Understanding the Onshore versus Offshore Forward Rate Basis: The Role of FX Position Limits and Margin Constraints

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Motivation

- Many EM currency forward markets are segmented.
- "EM" forwards are traded onshore and "US" forwards are traded offshore, outside the jurisdiction of countries.
- Global banks with access to both markets could arbitrage the price gap ("basis") away.
- During the crisis periods, the prices of EM forwards and US forwards with the same maturity diverged significantly.

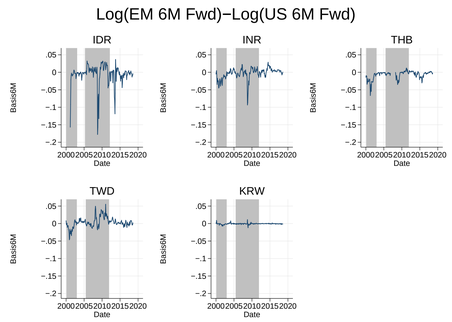

Fig. 1: EM Forward - US Forward Bases

- The magnitude of the deviation during the crisis roughly aligns with the tightness of capital-based position caps.
- **What are FX position limits?**
  - Limits on bank's foreign exchange net position, the absolute difference between its assets and liabilities denominated in foreign currency.
  - They are part of the regulatory framework in many emerging market economies.
  - Example: Banks in Indonesia can have maximum net position of 20 percent of their capital.

$$\frac{|\text{USD Asset} - \text{USD Liability}|}{\text{Capital}} \leq 20\%$$

	KRW	TWD	THB	INR	IDR
Basis during crisis - Basis during the rest	0.00%	-0.40%	1.10%	1.40%	2.60%
Position Limit as % of bank capital	200%	*	15%	25%	20%

Fig. 2: Basis and Position Limit

Research Questions

1. What explains the time-series and the cross-sectional variation in the "US" forward rate vs. "EM" forward rate basis?
2. Does the basis predict future excess returns on other assets?

Model

Framework: Garleanu & Pedersen (2011) extended

- Risky assets are indexed by location and currency:
  - trading location: e denotes EM, 0 denotes US
  - currency denomination: \$ denotes US Dollar, ₩ denotes EM currency
- Each asset i is characterized by
  - margin requirement m_t^i
  - price: $dP_t^i = (\mu_t^i P_t^i - \delta_t^i)dt + P_t \sigma_t^i dw_t$ where δ_t^i denotes dividend
- There are two consumption goods in EM (₩-denominated and \$-denominated) and one consumption good in the US.
- Riskless money-market assets:
  - u denotes uncollateralized, c denotes collateralized
- Three types of agents:
  - EM risk averse participants, US risk averse participants
  - Global banks are risk tolerant (log utility)
- Consider a global bank with two branches holding following assets and liabilities:

EM Branch (e)		US Branch (0)	
Assets:	Liabilities:	Assets:	Liabilities:
$\theta^{e\$}$	$\eta^{e\$u}$	$\theta^{0\$}$	$\eta^{0\$u}$
$\theta^{e₩}$			$\eta^{0\$c}$
	Capital in EM		Capital in US
EM forward (θ^{ef})		US forward (θ^{0f})	

Fig. 3: Balance Sheets

- **Global bank's optimization problem:**

$$\max_{\Theta, \eta^{0\$u}, \eta^{e\$u}} \quad r + \eta^{0\$u}(r^{0\$u} - r) + \eta^{e\$u}(r^{e\$u} - r) + \Theta'(\mu - r) - \frac{1}{2}\Theta'\Sigma\Theta$$

subject to:

1. **Funding (margin) constraint**:

$$\sum_{i \in \{e\$, e₩, 0\$\}} m^i |\theta^i| + \eta^{0\$u} + \eta^{e\$u} \leq 1$$

Each agent's capital uses in margin for positions in risky assets and riskless uncollateralized USD loans must be less than 100% of his wealth.

2. **Position limit constraint**:

$$\frac{|\theta^{e\$} + \theta^{ef} + \eta^{e\$u}|}{\theta^{e\$} + \theta^{e₩} + \eta^{e\$u}} \leq \frac{1}{\pi} \quad (= e.g.\ 20\%)$$

Ratio of net USD position to capital in EM should not exceed $1/\pi$.

