Breaking Parity: Eqilibrium exchange rates and currency premia

Mai Chi Dao   Pierre-Olivier Gourinchas   Oleg Itskhoki

Presented by Robin Li

Oct. 22nd, 2025

Motivation

- Research question: **What drives exchange rate?**
  - Exchange rates are disconnected from fundamentals Meese & Rogoff (1983)

Motivation

- Research question: **What drives exchange rate?**
  - Exchange rates are disconnected from fundamentals Meese & Rogoff (1983)

  - **Empirical**: macro-financial variables have explanatory power
    e.g. carry/dollar, convenience yields, global risk appetite, dealers' position
    Lustig-Roussanov-Verdelhan (11), Jiang-Krishnamurthy-Lustig (21),
    Du-Tepper-Verdelhan (18), Bianchi-Bigio-Engel (25), Koijen & Yogo (20)

Motivation

- Research question: **What drives exchange rate?**
  - Exchange rates are disconnected from fundamentals Meese & Rogoff (1983)
  - **Empirical**: macro-financial variables have explanatory power
    e.g. carry/dollar, convenience yields, global risk appetite, dealers' position
    Lustig-Roussanov-Verdelhan (11), Jiang-Krishnamurthy-Lustig (21),
    Du-Tepper-Verdelhan (18), Bianchi-Bigio-Engel (25), Koijen & Yogo (20)
  - **Theoretical**: frictional intermediation to explain disconnect and deviations
    Gabaix & Maggiori (15), Itskhoki & Mukhin (21), (25a) Kekre & Lenel (21), (25)

Motivation

- Research question: **What drives exchange rate?**
  - Exchange rates are disconnected from fundamentals Meese & Rogoff (1983)
  - **Empirical**: macro-financial variables have explanatory power
    e.g. carry/dollar, convenience yields, global risk appetite, dealers' position
    Lustig-Roussanov-Verdelhan (11), Jiang-Krishnamurthy-Lustig (21), Du-Tepper-Verdelhan (18), Bianchi-Bigio-Engel (25), Koijen & Yogo (20)
  - **Theoretical**: frictional intermediation to explain disconnect and deviations
    Gabaix & Maggiori (15), Itskhoki & Mukhin (21), (25a) Kekre & Lenel (21), (25)
- **This paper:** ER = prices clear currency demand and supply Evans & Lyons (02)

Motivation

- Research question: **What drives exchange rate?**
  - Exchange rates are disconnected from fundamentals Meese & Rogoff (1983)
  - **Empirical**: macro-financial variables have explanatory power
    e.g. carry/dollar, convenience yields, global risk appetite, dealers' position
    Lustig-Roussanov-Verdelhan (11), Jiang-Krishnamurthy-Lustig (21), Du-Tepper-Verdelhan (18), Bianchi-Bigio-Engel (25), Koijen & Yogo (20)
  - **Theoretical**: frictional intermediation to explain disconnect and deviations
    Gabaix & Maggiori (15), Itskhoki & Mukhin (21), (25a) Kekre & Lenel (21), (25)
- **This paper:** ER = prices clear currency demand and supply Evans & Lyons (02)

  $\Rightarrow$ ER must correlate strongly w CIP and UIP wedges (capture demand and supply)

  $\Rightarrow$ *Regardless of shifts are driven by fundamental or non-fundamental shocks*

Motivation

- Research question: **What drives exchange rate?**
  - Exchange rates are disconnected from fundamentals Meese & Rogoff (1983)
  - **Empirical**: macro-financial variables have explanatory power
    e.g. carry/dollar, convenience yields, global risk appetite, dealers' position
    Lustig-Roussanov-Verdelhan (11), Jiang-Krishnamurthy-Lustig (21),
    Du-Tepper-Verdelhan (18), Bianchi-Bigio-Engel (25), Koijen & Yogo (20)
  - **Theoretical**: frictional intermediation to explain disconnect and deviations
    Gabaix & Maggiori (15), Itskhoki & Mukhin (21), (25a) Kekre & Lenel (21), (25)
- **This paper:** ER = prices clear currency demand and supply Evans & Lyons (02)

  $\Rightarrow$ ER must correlate strongly w CIP and UIP wedges (capture demand and supply)

  $\Rightarrow$ *Regardless of shifts are driven by fundamental or non-fundamental shocks*

  $\Rightarrow$ **Provide a unifying theory that explains joint dynamics of UIP, CIP, spot/fwd ER**

Findings

- (log-linear) **UIP:** $\mathbb{E}_t[e_{t+1}] - e_t = i_t - i_t^*$; **CIP:** $f_t^{t+1} - e_t = i_t - i_t^*$; $e_t \equiv$ per USD

Findings

- (log-linear) **UIP:** $\mathbb{E}_t[e_{t+1}] - e_t = i_t - i_t^*$; **CIP:** $f_t^{t+1} - e_t = i_t - i_t^*$; $e_t \equiv$ per USD
- **Cross section:** local-currency (dollar) funding gap

Findings

- (log-linear) **UIP:** $\mathbb{E}_t[e_{t+1}] - e_t = i_t - i_t^*$; **CIP:** $f_t^{t+1} - e_t = i_t - i_t^*$; $e_t \equiv$ per USD
- **Cross section:** local-currency (dollar) funding gap
  - $\Rightarrow$ countries with an excess supply of local-currency savings, e.g. JPY/CHF

Findings

- (log-linear) **UIP:** $\mathbb{E}_t[e_{t+1}] - e_t = i_t - i_t^*$; **CIP:** $f_t^{t+1} - e_t = i_t - i_t^*$; $e_t \equiv$ per USD
- **Cross section:** local-currency (dollar) funding gap
  $\Rightarrow$ countries with an excess supply of local-currency savings, e.g. JPY/CHF

  $\Rightarrow$ low local currency interest rates $i_t \downarrow$ $\Rightarrow$ **-ve UIP premia**

Findings

- (log-linear) **UIP:** $\mathbb{E}_t[e_{t+1}] - e_t = i_t - i_t^*$; **CIP:** $f_t^{t+1} - e_t = i_t - i_t^*$; $e_t \equiv$ per USD

- **Cross section:** local-currency (dollar) funding gap
  $\Rightarrow$ countries with an excess supply of local-currency savings, e.g. JPY/CHF

