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The term structure of CIP violations

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NBER New Developments in Long-Term Asset Management

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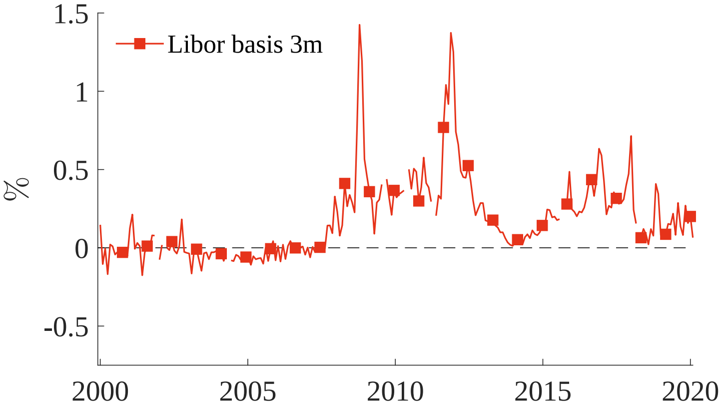
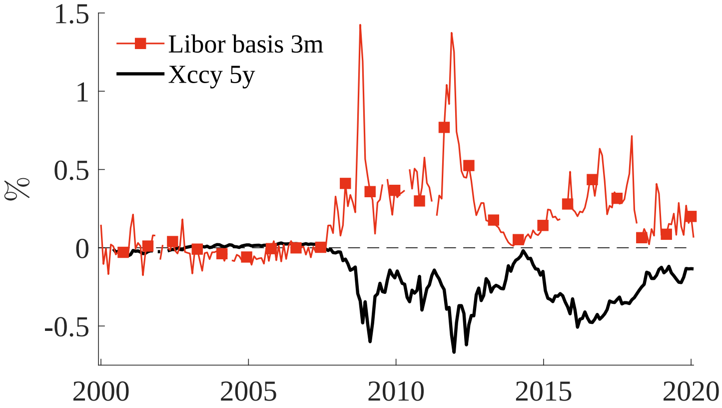
1.) LIBOR cross-currency basis b^i: $\ln(F/S) - (i^{\$} - i^{€})$



Term structure of CIP violations

1.) LIBOR cross-currency basis b^i: $\ln(F/S) - (i^{\$} - i^{€})$

2.) Xccy rate X: swapping $i^{\$}$ for $i^{€} + X$



This paper

- 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 $\neq$ 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

- True discount rates are unobservable, no obvious benchmark for EFRs
- Assume no-arb and use SDF approach, M & $\widehat{M}$ are USD- and EUR-denominated
- Derivatives collateralized at cost η to cover ctparty risk (Johannes & Sundaresan '07)
- SDF-based valuation

$$E_0(\underbrace{M_{0,T}} F_{0,T}) = S_0 \cdot E_0(\underbrace{\widehat{M}_{0,T}}), \tag{1}$$

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

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 & $\widehat{M}$ are USD- and EUR-denominated
- Derivatives collateralized at cost η to cover ctparty risk (Johannes & Sundaresan '07)
- SDF-based valuation

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

- In our framework, the cross-currency basis is

$$b^r_{0,T} = T^{-1} \ln \left(F_{0,T}/S_0\right) - (r'_{0,T} - \widehat{r}'_{0,T}) = 0 \tag{2}$$

- 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 = \$S/€1	Xccy Basis Swap	0	t	T
Xccy Swap	EUR Leg	$+$ €1	$-$ €$\left(\widehat{i}_{t-1} + X\right)$	$-$ €$\left(\widehat{i}_{T-1} + X\right)$ $-$ €1
	USD Leg	$-\ \$S_0$	$+\ \$S_0 i_{t-1}$	$+\ \$S_0 i_{T-1} + \$S_0$

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

$S =$ \$S/€1	Xccy Basis Swap	0	t	T
Xccy Swap	EUR Leg	$+$ €1	$-$ €$\left(\widehat{i}_{t-1} + X\right)$	$-$ €$\left(\widehat{i}_{T-1} + X\right) -$ €1
	USD Leg	$-\ \$S_0$	$+\ \$S_0 i_{t-1}$	$+\ \$S_0 i_{T-1} + \$S_0$

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

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

$S = \$S/€1$	Xccy Basis Swap	0	t	T
Xccy Swap	EUR Leg	$+ €1$	$- €\left(\widehat{i}_{t-1} + X\right)$	$- €\left(\widehat{i}_{T-1} + X\right) - €1$
	USD Leg	$- \$S_0$	$+ \$S_0 i_{t-1}$	$+ \$S_0 i_{T-1} + \$S_0$

