Long-Run UIP in Emerging Markets

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Disclaimer

- The views expressed in the paper are those of the authors and do not reflect those of the ESM, the HKMA, the HKIMR or the Hong Kong Academy of Finance.

Motivation

- UIP predicts that high-interest-rate currencies are expected to depreciate:

$$s_{t+k} - s_t = \alpha + \beta(i_{t,k} - i^*_{t,k}) + \epsilon_{t,t+k}$$

  with $\beta = 1$.

- A condition well known to fail spectacularly empirically.
- An exception is the evidence that UIP tends to hold at longer horizons for currencies in advanced economies (AEs)
- The empirical analysis of UIP for emerging market economies (EMs) remains an open question, regardless of the horizon

Motivation (Cont.)

- Evidence on UIP in EMs differs from that of AEs (Bansal and Dahlquist, 2000; Gilmore and Hayashi 2011, Chernov and Dahlquist, 2023, Kalemli-Özcan and Varela, 2021).

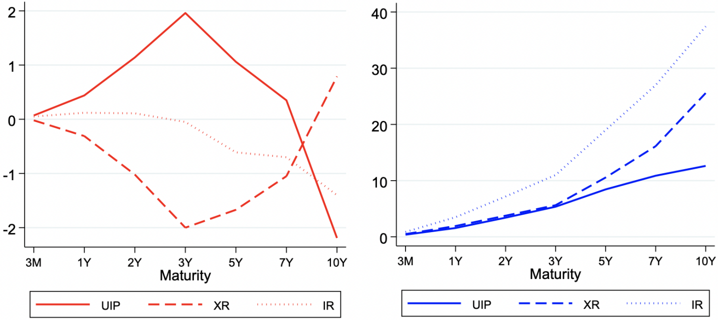

Figure 1: Average unconditional uncovered interest parity (UIP) deviation (solid line) along with its components – ex-post exchange rate change (XR) and interest rate differential (IR).

Motivation (Cont.)

- There is a positive correlation between UIP deviations and measures of credit risk for EMs.

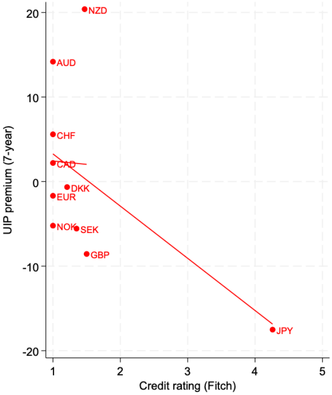

Figure 2: Average unconditional uncovered interest parity (UIP) deviation (vertical axis) against credit ratings (horizonal axis). Higher rating number = lower credit quality

This paper

- Explores long-run uncovered interest rate parity (LRUIP) in both AEs and EMs, showing that it fails to hold in EMs unless credit risk is controlled for.
- Provides a no-arbitrage asset pricing framework to guide the empirical analysis and interpret results

Related literature

- **The empirical literature on UIP deviations**
  Meredith & Chinn (1998, 2004, 2005), Lustig, Stathopoulos, & Verdelhan (2019), Bansal & Dahlquist (2000), Frankel & Poonawala (2010), Gilmore & Hayashi (2011), Boudoukh et al. (2016), Kalemli-Ozcan and Varela (2021), Chernov & Dahlquist (2023)
- **Sovereign credit risk and exchange rates**
  Della Corte et al., (2022), Della Corte et al. (2023), Corsetti et al. (2023), Du & Schreger (2016), Gourinchas & Dao (2023)
- **The theoretical literature on time-varying risk premia in exchange rates**