  $\Rightarrow$ low local currency interest rates $i_t \downarrow$ $\Rightarrow$ **-ve UIP premia**

  $\Rightarrow$ investors fund local currency and invest foreign currency

Findings

- (log-linear) **UIP:** $\mathbb{E}_t[e_{t+1}] - e_t = i_t - i_t^*$; **CIP:** $f_t^{t+1} - e_t = i_t - i_t^*$; $e_t \equiv$ per USD
- **Cross section:** local-currency (dollar) funding gap
  - $\Rightarrow$ countries with an excess supply of local-currency savings, e.g. JPY/CHF
  - $\Rightarrow$ low local currency interest rates $i_t \downarrow$ $\Rightarrow$ **-ve UIP premia**
  - $\Rightarrow$ investors fund local currency and invest foreign currency
  - $\Rightarrow$ covered: part of FX exposure to intermediaries iff f_t^{t+1} cheap $\Rightarrow$ **-ve CIP premia**

Findings

- (log-linear) **UIP:** $\mathbb{E}_t[e_{t+1}] - e_t = i_t - i_t^*$; **CIP:** $f_t^{t+1} - e_t = i_t - i_t^*$; $e_t \equiv$ per USD
- **Cross section:** local-currency (dollar) funding gap
  - $\Rightarrow$ countries with an excess supply of local-currency savings, e.g. JPY/CHF
  - $\Rightarrow$ low local currency interest rates $i_t \downarrow$ $\Rightarrow$ **-ve UIP premia**
  - $\Rightarrow$ investors fund local currency and invest foreign currency
  - $\Rightarrow$ covered: part of FX exposure to intermediaries iff f_t^{t+1} cheap $\Rightarrow$ **-ve CIP premia**
- **Time series**: global or currency-specific shocks
  - $\Rightarrow$ CIP premia variations driven by global financial condition
  - $\Rightarrow$ UIP premia, spot/fwd ER driven by currency-specific shocks (dealers' position)

Findings

- (log-linear) **UIP:** $\mathbb{E}_t[e_{t+1}] - e_t = i_t - i_t^*$; **CIP:** $f_t^{t+1} - e_t = i_t - i_t^*$; $e_t \equiv$ per USD

- **Cross section:** local-currency (dollar) funding gap
  - $\Rightarrow$ countries with an excess supply of local-currency savings, e.g. JPY/CHF
  - $\Rightarrow$ low local currency interest rates $i_t \downarrow$ $\Rightarrow$ **-ve UIP premia**
  - $\Rightarrow$ investors fund local currency and invest foreign currency
  - $\Rightarrow$ covered: part of FX exposure to intermediaries iff f_t^{t+1} cheap $\Rightarrow$ **-ve CIP premia**

- **Time series**: global or currency-specific shocks
  - $\Rightarrow$ CIP premia variations driven by global financial condition
  - $\Rightarrow$ UIP premia, spot/fwd ER driven by currency-specific shocks (dealers' position)

$\Rightarrow$ **Currency net demand volatile $\Rightarrow$ ER "excess" volatile from frictional interm.**

Model of Currency Intermediation

Model - Global Intermediary Bank's Balance Sheet

Table 1: International Bank: the Balance Sheet

Assets				Liabilities
$B_t^* \geq 0 : \underline{R}_t^*$	\$ reserves		net worth	W_t^* :
$H_t^* \geq 0 : \tilde{R}_{t+1}^*$	\$ risky investment		borrowing in \$	$D_t^* : R_t^*$
$A_t^* \quad : R_t \frac{\mathcal{E}_t}{\mathcal{E}_{t+1}}$	LC investment (\$ value)			
Off balance sheet (zero-wealth positions)				
$F_t^* \quad : \frac{R_t \mathcal{E}_t}{\mathcal{F}_t}\left(\frac{\mathcal{F}_t}{\mathcal{E}_{t+1}} - 1\right)$	currency forward			
$S_t^* \quad : R_t^* - R_t \frac{\mathcal{E}_t}{\mathcal{S}_t}$	currency swap			

- $\underline{R}_t^* :=$ \$ return on \$ reserves; $\tilde{R}_{t+1}^* :=$ realized \$ return on risky investment
- $\mathcal{E}_t :=$ spot ER (per \$); $R_t \frac{\mathcal{E}_t}{\mathcal{E}_{t+1}} :=$ \$ return LC investment; $D_t^* :=$ \$ funding

Model - Global Intermediary Bank's Balance Sheet

Table 1: International Bank: the Balance Sheet

Assets			Liabilities
$B^*_t \geq 0 : \underline{R}^*_t$	\$ reserves	net worth	$W^*_t :$
$H^*_t \geq 0 : \tilde{R}^*_{t+1}$	\$ risky investment	borrowing in \$	$D^*_t : R^*_t$
$A^*_t : R_t \frac{\mathcal{E}_t}{\mathcal{E}_{t+1}}$	LC investment (\$ value)		
Off balance sheet (zero-wealth positions)			
$F^*_t : \frac{R_t \mathcal{E}_t}{\mathcal{F}_t}\left(\frac{\mathcal{F}_t}{\mathcal{E}_{t+1}} - 1\right)$	currency forward		
$S^*_t : R^*_t - R_t \frac{\mathcal{E}_t}{\mathcal{S}_t}$	currency swap		

- $\underline{R}^*_t :=$ \$ return on \$ reserves; $\tilde{R}^*_{t+1} :=$ realized \$ return on risky investment
- $\mathcal{E}_t :=$ spot ER (per \$); $R_t \frac{\mathcal{E}_t}{\mathcal{E}_{t+1}} :=$ \$ return LC investment; $D^*_t :=$ \$ funding
- $F^*_t > 0 \equiv$ **sell** \$ fowards at $\mathcal{F}_t$; for every \$ at t; earns $\frac{R_t \mathcal{E}_t}{\mathcal{E}_{t+1}} - \frac{R_t \mathcal{E}_t}{\mathcal{F}_t}$ in t+1