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

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

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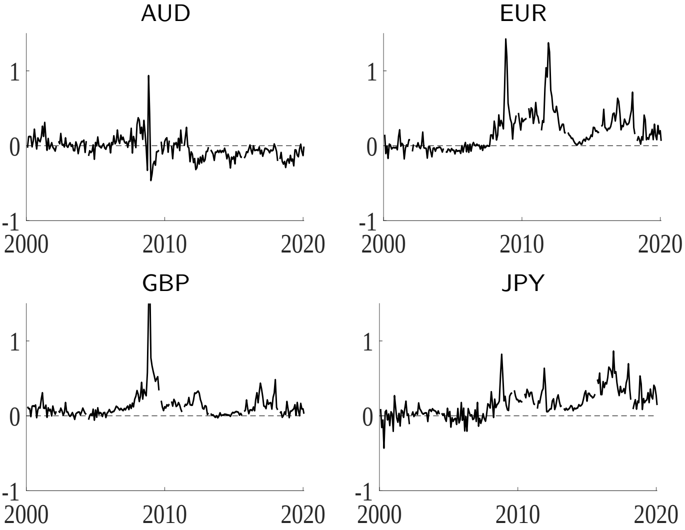
- Value xccy rate X relative to IRS by swapping floating for fixed:
$$X = f\left(M', \widehat{M}', CMS, \widehat{CMS}\right)$$
- Back out $M'_{0,T}$ and $\widehat{M}'_{0,T}$ from domestic/foreign LIBOR, IRS & short forwards
- Use implied discount factors to value longer forwards and xccy ("out-of-sample")
- 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 ...



Cross-currency basis 3 month

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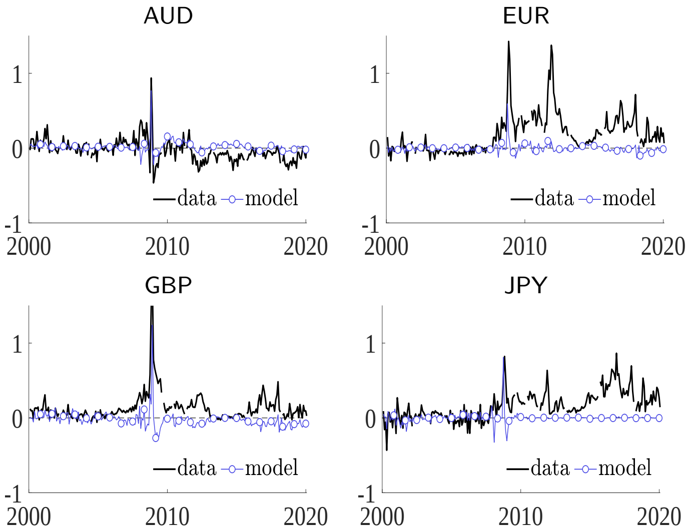
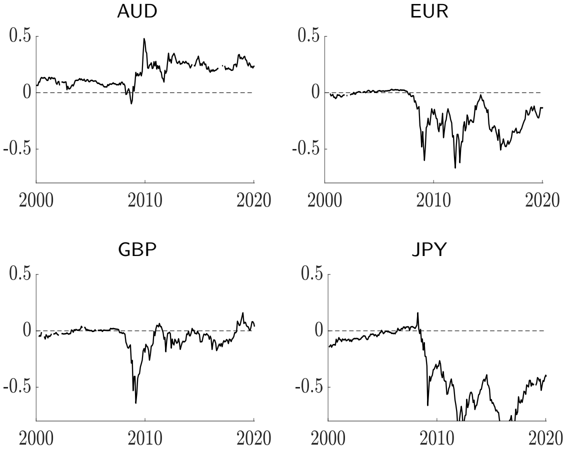
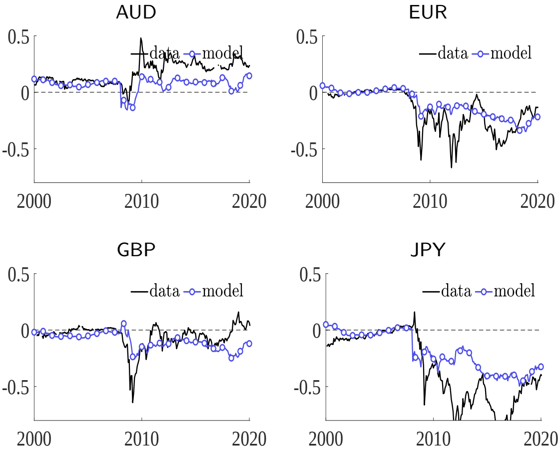
- Compare observed b^i to implied b^r



