + \gamma_i(r_{i,t} - r_t)Carry_{t+1} + \delta_i Carry_{t+1} + \tau_i Dollar_{t+1} + v_i VIX_{t+1} + \varepsilon_{i,t+1}$$



Source: Bloomberg Economics, author's estimation

Contemporaneous Interest Adjustment Model

$$\Delta s_{i,t+1} = \alpha_i + \beta_i(r_{i,t} - r_t) + \gamma_i(r_{i,t} - r_t)Carry_{t+1} + \delta_i Carry_{t+1} + \tau_i Dollar_{t+1} + v_i VIX_{t+1} + \varepsilon_{i,t+1}$$



Source: Bloomberg Economics, author's estimation

SUMMARY

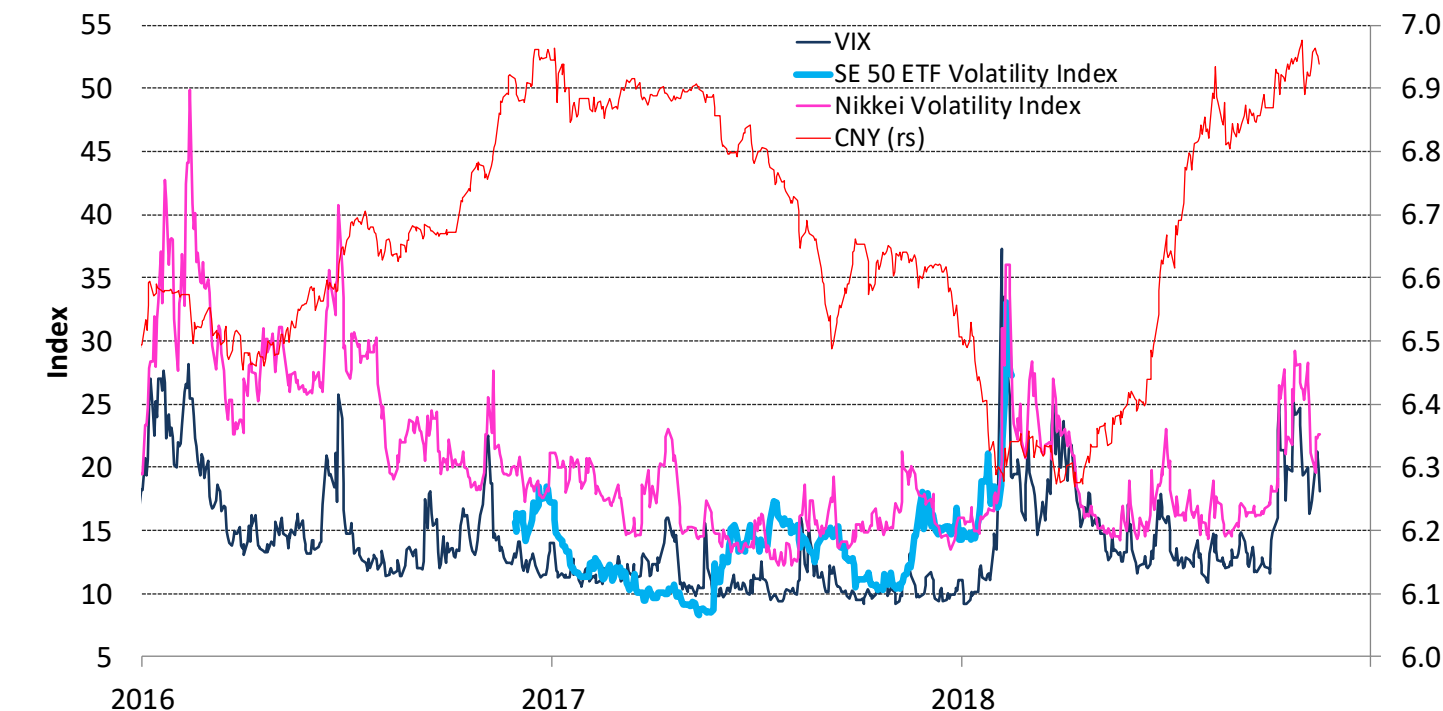
- ❖ Adding an uncertain gauge as a safe-haven currency risk factor on exchange rate factor model, well captures exchange movement with time-variant betas of risk factors.
- ❖ Replacing yield differentials – a key factor of uncovered interest rate parity conditions – with daily change in yield differentials and uncertainty gauges revived the explanatory power of yield differentials on the exchange rates, smoothing the beta of carry trade.
- ❖ The carry and dollar factors played a significant role to drive the exchange move, though the beta of the dollar factor have been less pronounced of some currencies, particularly after 2013.
- ❖ Instead, the market uncertainty -VIX- has increased its presence to swing the movement.