Outline

Outline

Sample and data

- G10 currencies and 10 (14) EM currencies with flexible exchange arrangements (EM10), as in Ilzetzki, Reinhart and Rogoff (2022):
  - **G-10:** Australia (AUD), Canada (CAD), Switzerland (CHF), Denmark (DKK), Germany (EUR), United Kingdom (GBP), Japan (JPY), Norway (NOK), New Zealand (NZD), Sweden (SEK), **plus Greece (GRC) and Italy (ITA)**
  - **EM-10:** Brazil (BRL), Chile (CHL), Colombia (COL), Israel (ISR), Korea (KOR), Mexico (MEX), Philippines (PHL), Poland (POL), South Africa (SAF), Thailand (THA), **plus Indonesia (IDR), Peru (PEN), Russia (RUS), and Turkey (TUR)**.
- **Time:** Monthly unbalanced data, longest coverage is 2000-2023.
- **Maturities:** 3-month, 1-year, 2-year, 3-year, 5-year, 7-year, 10-year.
- **Data source:** Bloomberg and Refinitiv.

UIP is violated both in the SR and LR for EMs

$$\Delta s_{i,t,t+k} = \beta_{1,k}\left(i_{i,t,k} - i^{USD}_{i,t,k}\right) + \delta_{i,k} + \epsilon_{i,t,t+k}$$

Maturity	G10	EM10
3M	-0.238*	-0.129*
	(0.661)	(0.636)
1Y	-0.339***	-0.509***
	(0.418)	(0.313)
2Y	-0.152***	-0.693***
	(0.287)	(0.210)
3Y	-0.110***	-0.634***
	(0.224)	(0.162)
5Y	0.184***	-0.392***
	(0.249)	(0.127)
7Y	0.581	-0.467***
	(0.276)	(0.121)
10Y	0.707	-0.571***
	(0.189)	(0.095)

Table 1: The table reports panel estimation results for different country groupings. Standard errors are bootstrapped. *, **, *** indicate that we can reject the null hypothesis that beta equals unity at the 10%, 5%, and 1% significance levels, respectively.

Outline

Asset pricing framework

- Standard no-arbitrage asset pricing framework (Campbell and Clarida, 1987; Froot and Ramadorai, 2005; Engel, 2016)
- Asset pricing framework with incomplete markets (Du and Schreger, 2016; Jiang et al., 2021)

Exchange rate determination (1-period bond)

$$s_t = \mathbb{E}_t \sum_{\tau=0}^{\infty} \left(y^{\$}_{t+\tau} - y^{*}_{t+\tau}\right) + \mathbb{E}_t \sum_{\tau=0}^{\infty} \left(\lambda^{\$,*}_{t+\tau} - \lambda^{*,*}_{t+\tau}\right) - \mathbb{E}_t \sum_{\tau=0}^{\infty} rp^{*}_{t+\tau} + \mathbb{E}_t \sum_{\tau=0}^{\infty} cp^{*}_{t+\tau}$$
$$+\mathbb{E}_t \left[\lim_{T\to\infty} s_{t+T}\right] - \mathbb{E}_t \left[\lim_{T\to\infty} L^{*,*}_{t+T}\right]$$

- where $rp^{*}_t = -\operatorname{cov}_t\left(m^{*}_{t+1}, \Delta s_{t+1}\right)$, $cp^{*}_t = -\operatorname{cov}_t\left(m^{*}_{t+1}, L^{*,*}_{t+1}\right)$
- The level of the exchange rate is driven by (i) the yield differential, (ii) the relative convenience yield, (iii) the currency risk premium, (iv) and the credit risk premium
- For the US investor, the level of exchange rate also includes a **quanto adjustment term**, i.e. $q_t = -\operatorname{cov}_t\left(-\Delta s_{t+1}, L^{*,*}_{t+1}\right)$