Model - Global Intermediary Bank's Balance Sheet

Table 1: International Bank: the Balance Sheet

Assets			Liabilities
$B_t^* \geq 0 \; : \; \underline{R}_t^*$	\$ reserves	net worth	$W_t^* :$
$H_t^* \geq 0 \; : \; \tilde{R}_{t+1}^*$	\$ risky investment	borrowing in \$	$D_t^* \; : \; R_t^*$
$A_t^* \; : \; R_t \frac{\mathcal{E}_t}{\mathcal{E}_{t+1}}$	LC investment (\$ value)		
Off balance sheet (zero-wealth positions)			
$F_t^* \; : \; \frac{R_t \mathcal{E}_t}{\mathcal{F}_t}\left(\frac{\mathcal{F}_t}{\mathcal{E}_{t+1}} - 1\right)$	currency forward		
$S_t^* \; : \; R_t^* - R_t \frac{\mathcal{E}_t}{\mathcal{S}_t}$	currency swap		

- $\underline{R}_t^* :=$ \$ return on \$ reserves; $\tilde{R}_{t+1}^* :=$ realized \$ return on risky investment
- $\mathcal{E}_t :=$ spot ER (per \$); $R_t \frac{\mathcal{E}_t}{\mathcal{E}_{t+1}} :=$ \$ return LC investment; $D_t^* :=$ \$ funding
- $F_t^* > 0 \equiv$ **sell** \$ fowards at $\mathcal{F}_t$; for every \$ at t; earns $\frac{R_t \mathcal{E}_t}{\mathcal{E}_{t+1}} - \frac{R_t \mathcal{E}_t}{\mathcal{F}_t}$ in t+1
- $S_t^* > 0 \equiv$ swaps \$ for $\mathcal{E}_t$ LC at t; swap cash flow + principal $\left(R_t^* - R_t \frac{\mathcal{E}_t}{\mathcal{S}_t}\right)$ at t+1

Model - Global Intermediary Bank's Net Worth

- Bank's period $t+1$ net worth (in \$)

$$W^*_{t+1} = \underline{R}^*_t B^*_t + \tilde{R}^*_{t+1} H^*_t + R_t \frac{\mathcal{E}_t}{\mathcal{E}_{t+1}} A^*_t - R^*_t D^*_t + R_t \frac{\mathcal{E}_t}{\mathcal{F}_t} \left(\frac{\mathcal{F}_t}{\mathcal{E}_{t+1}} - 1 \right) F^*_t + \left(R^*_t - R_t \frac{\mathcal{E}_t}{\mathcal{S}_t} \right) S^*_t$$

Model - Global Intermediary Bank's Net Worth

- Bank's period $t+1$ net worth (in \$)

$$W^*_{t+1} = \underline{R}^*_t B^*_t + \tilde{R}^*_{t+1} H^*_t + R_t \frac{\mathcal{E}_t}{\mathcal{E}_{t+1}} A^*_t - R^*_t D^*_t + R_t \frac{\mathcal{E}_t}{\mathcal{F}_t} \left(\frac{\mathcal{F}_t}{\mathcal{E}_{t+1}} - 1 \right) F^*_t + \left(R^*_t - R_t \frac{\mathcal{E}_t}{\mathcal{S}_t} \right) S^*_t$$

- **Lemma 1**: assume $\mathcal{S}_t = \mathcal{F}_t$, then net worth can be written as

$$W^*_{t+1} = R^*_t (W^*_t - H^*_t - B^*_t) + \underline{R}^*_t B^*_t + \tilde{R}^*_{t+1} H^*_t + \text{CIP}_t \cdot X^*_t + \text{UIP}_{t+1} \cdot Z^*_t$$

  - $X^*_t = F^*_t + S^*_t$ off-balance-sheet exposure; $Z^*_t = A^*_t + F^*_t$ currency-risk exposure
  - (realized) UIP and CIP premia are given by (compensation for exposures)

$$\text{UIP}_{t+1} \equiv R_t \frac{\mathcal{E}_t}{\mathcal{E}_{t+1}} - R^*_t; \quad \text{and} \quad \text{CIP}_{t+1} \equiv R^*_t - R_t \frac{\mathcal{E}_t}{\mathcal{F}_t}$$

Model - Global Intermediary Bank's Net Worth

- Bank's period $t+1$ net worth (in \$)

$$W^*_{t+1} = \underline{R}^*_t B^*_t + \tilde{R}^*_{t+1} H^*_t + R_t \frac{\mathcal{E}_t}{\mathcal{E}_{t+1}} A^*_t - R^*_t D^*_t + R_t \frac{\mathcal{E}_t}{\mathcal{F}_t} \left(\frac{\mathcal{F}_t}{\mathcal{E}_{t+1}} - 1 \right) F^*_t + \left(R^*_t - R_t \frac{\mathcal{E}_t}{\mathcal{S}_t} \right) S^*_t$$

- **Lemma 1**: assume $\mathcal{S}_t = \mathcal{F}_t$, then net worth can be written as

$$W^*_{t+1} = R^*_t (W^*_t - H^*_t - B^*_t) + \underline{R}^*_t B^*_t + \tilde{R}^*_{t+1} H^*_t + \text{CIP}_t \cdot X^*_t + \text{UIP}_{t+1} \cdot Z^*_t$$

  - $X^*_t = F^*_t + S^*_t$ off-balance-sheet exposure; $Z^*_t = A^*_t + F^*_t$ currency-risk exposure
  - (realized) UIP and CIP premia are given by (compensation for exposures)

$$\text{UIP}_{t+1} \equiv R_t \frac{\mathcal{E}_t}{\mathcal{E}_{t+1}} - R^*_t; \quad \text{and} \quad \text{CIP}_{t+1} \equiv R^*_t - R_t \frac{\mathcal{E}_t}{\mathcal{F}_t}$$

$\Rightarrow$ CIP premium: cost of foregoing LC return R_t relative to dollar return R^*_t

Model - Global Intermediary Bank's Net Worth

- Bank's period $t+1$ net worth (in \$)

$$W^*_{t+1} = \underline{R}^*_t B^*_t + \tilde{R}^*_{t+1} H^*_t + R_t \frac{\mathcal{E}_t}{\mathcal{E}_{t+1}} A^*_t - R^*_t D^*_t + R_t \frac{\mathcal{E}_t}{\mathcal{F}_t} \left(\frac{\mathcal{F}_t}{\mathcal{E}_{t+1}} - 1 \right) F^*_t + \left(R^*_t - R_t \frac{\mathcal{E}_t}{\mathcal{S}_t} \right) S^*_t$$

