The term structure of CIP violations

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NBER New Developments in Long-Term Asset Management
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1.) LIBOR cross-currency basis $b^i$: $\ln \left( \frac{F}{S} \right) - (i^\$ - i^\€)$
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2.) Xccy rate $X$: swapping $i^\$ \text{ for } i^€ + X$
The literature ascribes CIP deviations to financial intermediary constraints (ICs)
- IC consistent with two paradigms: no-arbitrage (NA) or limits-to-arbitrage (LTA)
- Long-term CIP (xccy): we attribute 2/3 to NA and 1/3 to LTA

1. Conceptual framework
- No-arbitrage approach requires revisiting nature of effective funding rates (EFRs)
- No-arbitrage EFRs fully plausible with zero basis and non-zero xccy rates
- Cross-currency basis & xccy rate can be zero jointly only if EFR is LIBOR & riskless

2. Empirical approach
- Use no-arb model to infer latent EFRs from related derivatives (interest rate swaps)
- Makes valuation of xccy an “out-of-sample” exercise
  2.1 EFR is an intuitive combo of 3 observable rates, substantively ≠ LIBOR
  2.2 Implied EFRs give zero basis & non-zero xccy with small pric. error (3/24bps on avg.)
  2.3 Implied SDFs & xccy pricing errors related to classical variables of ICs
Valuation of forward rates & short-term CIP

➢ True discount rates are unobservable, no obvious benchmark for EFRs

➢ Assume no-arb and use SDF approach, $M$ & $\hat{M}$ are USD- and EUR-denominated

➢ Derivatives collateralized at cost $\eta$ to cover ctparty risk (Johannes & Sundaresan '07)

➢ SDF-based valuation

$$ E_0(M_{0,T} F_{0,T}) = S_0 \cdot E_0(\hat{M}_{0,T}), $$ (1)
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$$E_0(M_{0,T}e^{\eta_{0,T}} F_{0,T}) = S_0 \cdot E_0(M'_{0,T}e^{\hat{\eta}_{0,T}}),$$

(1)
Valuation of forward rates & short-term CIP

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- SDF-based valuation

\[
E_0(M_0,T e^{\eta_0,T} F_0,T) = S_0 \cdot E_0(\hat{M}_0,T e^{\hat{\eta}_0,T}),
\]

(1)

- In our framework, the cross-currency basis is

\[
b^r_{0,T} = T^{-1} \ln (F_0,T / S_0) - (r_{0,T} - \hat{r}_{0,T}) = 0
\]

(2)

- Contrast with \( b^i_{0,T} \), which does not have to be equal to zero unless \( i = r' \).
### Value xccy rate \( X \) using SDF-approach: package of FRNs

\[
S = \frac{S}{e^{1}} \\
\text{Xccy Basis Swap} & \quad 0 & \quad t & \quad T \\
\text{Xccy Swap EUR Leg} & \quad + \, €1 & \quad - \, e^{(i_{t-1} + X)} & \quad - \, e^{(i_{T-1} + X)} - \, €1 \\
\text{USD Leg} & \quad - \, S_{0} & \quad + \, S_{0}i_{t-1} & \quad + \, S_{0}i_{T-1} + \, S_{0} \\
\]

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**McGill**
Valuation of cross-currency basis swaps and long-term CIP

**Value xccy rate** $X$ **using SDF-approach:** package of FRNs

$$S = \frac{S}{\varepsilon} \quad \text{Xccy Basis Swap} \quad 0 \quad t \quad T$$

<table>
<thead>
<tr>
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<th>USD Leg</th>
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<tr>
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**$X \neq 0$ does not necessarily contradict NA, follows if EFR \neq LIBOR**
Valuation of cross-currency basis swaps and long-term CIP

- **Value xccy rate** $X$ **using SDF-approach**: package of FRNs

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- $X \neq 0$ does not necessarily contradict NA, follows if EFR $\neq$ LIBOR

- Cross-currency basis & $X$ can be zero jointly only if EFR is LIBOR & riskless
Empirical Strategy

- Value xccy rate $X$ relative to IRS by swapping floating for fixed:
  \[ X = f \left( M', \hat{M}', CMS, \hat{CMS} \right) \]

- Back out $M'_{0,T}$ and $\hat{M}'_{0,T}$ from domestic/foreign LIBOR, IRS & short forwards

- Use implied discount factors to value longer forwards and xccy (“out-of-sample”)

- Estimated $\eta_t = \delta_{\eta,0}$ (constant), so latent cost of collateral is not a “wedge”

- G11 currencies, January 2000 - December 2019, maturities up to 30 years
Cross-currency basis 3 months

- Compare observed $b^i$ to ...

AUD

EUR

GBP

JPY
Cross-currency basis 3 month

- Compare observed $b^i$ to implied $b^r$
Compare observed $X_{0,T}$ to ...
Compare observed $X_{0,T}$ to model-implied $X_{0,T}$ (avg. pric. error 3/24 bps)
Interest rate proxies 1Y
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EUR

- model
- $y + \lambda - CDS$

GBP

- model
- $y + \lambda - CDS$

JPY

- model
- $y + \lambda - CDS$

USD

- model
- $y + \lambda - CDS$
Interest rate proxies 1Y (linear combo of $y + \lambda$, CDS, $i$)
Drivers of SDFs & xccy no-arb deviations

- We examine drivers of SDFs (NA) & xccy no-arb deviations (LTA), panel regressions
  - ICs could operate through SDFs (NA) or through xccy pricing errors (LTA)

1. SDFs correlated with Interm. Cap. Ratio (ICR), USD Factor & uncertainty measures
   \[ m_{t,t+1} = f(\text{ICR}, \text{USD}, \text{Macro.Unc}, \text{Fin.Unc}) \]

2. Xccy no-arb deviations correlated with ICR, USD Factor & LIBOR-OIS
   \[ \Delta xccy^e = f(\Delta \text{ICR}, \Delta \text{USD}, \Delta \text{LIBOR-OIS}) \]

- Cannot identify different theoretical constraint-based channels, but ...

- Can attribute CIP violations to NA vs LTA

3. Variance decomposition: xccy(data) vs xccy(model) + orthogonal pricing errors
   - 68% of variance is the no-arb model (NA)
   - 32% of variance is consistent with limits-to-arb (LTA)
Study of CIP violations involves two related, yet different questions:
- Do intermediary constraints explain CIP violations?
- Do CIP violations represent no-arbitrage violations?

We develop a NA framework that allows us to attribute $2/3$ to NA and $1/3$ to LTA.

Aggregate measures of intermediary constraints are related to both NA and LTA.
Thank You!