POLICY IMPLICATION

- The dynamic FX driver's shift to VIX could come from a change in carry trade currencies stimulated by the U.S. monetary policy tightening and internationalization of the emerging currencies including the RMB.
 - The global uncertainty measurement shows greater impacts on the exchange rate movement. If uncertainty drives the exchange rate movement, the wider disclosure of uncertainty measurement is likely to increase the predictability of exchange rate movement
- Keeping uncertainty trackable could be a new key role of the monetary authority in exchange rate stability.

EQUITY PRICE CO-MOVEMENT IN GLOBAL FINANCIAL MARKET

The first new equity derivative was allowed by Chinese regulators since the 2010 introduction of index futures, but its publication had suddenly stopped in February 2018 during the U.S. equity market tumbles



Source: Bloomberg

FUTURE RESEARCH

- Other Base Currency

→ GBP, JPY, CHF, CNY

→ Recent BIS paper (McCauley, Shu 2018) pointed out the relationship between RMB policy and currency co-movement

- Monetary policy and structural breaks of risk factors
- Unveil its relationship to capital flows and liquidity

DISCLAIMER

The BLOOMBERG PROFESSIONAL® service and BLOOMBERG Data (the “Services”) are owned and distributed by Bloomberg Finance L.P. (“BFLP”) in all jurisdictions other than Argentina, Bermuda, China, India, Japan, and Korea (the “BLP Countries”). BFLP is a wholly owned subsidiary of Bloomberg L.P. (“BLP”). BLP provides BFLP with global marketing and operational support and service for the Services and distributes the Services either directly or through a non-BFLP subsidiary in the BLP Countries. Certain functionalities distributed via the Services are available only to sophisticated institutional investors and only where the necessary legal clearance has been obtained. BFLP, BLP and their affiliates do not guarantee the accuracy of prices or information in the Services. Nothing in the Services shall constitute or be construed as an offering of financial instruments by BFLP, BLP or their affiliates, or as investment advice or recommendations by BFLP, BLP or their affiliates of an investment strategy or whether or not to “buy”, “sell” or “hold” an investment. Information available via the Services should not be considered as information sufficient upon which to base an investment decision. BLOOMBERG, BLOOMBERG PROFESSIONAL, BLOOMBERG MARKETS, BLOOMBERG NEWS, BLOOMBERG ANYWHERE, BLOOMBERG TRADEBOOK, BLOOMBERG TELEVISION, BLOOMBERG RADIO, BLOOMBERG PRESS and BLOOMBERG.COM are trademarks and service marks of BFLP, a Delaware limited partnership, or its subsidiaries. © 2016 Bloomberg Finance L.P. All rights reserved. This document and its contents may not be forwarded or redistributed without the prior consent of Bloomberg.

Bloomberg Intelligence is a service provided by Bloomberg Finance L.P. and its affiliates. Bloomberg Intelligence shall not constitute, nor be construed as, investment advice or investment recommendations (i.e., recommendations as to whether or not to “buy”, “sell”, “hold”, or to enter or not to enter into any other transaction involving any specific interest) or a recommendation as to an investment or other strategy. No aspect of the Bloomberg Intelligence function is based on the consideration of a customer's individual circumstances. Bloomberg Intelligence should not be considered as information sufficient upon which to base an investment decision. You should determine on your own whether you agree with Bloomberg Intelligence.

Bloomberg Intelligence is offered where the necessary legal clearances have been obtained. Bloomberg Intelligence should not be construed as tax or accounting advice or as a service designed to facilitate any Bloomberg Intelligence subscriber's compliance with its tax, accounting, or other legal obligations. Employees involved in Bloomberg Intelligence may hold positions in the securities analyzed or discussed on Bloomberg Intelligence.