From 1-period bond to n-period bond

- If we move from the perspective of a one-period bond to n-period bond, we obtain an equation for exchange rates as follows:

$$s_t = n\mathbb{E}_t \sum_{\tau=0}^{\infty} \left(y_{t+\tau}^{\$(n)} - y_{t+\tau}^{*(n)} \right) + \mathbb{E}_t \sum_{\tau=0}^{\infty} \left(\lambda_{t+\tau}^{\$,*} - \lambda_{t+\tau}^{*,*} \right) - \mathbb{E}_t \sum_{\tau=0}^{\infty} rp_{t+\tau}^{*} + \mathbb{E}_t \sum_{\tau=0}^{\infty} cp_{t+\tau}^{*}$$
$$+\mathbb{E}_t \sum_{\tau=0}^{\infty} \left(tp_{t+\tau}^{*,*} - tp_{t+\tau}^{\$,\$} \right) + \mathbb{E}_t \sum_{\tau=0}^{\infty} \left[\left(\lambda_{t+\tau}^{*,*} - \lambda_{t+\tau}^{*,*(n)} \right) - \left(\lambda_{t+\tau}^{\$,\$} - \lambda_{t+\tau}^{\$,\$(n)} \right) \right] + \bar{s}_t$$

- s_t is driven by: (i) the yield differential, (ii) the relative convenience yield, (iii) the currency risk premium, (iv) the credit risk premium, (v) the relative term premium, (vi) the relative slope of the term structure of convenience yields

Outline

Empirical strategy (Jiang et al., 2021)

- We want to estimate correlation between s_t and its drivers
- Using $\Delta s_{t+1} = \mathbb{E}_t [\Delta s_{t+1}] + (\mathbb{E}_{t+1} - \mathbb{E}_t) s_{t+1}$, write innovations to s_t:

$$
\begin{aligned}
(\mathbb{E}_{t+1} - \mathbb{E}_t) s_{t+1} = & -(\mathbb{E}_{t+1} - \mathbb{E}_t) \sum_{\tau=1}^{\infty} \left(\lambda_{t+\tau}^{\$,*} - \lambda_{t+\tau}^{*,*} \right) + (\mathbb{E}_{t+1} - \mathbb{E}_t) \sum_{\tau=1}^{\infty} \left(y_{t+\tau}^{\$} - y_{t+\tau}^{*} \right) \\
& - (\mathbb{E}_{t+1} - \mathbb{E}_t) \sum_{\tau=1}^{\infty} rp_{t+\tau}^{*} + (\mathbb{E}_{t+1} - \mathbb{E}_t) \sum_{\tau=1}^{\infty} cp_{t+\tau}^{*} \\
& + (\mathbb{E}_{t+1} - \mathbb{E}_t) \sum_{\tau=1}^{\infty} \left(tp_{t+\tau}^{*,*} - tp_{t+\tau}^{\$,\$} \right) \\
& + (\mathbb{E}_{t+1} - \mathbb{E}_t) \sum_{\tau=1}^{\infty} \left[\left(\lambda_{t+\tau}^{*,*} - \lambda_{t+\tau}^{*,*(n)} \right) - \left(\lambda_{t+\tau}^{\$,\$} - \lambda_{t+\tau}^{\$,\$(n)} \right) \right] \\
& + (\mathbb{E}_{t+1} - \mathbb{E}_t) \lim_{T \to \infty} s_{t+T} - (\mathbb{E}_{t+1} - \mathbb{E}_t) \lim_{T \to \infty} L_{t+T}^{*}
\end{aligned} \tag{1}
$$

Assumptions

Extracting innovations

1. Extract innovations to the RHS variables as residuals from:
$$\Delta \overline{z}_t = \alpha + \beta_1 \overline{z}_{t-1} + \epsilon_t^z \quad (2)$$
where z is any variable in Equation (1) and $\overline{z}$ is the average of z across countries within the country group.
2. Run regressions of the one-month change $\Delta \overline{s}_t$ on the innovations, one at a time:
$$\Delta \overline{s_t} = \delta_z \widehat{\epsilon_t}^z + \omega_{z,t} \quad (3)$$
and jointly:
$$\Delta \overline{s_t} = \delta_1 \widehat{\epsilon_t}^1 + \delta_2 \widehat{\epsilon_t}^2 + \delta_3 \widehat{\epsilon_t}^3 + \ldots + \omega_t \quad (4)$$