- **Lemma 1**: assume $\mathcal{S}_t = \mathcal{F}_t$, then net worth can be written as

$$W^*_{t+1} = R^*_t (W^*_t - H^*_t - B^*_t) + \underline{R}^*_t B^*_t + \tilde{R}^*_{t+1} H^*_t + \text{CIP}_t \cdot X^*_t + \text{UIP}_{t+1} \cdot Z^*_t$$

  - $X^*_t = F^*_t + S^*_t$ off-balance-sheet exposure; $Z^*_t = A^*_t + F^*_t$ currency-risk exposure
  - (realized) UIP and CIP premia are given by (compensation for exposures)

$$\text{UIP}_{t+1} \equiv R_t \frac{\mathcal{E}_t}{\mathcal{E}_{t+1}} - R^*_t; \quad \text{and} \quad \text{CIP}_{t+1} \equiv R^*_t - R_t \frac{\mathcal{E}_t}{\mathcal{F}_t}$$

$\Rightarrow$ CIP premium: cost of foregoing LC return R_t relative to dollar return R^*_t

$\Rightarrow$ UIP premium: risk of the LC depreciation (an increase in $\mathcal{E}_{t+1}$)

Model - Bank's Problem

- **Bank's pb**: for given $\{\underline{R}_t^*, R_t^*, R_t, \tilde{R}_{t+1}^*, \mathcal{E}_t, \mathcal{F}_t\}$, maximize PDV of net worth

$$\max_{\{B_t^* \geq 0, H_t^* \geq 0, X_t^*, Z_t^*\}} \mathbb{E}_t \Theta_{t+1} W_{t+1}^*$$

$$\text{s.t.} \quad W_{t+1}^* = R_t^*(W_t^* - H_t^* - B_t^*) + \underline{R}_t^* B_t^* + \tilde{R}_{t+1}^* H_t^* + \text{CIP}_t \cdot X_t^* + \text{UIP}_{t+1} \cdot Z_t^*$$

$$\textbf{(balance-sheet constraint - BSC)} \quad B_t^* \geq a_t H_t^* + b_t |Z_t^*| + \delta |X_t^*|$$

$$\text{where} \quad a_t = \frac{\alpha}{2} \frac{H_t^*}{W_t^*}, \quad b_t \equiv \frac{\gamma}{2} \frac{\sigma_t |Z_t|}{W_t^*}, \quad \sigma_t^2 \equiv R_t^2 \cdot \text{var}_t(\mathcal{E}_t / \mathcal{E}_{t+1}), \quad |X_t^*| \leq \bar{X}^*$$

Model - Bank's Problem

- **Bank's pb**: for given $\{\underline{R}^*_t, R^*_t, R_t, \tilde{R}^*_{t+1}, \mathcal{E}_t, \mathcal{F}_t\}$, maximize PDV of net worth

$$\max_{\{B^*_t \geq 0, H^*_t \geq 0, X^*_t, Z^*_t\}} \mathbb{E}_t \Theta_{t+1} W^*_{t+1}$$

$$\text{s.t.} \quad W^*_{t+1} = R^*_t (W^*_t - H^*_t - B^*_t) + \underline{R}^*_t B^*_t + \tilde{R}^*_{t+1} H^*_t + \text{CIP}_t \cdot X^*_t + \text{UIP}_{t+1} \cdot Z^*_t$$

$$\textbf{(balance-sheet constraint - BSC)} \quad B^*_t \geq a_t H^*_t + b_t |Z^*_t| + \delta |X^*_t|$$

$$\text{where} \quad a_t = \frac{\alpha}{2} \frac{H^*_t}{W^*_t}, \quad b_t \equiv \frac{\gamma}{2} \frac{\sigma_t |Z_t|}{W^*_t}, \quad \sigma^2_t \equiv R^2_t \cdot \text{var}_t(\mathcal{E}_t / \mathcal{E}_{t+1}), \quad |X^*_t| \leq \bar{X}^*$$

- Coefficients $\alpha, \gamma, \delta > 0$ reflect regulation and value-at-risk considerations
  - Required reserves: costly when $\underline{R}^*_t < R^*_t$; more when higher $H^* > 0$ and $|Z^*_t|$
  - **value-at-risk**: pass-through of ER vol on net worth vol $\frac{\partial (W^*_{t+1} / W^*_t)}{\partial (\mathcal{E}_t / \mathcal{E}_{t+1})} = R_t \frac{Z^*_t}{W^*_t}$
    $\Rightarrow$ additional exposure $|Z^*_t| \Rightarrow \uparrow$ contribution to vol. $W^*_{t+1} \Rightarrow \uparrow \propto \{\frac{H^*_t}{W^*_t}, \sigma_t \frac{|Z^*_t|}{W^*_t}\}$
  - $|X^*_t|$ carries only counterparty risk $\Rightarrow$ value at risk $\uparrow$ linearly with exposure

Model - Bank's Problem continued

- **Assumption 1:** $\underline{R}_t^* < R_t^*$ **and** $\mathbb{E}_t[\Theta_{t+1}\tilde{R}_{t+1}] > 1$, $\frac{\mu_t}{R_t^*} :=$ Lag. multiplier on BSC

  Proposition 1: Under A1, $\mu_t = R_t^* - \underline{R}_t^* > 0$, then BSC is binding

  $\Rightarrow$ swap exchange rate equals the forward exchange rate $\mathcal{S}_t = \mathcal{F}_t$;

  $\Rightarrow$ supply schedules for spot and forward currency are:

$$\overline{\text{UIP}}_t \equiv \mathbb{E}_t\left[\frac{\Theta_{t+1}}{\mathbb{E}_t\Theta_{t+1}}\text{UIP}_{t+1}\right] = \gamma\mu_t\frac{\sigma_t Z_t^*}{W_t^*}; \quad \text{CIP}_t = \delta\mu_t \cdot \text{sign}(X_t^*) \quad \text{for } |X_t^*| \leq \bar{X}^*$$