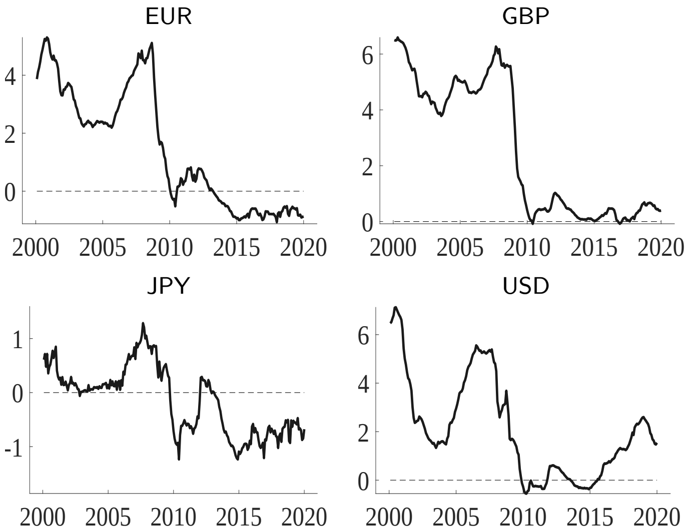
- Compare observed $X_{0,T}$ to ...



- Compare observed $X_{0,T}$ to model-implied $X_{0,T}$ (avg. pric. error 3/24 bps)



Interest rate proxies 1Y



Interest rate proxies 1Y

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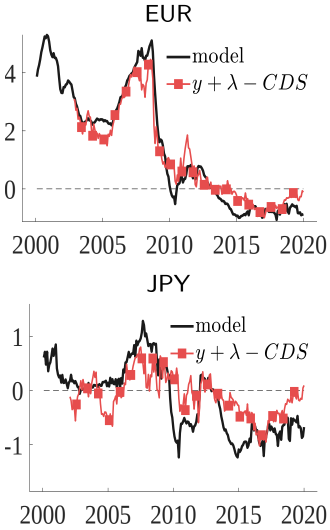

Interest rate proxies 1Y (linear combo of $y + \lambda$, CDS, i)

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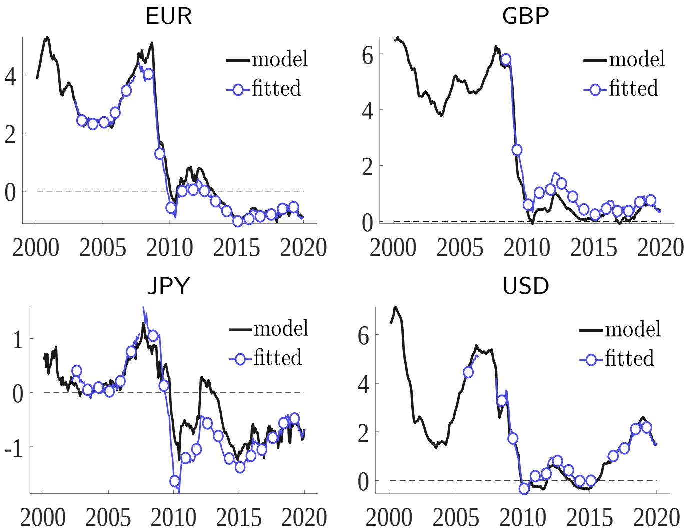

- We examine drivers of SDFs (NA) & xccy no-arb deviations (LTA), panel regressions
  - ICs could operate through SDFs (NA) or through xccy pricing errors (LTA)

1. SDFs correlated with Interm. Cap. Ratio (ICR), USD Factor & uncertainty measures

$$m_{t,t,+1} = f\left(ICR, USD, Macro\_Unc, Fin\_Unc\right)$$

2. Xccy no-arb deviations correlated with ICR, USD Factor & LIBOR-OIS

$$\Delta xccy^{e} = f\left(\Delta ICR, \Delta USD, \Delta LIBOR\text{–}OIS\right)$$

- 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 errros
   - 68% of variance is the no-arb model (NA)
   - 32% of variance is consistent with limits-to-arb (LTA)

Conclusion

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- 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 !