Yield differential

Wrong sign in EMs

EMs	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{\epsilon}\left(y^{\$} - \bar{y}^{*}\right)$	-0.700***					-0.402**
	(0.129)					(0.191)
$\widehat{\epsilon x}^{\text{tb,AE}}$		-9.874***				-4.865***
		(1.854)				(1.377)
$\widehat{\epsilon}\overline{cds}$			1.728***			1.256***
			(0.115)			(0.188)
$\widehat{\epsilon}\left(\overline{tp^{*,*} - tp^{\$,\$}}\right)$				-0.345**		-0.412**
				(0.156)		(0.203)
$\widehat{\epsilon}\left(\overline{x^{\text{tb,5y}} - x^{\text{tb,1y}}}\right)$					-4.151***	-0.773
					(0.671)	(0.552)
R^2	0.127	0.123	0.528	0.023	0.159	0.574

AEs	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{\epsilon}\left(y^{\$} - \bar{y}^{*}\right)$	1.068***					1.111***
	(0.205)					(0.295)
$\widehat{\epsilon x}^{\text{tb}}$		-9.390***				-6.522***
		(1.797)				(1.569)
$\widehat{\epsilon}\overline{cds}$			3.577***			2.122***
			(0.460)			(0.493)
$\widehat{\epsilon}\left(\overline{tp^{*,*} - tp^{\$,\$}}\right)$				-1.169***		0.0166
				(0.196)		(0.259)
$\widehat{\epsilon}\left(\overline{x^{\text{tb,5y}} - x^{\text{tb,1y}}}\right)$					-4.334***	-2.584***
					(0.638)	(0.646)
R^2	0.118	0.119	0.230	0.183	0.185	0.486

Relative convenience yield

Covaries with exchange rate returns consistent with the theory both in AEs and EMs

EMs	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{\epsilon}\left(y^{\$} - \bar{y}^{*}\right)$	-0.700***					-0.402**
	(0.129)					(0.191)
$\widehat{\epsilon x}^{tb,AE}$		-9.874***				-4.865***
		(1.854)				(1.377)
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$\widehat{\epsilon}\left(\overline{x^{tb,5y} - x^{tb,1y}}\right)$					-4.334***	-2.584***
					(0.638)	(0.646)
R^2	0.118	0.110	0.230	0.183	0.185	0.486

Credit risk

Affects both the G10 and the EM10 currencies, but explains more variation in EMs

EMs	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{\epsilon}\left(y^{\$} - \bar{y}^{*}\right)$	-0.700***					-0.402**
	(0.129)					(0.191)
$\widehat{\epsilon}\overline{x}^{\text{tb,AE}}$		-9.874***				-4.865***
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$\widehat{\epsilon}\left(\overline{x^{\text{tb,5y}} - x^{\text{tb,1y}}}\right)$					-4.334***	-2.584***
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R^2	0.118	0.119	0.230	0.183	0.185	0.486

Term premium

Explains a much smaller share in exchange rate variations in EMs

EMs	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{\epsilon}\left(y^{\$} - \bar{y}^{*}\right)$	-0.700***					-0.402**
	(0.129)					(0.191)
$\widehat{\epsilon}\overline{x}^{\text{tb,AE}}$		-9.874***				-4.865***
		(1.854)				(1.377)
$\widehat{\epsilon}\overline{cds}$			1.728***			1.256***
			(0.115)			(0.188)
$\widehat{\epsilon}\left(\overline{tp^{*,*} - tp^{\$,\$}}\right)$				-0.345**		-0.412**
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					(0.638)	(0.646)
R^2	0.118	0.119	0.230	0.183	0.185	0.486