Model - Bank's Problem continued

- **Assumption 1:** $\underline{R}_t^* < R_t^*$ **and** $\mathbb{E}_t[\Theta_{t+1}\tilde{R}_{t+1}] > 1$, $\frac{\mu_t}{R_t^*} :=$ Lag. multiplier on BSC

  Proposition 1: Under A1, $\mu_t = R_t^* - \underline{R}_t^* > 0$, then BSC is binding

  $\Rightarrow$ swap exchange rate equals the forward exchange rate $\mathcal{S}_t = \mathcal{F}_t$;

  $\Rightarrow$ supply schedules for spot and forward currency are:

$$\overline{\text{UIP}}_t \equiv \mathbb{E}_t\left[\frac{\Theta_{t+1}}{\mathbb{E}_t\Theta_{t+1}}\text{UIP}_{t+1}\right] = \gamma\mu_t\frac{\sigma_t Z_t^*}{W_t^*}; \quad \text{CIP}_t = \delta\mu_t \cdot \text{sign}(X_t^*) \quad \text{for } |X_t^*| \leq \bar{X}^*$$

- Shadow cost of $\uparrow$ exposure $|Z_t^*| \Rightarrow B_t^*$ convex in $|Z_t^*|$, $\overline{\text{UIP}}$ linear in $\frac{\sigma_t Z_t^*}{W_t^*}$

  $\Rightarrow$ A_t^*, F_t^* need $\overline{\text{UIP}} \equiv R_t\frac{\mathcal{E}_t}{\hat{\mathcal{E}}_t} - R_t^*$, $\frac{1}{\hat{\mathcal{E}}_t} = \left(\mathbb{E}_t\frac{\Theta_{t+1}}{\mathbb{E}_t\Theta_{t+1}}\mathcal{E}_{t+1}^{-1}\right)$ risk-neutral expt. future spot

  $\Rightarrow$ F_t^* require additional CIP premium $\Rightarrow$ return $= \overline{\text{UIP}}_t + \text{CIP}_t = R_t\mathcal{E}_t(\frac{1}{\hat{\mathcal{E}}_t} - \frac{1}{\mathcal{F}_t})$

Model - Bank's Problem continued

- **Assumption 1:** $\underline{R}_t^* < R_t^*$ **and** $\mathbb{E}_t[\Theta_{t+1}\tilde{R}_{t+1}] > 1$, $\frac{\mu_t}{R_t^*} :=$ Lag. multiplier on BSC

  Proposition 1: Under A1, $\mu_t = R_t^* - \underline{R}_t^* > 0$, then BSC is binding

  $\Rightarrow$ swap exchange rate equals the forward exchange rate $\mathcal{S}_t = \mathcal{F}_t$;

  $\Rightarrow$ supply schedules for spot and forward currency are:

$$\overline{\text{UIP}}_t \equiv \mathbb{E}_t\left[\frac{\Theta_{t+1}}{\mathbb{E}_t\Theta_{t+1}}\text{UIP}_{t+1}\right] = \gamma\mu_t\frac{\sigma_t Z_t^*}{W_t^*}; \quad \text{CIP}_t = \delta\mu_t \cdot \text{sign}(X_t^*) \quad \text{for } |X_t^*| \leq \bar{X}^*$$

- Shadow cost of $\uparrow$ exposure $|Z_t^*| \Rightarrow B_t^*$ convex in $|Z_t^*|$, $\overline{\text{UIP}}$ linear in $\frac{\sigma_t Z_t^*}{W_t^*}$

  $\Rightarrow$ A_t^*, F_t^* need $\overline{\text{UIP}} \equiv R_t\frac{\mathcal{E}_t}{\hat{\mathcal{E}}_t} - R_t^*$, $\frac{1}{\hat{\mathcal{E}}_t} = \left(\mathbb{E}_t\frac{\Theta_{t+1}}{\mathbb{E}_t\Theta_{t+1}}\mathcal{E}_{t+1}^{-1}\right)$ risk-neutral expt. future spot

  $\Rightarrow$ F_t^* require additional CIP premium $\Rightarrow$ return $= \overline{\text{UIP}}_t + \text{CIP}_t = R_t\mathcal{E}_t(\frac{1}{\hat{\mathcal{E}}_t} - \frac{1}{\mathcal{F}_t})$

- Shadow cost of expanding $|X^*|$ (requiring one \$ reserves B_t^*) = μ_t

  $\Rightarrow$ only counterparty risk $\Rightarrow$ reserves $\uparrow \propto |X_t^*| \Rightarrow$ CIP constant per $|X_t^*|$ & same sign

  $\Rightarrow$ $X_t^* = \bar{X}^* \cdot \text{sign}(\text{CIP}_t)$, when $|\text{CIP}_t| > \delta\mu_t$; $X_t^* = 0$ when $|\text{CIP}_t| < \delta\mu_t$

Model - Currency Market Equilibrium

- Bank i with exogenous BSC parameters $\{\gamma_{i,t}, \delta_{i,t}\}$, endo. $\{W^*_{i,t}, X^*_{i,t}, Z^*_{i,t}\}$.
- Denote $\mathbb{Z}^*_t$ and $\mathbb{X}^*_t$ agg. demand to sell currency risk and buy currency swaps
  - $\mathbb{Z}^*_t \equiv \mathbb{A}^*_t + \mathbb{F}^*_t$; $\mathbb{F}^*_t :=$ demand buy \$ forwards; $\mathbb{A}^*_t :=$ excess demand LC invest.
  - $\mathbb{X}^*_t \equiv \mathbb{F}^*_t + \mathbb{S}^*_t$; $\mathbb{S}^*_t :=$ demand to swap dollars for local currency
- In equilibrium, dealer banks clear/intermediate the currency market

$$\mathbb{Z}^*_t = \sum_i (A^*_{i,t} + F^*_{i,t}) \quad \text{(unhedged)} \quad \text{and} \quad \mathbb{X}^*_t = \sum_i (F^*_{i,t} + S^*_{i,t}) \quad \text{(hedged)}$$