First Order Conditions

1. Shadow Cost of Margin Constraint ψ is captured by:

$$\psi = r^{0\$u} - r$$

2. Shadow Cost of Position Limit λ is captured by:

$$\lambda = r^{0\$u} - r^{e\$u}$$

3. Excess Returns on US Assets

$$\mu^{0\$i} - r = \begin{cases} \beta^{0\$i} + \psi m^{0\$i} & \text{if long} \\ \beta^{0\$i} - \psi m^{0\$i} & \text{if short} \end{cases}$$

4. Excess Returns on EM Assets

- <u>USD-denominated Assets</u>
  If GB is net USD long in the EM:

$$\mu^{e\$i} - r = \begin{cases} \beta^{e\$i} + \psi m^{e\$i} - \lambda(1-\pi) & \text{if long} \\ \beta^{e\$i} - \psi m^{e\$i} - \lambda(1-\pi) & \text{if short} \end{cases}$$

  If GB is net USD short in the EM:

$$\mu^{e\$i} - r = \begin{cases} \beta^{e\$i} + \psi m^{e\$i} - \lambda(1+\pi) & \text{if long} \\ \beta^{e\$i} - \psi m^{e\$i} - \lambda(1+\pi) & \text{if short} \end{cases}$$

- <u>EM Currency-denominated Assets</u>

$$\mu^{e₩i} - r = \begin{cases} \beta^{e₩i} + \psi m^{e₩i} - \lambda & \text{if long} \\ \beta^{e₩i} - \psi m^{e₩i} - \lambda & \text{if short} \end{cases}$$

5. Basis

GB net $\begin{Bmatrix} \text{long} \\ \text{short} \end{Bmatrix}$ USD

US Fwd	EM Fwd	Basis
Long	Short	$\psi(m^{0f} + m^{ef}) \begin{Bmatrix} -\lambda\pi \\ +\lambda\pi \end{Bmatrix}$
Short	Long	$-\psi(m^{0f} + m^{ef}) \begin{Bmatrix} -\lambda\pi \\ +\lambda\pi \end{Bmatrix}$
Long	Long	$\psi(m^{0f} - m^{ef}) \begin{Bmatrix} -\lambda\pi \\ +\lambda\pi \end{Bmatrix}$
Short	Short	$\psi(-m^{0f} + m^{ef}) \begin{Bmatrix} -\lambda\pi \\ +\lambda\pi \end{Bmatrix}$

Key Predictions

1. **Shadow Cost of Margin Constraint (ψ)** vs. GB's Net Worth Share

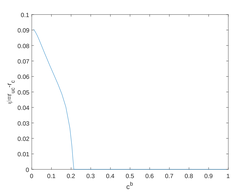

Fig. 4: Model

ψ vs. C^{GB}/C^{World}

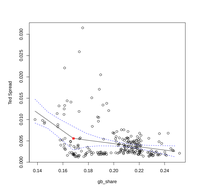

Fig. 5: Data

TED Spread vs. ME^{GB}/ME^{World}

2. **Basis measures the shadow cost of position limit (λ)** if margins for forwards are small ($m^{0f} \approx m^{ef} \approx 0$).

$$Basis = \begin{cases} -\lambda\pi & \text{if net USD long} \\ \lambda\pi & \text{if net USD short} \end{cases}$$

$$\hat{\lambda}_t^{EM} = \frac{|Basis_t^{EM}|}{\pi_t^{EM}}$$

3. **Shadow Cost of Position Limit Constraint (λ)** vs. GB's Net Worth Relative to EM's Net Worth ($C^{GB}/(C^{GB} + C^{EM}) \equiv x$)

- Suppose \$ assets are riskier than ₩ assets in the EM.
  ⇒ risk-tolerant GB holds (riskier) \$ assets.
  ⇒ When $x \downarrow$, premium on \$ assets in EM ↑, and

position limit is $\begin{Bmatrix} \text{more binding } (\lambda \uparrow) \\ \text{less binding } (\lambda \downarrow) \end{Bmatrix}$

if GB is net $\begin{Bmatrix} \text{long} \\ \text{short} \end{Bmatrix}$ USD in EM

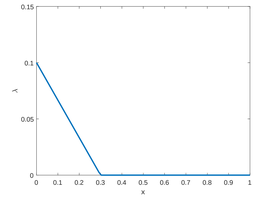

Fig. 6: λ vs. $C^{GB}/(C^{GB} + C^{EM})$

when GB is net long USD in EM

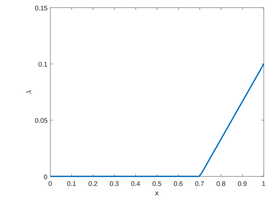

Fig. 7: λ vs. $C^{GB}/(C^{GB} + C^{EM})$

when GB is net short USD in EM

4. **Return Predictability**
Buying ₩-denominated EM asset relaxes position limit constraint, regardless of GB's net USD position in EM. Regression of quarterly excess return (including exchange rate return) on lagged lambda and lagged TED spread.

Preliminary Results:

	IDR Stock	IDR Stock
Lambda Lag	-9.986***	-8.335**
	(-5.54)	(-2.99)
Ted3M Lag		-5.611
		(-1.39)
Constant	0.0698**	0.0887**
	(3.35)	(3.27)
Observations	61	61
Adjusted R^2	0.14	0.15

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Fig. 8: Stock Return

	IDR Bond	IDR Bond
Lambda Lag	-3.655***	-2.974*
	(-4.07)	(-2.06)
Ted3M Lag		-2.315*
		(-2.03)
Constant	0.0120	0.0198*
	(1.71)	(2.44)
Observations	61	61
Adjusted R^2	0.17	0.19

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Fig. 9: Government Bond Return

Acknowledgments

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