Similar results when we horse-race all drivers

EMs	(1)	(2)	(3)	(4)	(5)	**(6)**
$\widehat{\epsilon}\left(y^{\$} - \bar{y}^{*}\right)$	-0.700***					-0.402**
	(0.129)					(0.191)
$\widehat{\epsilon x}^{tb,AE}$		-9.874***				-4.865***
		(1.854)				(1.377)
$\widehat{\epsilon}\overline{cds}$			1.728***			1.256***
			(0.115)			(0.188)
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				(0.156)		(0.203)
$\widehat{\epsilon}\left(\overline{x^{tb,5y} - x^{tb,1y}}\right)$					-4.151***	-0.773
					(0.671)	(0.552)
R^2	0.127	0.123	0.528	0.023	0.159	0.574

AEs	(1)	(2)	(3)	(4)	(5)	**(6)**
$\widehat{\epsilon}\left(y^{\$} - \bar{y}^{*}\right)$	1.068***					1.111***
	(0.205)					(0.295)
$\widehat{\epsilon x}^{tb}$		-9.390***				-6.522***
		(1.797)				(1.569)
$\widehat{\epsilon}\overline{cds}$			3.577***			2.122***
			(0.460)			(0.493)
$\widehat{\epsilon}\left(\overline{tp^{*,*} - tp^{\$,\$}}\right)$				-1.169***		0.0166
				(0.196)		(0.259)
$\widehat{\epsilon}\left(\overline{x^{tb,5y} - x^{tb,1y}}\right)$					-4.334***	-2.584***
					(0.638)	(0.646)
R^2	0.118	0.119	0.230	0.183	0.185	0.486

Augmenting LRUIP regressions

We estimate an augmented LR-UIP regression with credit-risk variables:

$$\Delta s_{i,t,t+k} = \beta_{1,k} \left(i^{*}_{i,t,k} - i^{USD}_{i,t,k} \right) + \beta_{2,k} z_{i,t,k} + \beta_{3,k} z_{i,t,k} * \left(i^{*}_{i,t,k} - i^{USD}_{i,t,k} \right) + \delta_{i,k} + \epsilon_{i,t,t+k}$$

where $k = 5y$ and $z_{i,t,k}$ is a country-specific credit-risk variable, alternatively proxied by:

- $cds_{i,t,k}$: log of CDS spreads of country i at time t
- $c^{SP}_{i,t,LT}$: S&P credit rating for local currency bonds of country i at time t

$\delta_{i,k}$ is a country fixed effect.

Augmented UIP regressions: EMs

Controlling for credit risk helps bringing the coefficient close to unity

	(1)	(2)	(3)
$(i^{*}_{5y} - i^{USD}_{5y})$	-0.430**	1.133*	1.324***
	(0.187)	(0.640)	(0.304)
cds_{5y}			-0.049
			(0.618)
c^{SP}_{LT}		-0.008	
		(0.028)	
$c^{SP}_{LT} * (i^{*}_{5y} - i^{USD}_{5y})$		-0.243***	
		(0.081)	
$cds_{5y} * (i^{*}_{5y} - i^{USD}_{5y})$			-8.292***
			(1.779)
$H_0 : \beta_1 = 1$	***		
N	1,446	1,446	1,331
R^2	0.021	0.074	0.153

Outline

Work in progress

- Explore the role of exchange rate regimes and definition of our sample
- Assess the results over an expanded sample (depending on country/data availability)
- Investigate the role of the real exchange rate (Chernov et al., 2023)
- Probability of default and UIP deviations in our results.
- Explore the predictive power of credit risk in a forecasting exercise
- Assess the robustness of results against different standard errors methodologies

Outline

Conclusions

- We find that, in emerging markets, there are deviations from UIP even in the long-run
- We propose a simple no-arbitrage framework to introduce credit risk into the analysis, controlling for bonds' convenience yields
- We find that credit risk is more important than the term premium for EMs. The relative convenience yield plays an important role in both sets of currencies
- Augmenting the LR-UIP regressions with measures of credit risk helps bring the coefficient close to unity in EMs

Thank you!