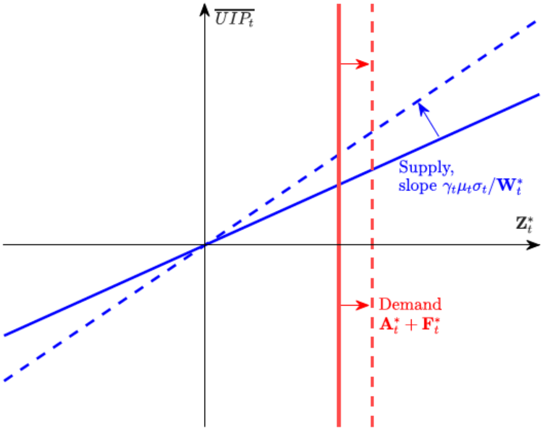
- **Proposition:** Eqm UIP & CIP premia as functions of agg. FX demand $\{\mathbb{Z}^*_t, \mathbb{X}^*_t\}$

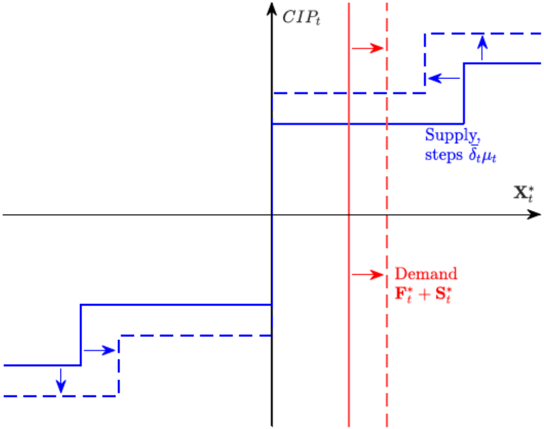
$$\overline{\text{UIP}}_t = R_t \frac{\mathcal{E}_t}{\hat{\mathcal{E}}_t} - R^*_t = \bar{\gamma}_t \mu_t \sigma_t \cdot \frac{\mathbb{Z}^*_t}{\mathbb{W}^*_t}; \quad \text{CIP}_t = R^* - R_t \frac{\mathcal{E}_t}{\mathcal{F}_t} = \bar{\delta} \mu_t \text{sign}(\mathbb{X}^*_t)$$

  - $\mathbb{W}^*_t = \sum_i W^*_{i,t}$ agg. NW of banks; $\bar{\gamma}_t \equiv \left(\sum_i \frac{W^*_{i,t}/\gamma_{i,t}}{\mathbb{W}^*_t}\right)^{-1}$; $\bar{\delta}_t = \delta_{i,t}$ tightness BCS
  - $\mu_t :=$ overall tightened funding constraints; $\bar{\delta}_t \mu_t :=$ agg. financial condition

Model - Currency Market Eqm Illustration

$$\overline{\text{UIP}}_t = \bar{\gamma}_t \mu_t \sigma_t \cdot \frac{\mathbb{Z}_t^*}{\mathbb{W}_t^*} \qquad \text{CIP}_t = \bar{\delta}\mu_t \text{sign}(\mathbb{X}_t^*)$$





Model - Summary & Testable Implications

- **Panel** of currencies k: recall $\mu_t = R_t^* - \underline{R}_t^* > 0$, common across currencies

$$\overline{\text{UIP}}_{kt} = R_{kt}\frac{\mathcal{E}_{kt}}{\hat{\mathcal{E}}_{kt}} - R_{kt}^* = \bar{\gamma}_{kt}\mu_t\sigma_{kt} \cdot \frac{\mathbb{Z}_{kt}^*}{\mathbb{W}_{kt}^*}; \quad \text{CIP}_{kt} = R^* - R_{kt}\frac{\mathcal{E}_{kt}}{\mathcal{F}_{kt}} = \bar{\delta}\mu_t \cdot \text{sign}(\mathbb{X}_{kt}^*)$$

Model - Summary & Testable Implications

- **Panel** of currencies k: recall $\mu_t = R_t^* - \underline{R}_t^* > 0$, common across currencies

$$\overline{\text{UIP}}_{kt} = R_{kt}\frac{\mathcal{E}_{kt}}{\hat{\mathcal{E}}_{kt}} - R_{kt}^* = \bar{\gamma}_{kt}\mu_t\sigma_{kt}\cdot\frac{\mathbb{Z}_{kt}^*}{\mathbb{W}_{kt}^*}; \quad \text{CIP}_{kt} = R^* - R_{kt}\frac{\mathcal{E}_{kt}}{\mathcal{F}_{kt}} = \bar{\delta}\mu_t\cdot\text{sign}(\mathbb{X}_{kt}^*)$$

- **Cross section**: currencies w excess supply of LC savings $\mathbb{A}_{kt}^* < 0$, e.g. JPY
  - **(A2)** in the long run, $\mathbb{E}\{\frac{\mathcal{E}_{kt}}{\mathcal{E}_{kt+1}}\} \approx 1 \Rightarrow$ NER follows martingale $\Rightarrow$ interest rate
  - **(A3)** currency with systematic local-currency funding abandance i.e. $\mathbb{A}_{kt}^* < 0$
    (a) $R_{kt} < R_t^*$; (b) x-demand LC forward $\mathbb{F}_{kt}^* < 0$; (c) x-demand \$ swaps $\mathbb{S}_{kt}^* < 0$

$\Rightarrow$ $\mathbb{E}\{\overline{\text{UIP}}_{kt}\} = \mathbb{E}\{R_{kt} - R_t^*\} < 0$; $\quad \text{CIP}_{kt} = R_t^* - R_{kt}\frac{\mathcal{E}_{kt}}{\mathcal{F}_{kt}} < 0 \Rightarrow \frac{\mathcal{F}_{kt}}{\mathcal{E}_{kt}} < \frac{R_{kt}}{R_t^*} < 1$

Model - Summary & Testable Implications

- **Panel** of currencies k: recall $\mu_t = R^*_t - \underline{R}^*_t > 0$, common across currencies

$$\overline{\text{UIP}}_{kt} = R_{kt}\frac{\mathcal{E}_{kt}}{\hat{\mathcal{E}}_{kt}} - R^*_{kt} = \bar{\gamma}_{kt}\mu_t\sigma_{kt}\cdot\frac{\mathbb{Z}^*_{kt}}{\mathbb{W}^*_{kt}}; \quad \text{CIP}_{kt} = R^* - R_{kt}\frac{\mathcal{E}_{kt}}{\mathcal{F}_{kt}} = \bar{\delta}\mu_t\cdot\text{sign}(\mathbb{X}^*_{kt})$$

- **Cross section**: currencies w excess supply of LC savings $\mathbb{A}^*_{kt} < 0$, e.g. JPY
  - **(A2)** in the long run, $\mathbb{E}\{\frac{\mathcal{E}_{kt}}{\mathcal{E}_{kt+1}}\} \approx 1 \Rightarrow$ NER follows martingale $\Rightarrow$ interest rate
  - **(A3)** currency with systematic local-currency funding abandance i.e. $\mathbb{A}^*_{kt} < 0$
    (a) $R_{kt} < R^*_t$; (b) x-demand LC forward $\mathbb{F}^*_{kt} < 0$; (c) x-demand \$ swaps $\mathbb{S}^*_{kt} < 0$

$$\Rightarrow \mathbb{E}\{\overline{\text{UIP}}_{kt}\} = \mathbb{E}\{R_{kt} - R^*_t\} < 0; \quad \text{CIP}_{kt} = R^*_t - R_{kt}\frac{\mathcal{E}_{kt}}{\mathcal{F}_{kt}} < 0 \Rightarrow \frac{\mathcal{F}_{kt}}{\mathcal{E}_{kt}} < \frac{R_{kt}}{R^*_t} < 1$$

- **Time series** small LC demand shock $df^*_{kt} \equiv$ purchase \$ $\Rightarrow \frac{d\mathbb{Z}^*_{kt}}{df^*_{kt}} > 0$, $\frac{d\mathbb{X}^*_{kt}}{df^*_{kt}} > 0$

$$\Rightarrow \frac{d\text{UIP}_{kt}}{df^*_{kt}} > 0,\ \frac{d\text{CIP}_{kt}}{df^*_{kt}} = 0; \quad \textbf{+ shock } d\mu_t > 0 \Rightarrow \frac{d|\overline{\text{UIP}}_{kt}|}{d\mu_t} > 0 \propto \mathbb{A}^*_{kt},\ \frac{d|\text{CIP}_{kt}|}{d\mu_t} > 0$$

Empirical Results

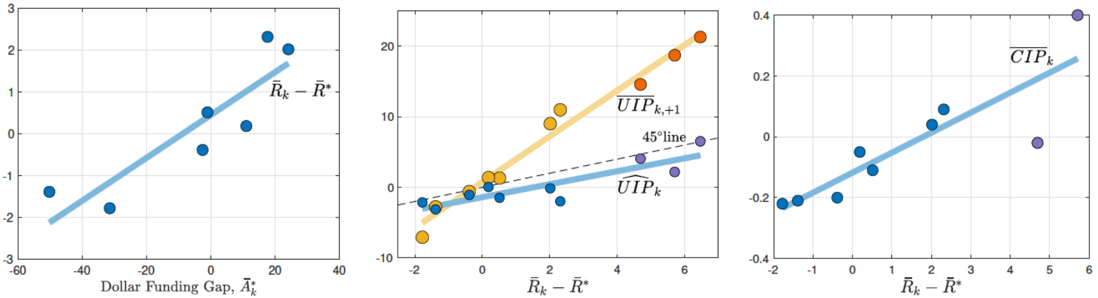
Empirics - Data

- Dealer banks' net FX futures position from CFTC's TFF weekly report (CME)
  - G7 (JPY, CHF, EUR, GBP, CAD, AUD, NZD) + & 4 EMs (MXN, ZAR, BRL, RUB)
  - Dealer, Asset Manager, Leveraged Funds, and Other (e.g. corporate treasurers)
  - Coverage: June 2006 to August 2024
- Dealers' net futures position, scaled by market size: $t =$ month; k = currency

$$f^*_{kt} = 100 \cdot \frac{\text{Dealer Net Position}_{kt}}{\frac{1}{12}\sum_{j=0}^{11} \text{Open Interest}_{k,t+1}}, \quad \text{std}(\Delta f^*_{kt}) \approx 20$$

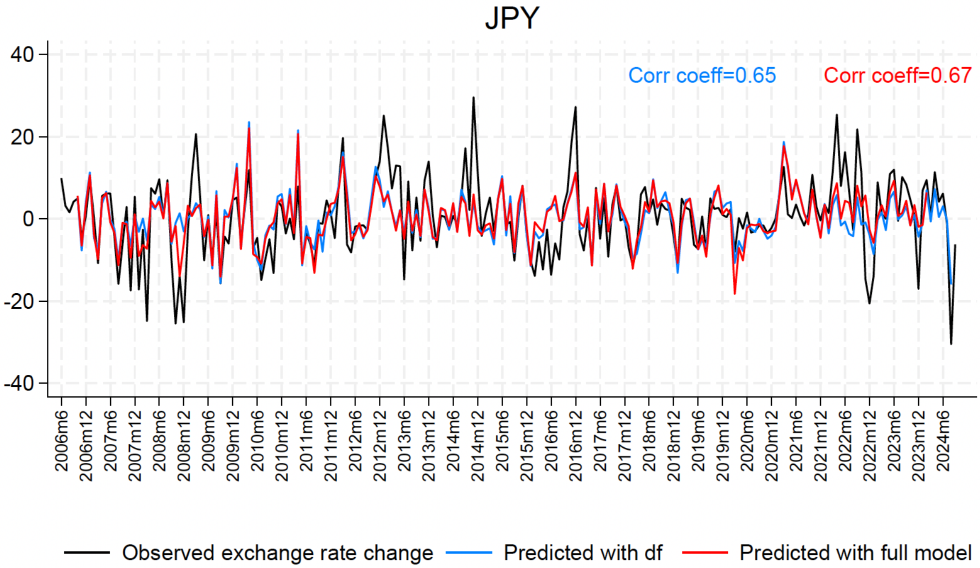
  - $f^*_{kt} > 0$ mean dealer banks long FX currency k futures and short \$ futures;
  - variation in f^*_{kt} from net position in numerator
- Various conventional measures of financial and dollar cycles:
  - interest rates, VIX, broad dollar index, treasury basis, intermediary wealth