Exchange rate process

Back

$$\Delta s_{t+1} = m^{\$}_{t+1} - m^{*}_{t+1} + \eta_{t+1} + \lambda^{\$,\$}_{t} - \lambda^{\$,*}_{t}$$

or

$$\frac{S_{t+1}}{S_t} = \frac{M^{\$}_{t+1} e^{\lambda^{\$,\$}_{t}}}{M^{*}_{t+1} e^{\lambda^{\$,*}_{t}}} e^{\eta_{t+1}} = \frac{M^{\$}_{t+1} e^{\lambda^{*,\$}_{t} + L^{*,*}_{t+1}}}{M^{*}_{t+1} e^{\lambda^{*,*}_{t} + L^{*,*}_{t+1}}} e^{\eta_{t+1}}$$

where η_{t+1} is an incomplete markets wedge that allows for:

1. convenience yield and credit risk to have an impact on the XR
2. deviations from UIP even under risk neutrality

CIP deviations and local currency credit spread in EMs

(Du and Schreger, 2016)

CIP deviations reflect **sovereign default risk**:

$$CIP_{i,t} \equiv y_{i,t}^{\text{Govt}} - \rho_{i,t} - y_{\$,t}^{\text{Govt}}$$

$$y_{i,t}^{\text{Govt}} \approx y_{i,t}^{rf} - \lambda_{i,t} + L_{i,t}$$

$$y_{\$,t}^{\text{Govt}} \approx y_{\$,t}^{rf} - \lambda_{\$,t} + L_{\$,t}$$

$$CIP_{i,t} \approx \underbrace{\hat{\lambda}_{i,t}}_{\text{Relative CY}} - \underbrace{\hat{L}_{i,t}}_{\text{Relative Credit Spread}} + \underbrace{\tau_{i,t}}_{\text{RiskFree CIP Deviation}}$$

- **Assumptions:** $\lambda_{i,t} \approx 0, \lambda_{\$,t} \approx 0, \tau_{i,t} \approx 0, L_{\$,t} \approx 0$ imply $CIP_{i,t} \approx L_{i,t}$

Back

CIP deviations and convenience yields in G-10
(Jiang et al., 2021, Du et al., 2018)

CIP deviations **reflect convenience yields**:

$$CIP_{i,t} \equiv y_{i,t}^{\text{Govt}} - \rho_{i,t} - y_{\$,t}^{\text{Govt}}$$

$$y_{i,t}^{\text{Govt}} \approx y_{i,t}^{rf} - \lambda_{i,t} + L_{i,t}$$

$$y_{\$,t}^{\text{Govt}} \approx y_{\$,t}^{rf} - \lambda_{\$,t} + L_{\$,t}$$

$$CIP_{i,t} \approx \underbrace{\hat{\lambda}_{i,t}}_{\text{Relative CY}} - \underbrace{\hat{L}_{i,t}}_{\text{Relative Credit Spread}} + \underbrace{\tau_{i,t}}_{\text{RiskFree CIP Deviation}}$$

- **Assumptions:** $L_{i,t} \approx 0$, $L_{\$,t} = 0$, $\tau_{it} \approx 0$ imply $CIP_{i,t} \approx \hat{\lambda}_{i,t}$

Back

Assumptions

- $\mathbb{E}_t \left[\lim_{T\to\infty} L^{*,*}_{t+T+1} \right]$ is zero.
    - Government meets its obligations in the LR $\rightarrow$ the probability of default $\downarrow$ as $T \rightarrow \infty$.
- $\mathbb{E}_t \left[\lim_{T\to\infty} s_{t+T+1} \right]$ is constant.
    - No bubble condition.

      (Lustig et al., 2019, Jiang et al., 2021)

Back