Empirics - Cross-section of Currency Returns

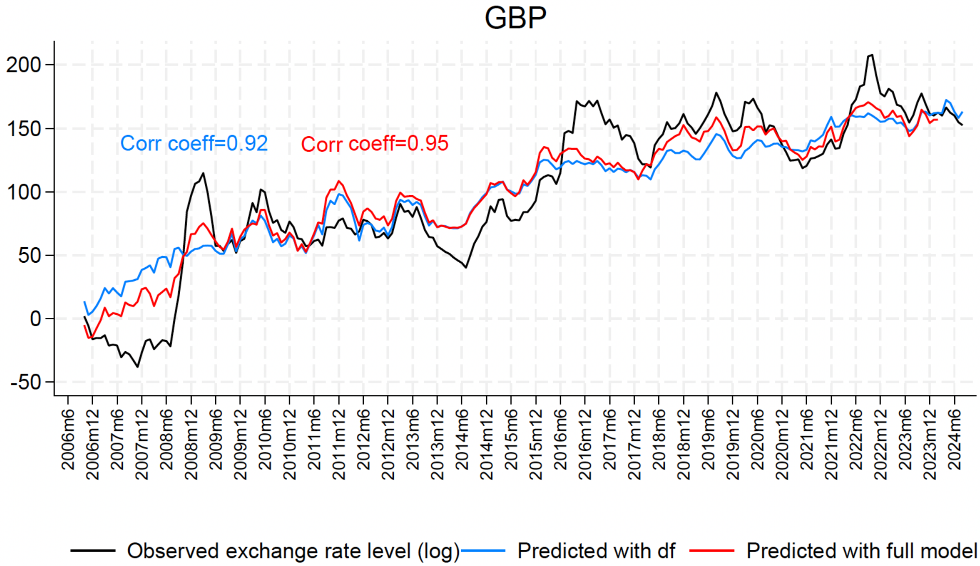


- Countries with excess supply of LC savings have low nominal interest rate
- Countries with high LC rates, feature UIP deviations $\propto$ interest rate differential
- Same is true for CIP deviations $\Rightarrow$ +ve correlation with interest rate differential
- Average CIP deviations $>>$ average UIP deviations (20 vs 200 bps).

Empirics - Exchange Rates Fit (change): JPY



Empirics - Exchange Rates Fit (level): GBP



Empirics - Exchange Rates Dynamics

	JPY	CHF	EUR	GBP	CAD	AUD	NZD	MXN	G7+ Panel	
Dep.var: $\Delta \log \mathcal{E}_{kt}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Δf^*_{kt}	0.071^{***}	0.061^{***}	0.103^{***}	0.060^{***}	0.050^{***}	0.062^{***}	0.069^{***}	0.045^{***}	0.068^{***}	0.056^{***}
	[9.04]	[12.65]	[9.71]	[7.63]	[11.63]	[11.79]	[15.87]	[4.00]	[26.81]	[26.48]
$\Delta f^*_{k,t-1}$	0.006	−0.005	0.007	−0.005	−0.003	0.004	−0.002	0.006	−0.002	−0.006
	[0.97]	[1.17]	[0.98]	[1.16]	[0.54]	[0.55]	[0.46]	[0.86]	[0.50]	[1.54]
$\Delta f^*_{k,t-2}$	0.015^{**}	0.018^{***}	0.027^{***}	0.004	0.003	0.008	0.015^{***}	0.010	0.013^{***}	0.010^{***}
	[2.21]	[5.11]	[4.35]	[0.90]	[0.73]	[1.04]	[2.71]	[1.65]	[4.61]	[3.94]
$\Delta(i_{kt} - i^*_t)$	-1.739^{**}	−0.004	-2.906^{***}	-2.875^{***}	-2.942^{***}	-3.793^{***}	-2.908^{***}	−1.362	-2.563^{***}	-2.887^{**}
	[2.31]	[0.00]	[3.14]	[3.95]	[3.72]	[3.60]	[4.46]	[1.59]	[4.40]	[2.09]
ΔT-basis$_t$	0.851	-1.802^{*}	−1.533	−1.052	-2.591^{***}	-3.104^{***}	-2.089^{**}	-3.336^{**}	-1.608^{***}	
	[1.00]	[1.90]	[1.55]	[1.31]	[2.78]	[3.24]	[2.03]	[2.43]	[2.91]	
$\Delta \log \text{VIX}_t$	-0.014^{*}	−0.004	−0.006	0.001	0.010^{*}	0.034^{***}	0.019^{**}	0.034^{**}	0.005	
	[1.68]	[0.44]	[0.72]	[0.18]	[1.86]	[4.07]	[2.17]	[2.40]	[0.97]	
$\Delta \log \mathbb{W}^*_t$	0.011	−0.030	-0.074^{***}	-0.098^{***}	-0.086^{***}	-0.084^{***}	-0.104^{***}	-0.115^{***}	-0.067^{***}	
	[0.44]	[1.64]	[5.31]	[3.26]	[4.17]	[3.16]	[2.82]	[2.81]	[3.79]	
$\log \mathcal{E}_{k,t-1}$	0.007	−0.017	0.017	−0.002	−0.002	0.004	−0.004	−0.005	−0.001	−0.009
	[0.84]	[1.58]	[1.50]	[0.17]	[0.18]	[0.39]	[0.36]	[0.66]	[0.09]	[1.27]
Observations	209	209	209	209	209	209	209	209	1,463	1,463
# currency FE									7	7
Time FE										✓
R^2	0.450	0.436	0.473	0.485	0.592	0.606	0.607	0.444	0.464	0.700
Due to Δf^*_{kt}:										
share of R^2	0.812	0.890	0.686	0.636	0.515	0.416	0.628	0.352	0.776	0.602
std of innovation (%)	1.32	1.30	1.16	1.09	0.93	1.23	1.61	0.91	1.29	0.87
half-life (months)	8	6	∞	6	6	13	6	7	8	6

Conclusion

Conclusion

- Cross section, driven by net local-currency supply of savings
- Time series, CIP across currencies driven by common financial shocks
- UIP and exchange rates respond to currency-specific demand shocks

Conclusion

- Cross section, driven by net local-currency supply of savings
- Time series, CIP across currencies driven by common financial shocks
- UIP and exchange rates respond to currency-specific demand shocks
- Does not identify primitive drivers of currency demand
  macro news shocks, pure financial shocks, or their combination