The Market for Sharing Interest Rate Risk: Quantities and Asset Prices

Khetan, Li, Neamtu & Sen (2025)

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March 22, 2025

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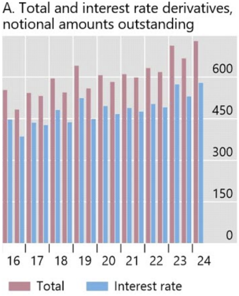
Motivation and positioning

- Immense market for OTC derivatives; dominated by **interest rate derivatives**.



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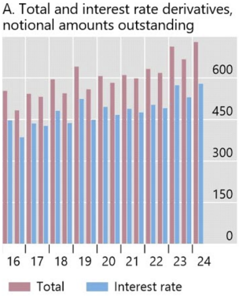

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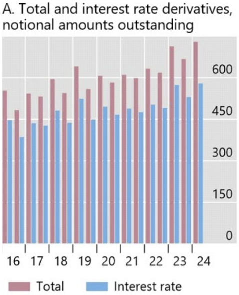

- **Questions**: *Who are the major players in the swap market? What determines their demand for swaps? How does investor composition affect swap rates and spreads?*

- Literature on interest rate swaps limited by data availability on **quantities**.
  - $\Longrightarrow$ Reduced-form: Duffie & Singleton (1997); Collin-Dufresne & Solnik (2001), . . .
  - $\Longrightarrow$ Swap demand: Klingler & Sundaresan (2019); Hanson, Malkhozov & Venter (2024), . . .

This paper answers all of these questions

Novel data and facts on the UK swap market

- **Investor-level** transactions and positions data from BoE; $\approx$ 60% of global volume.
- Highly segmented market across maturities: demand imbalances matter a lot!
  $\Longrightarrow$ Long-term: pension funds and insurance; short-term: banks and investment funds.

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- Heterogeneous sensitivity to movements in interest rates; segmentation.
- Demand estimation using a novel instrument: **portfolio compression**

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Preferred-habitat model and counterfactuals

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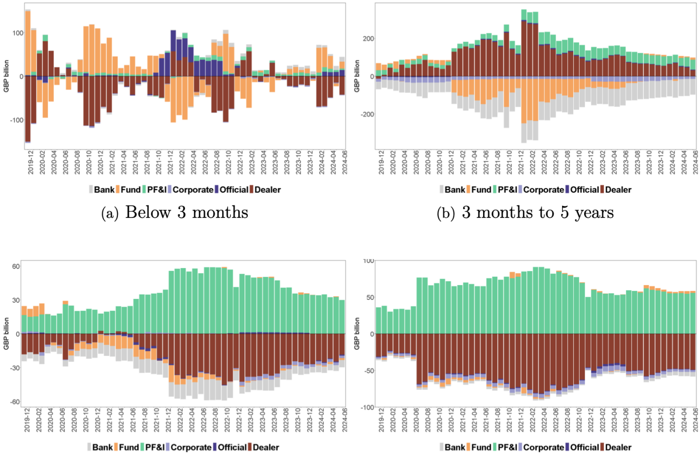
The market for interest rate swaps is highly segmented

Figure 3: Net Outstanding Positions by Maturity Group



(a) Below 3 months

(b) 3 months to 5 years

(c) 5 years to 10 years

(d) 10 years & above

A (simplified) demand system to organize the results

- Consider a linear demand system; sector i, maturity m, time t.

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$$\Delta R_t = \phi \Delta R_{t-1} + \varepsilon_{rt} \quad : \quad \varepsilon_{rt} \sim \mathcal{N}(0, \sigma_r^2) \qquad \text{(IR Dynamics)}$$

- Demand for interest rate swaps responds to swap spreads and interest rate levels.
  $\Longrightarrow$ Swaps and bonds **perfect substitutes**: demand responds to spread only.
- Latent demand i.i.d in the cross-section, but $\mathbb{C}\text{ov}(\varepsilon_{it}^{(m)}, \varepsilon_{rt}) \neq 0$.
  $\Longrightarrow$ Shifts in swaps demand likely correlated to interest rate innovations ε_{rt}.

Interpreting how demand for swaps responds to interest rates

- Taking Treasury yields as given, market clearing for swaps implies

$$\Delta q_{it}^{(m)} = \left(\lambda_i^{(m)} - \zeta_i \frac{\lambda_S^{(m)}}{\zeta_S} \right) \Delta R_t - \frac{\zeta_i}{\zeta_S} \varepsilon_{St}^{(m)} + \varepsilon_{it}^{(m)}$$

- **(1)** A regression of $\Delta q_{it}^{(m)}$ on contemporaneous ΔR_t suffers from OVB.
- **(2)** Separate who responds to ΔR_t ($\lambda_i^{(m)}$) from who provides elasticity (ζ_i).

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- Using lagged changes ΔR_t addresses **(1)**; but still need to take care of **(2)**.

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- **Suggestion**: *Estimates of λ_i make economic sense; can use $\hat{\zeta}_i$ from IV to unpack λ_i and ζ_i; response to ΔR_t relevant for monetary policy transmission?*

Bond substitutability and investor-dealer relations

- Given granularity of the data, demand estimation at investor-dealer level.
- **Assumptions**: swaps/bonds perfect **substitutes**; **sticky** investor-dealer relations.

$$\Delta q_{it}^{(m)} = \zeta_{im} \Delta \text{Spread}_{it}^{(m)} - \zeta_{jm} \Delta \text{Spread}_{jt}^{(m)} - \zeta_{iT} \Delta y_{T,t}^{(m)} + \lambda_i^{(m)} \Delta R_t + \varepsilon_{it}^{(m)}$$

where $\text{Spread}_{jt}^{(m)}$ is the swap spread offered by dealer j and $y_{T,t}^{(m)}$ Treasury yield.

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- **Question**: *Why do end-users remain with the same dealers? Are they getting more favorable terms? Do investor-dealer relations matter for swap rates?*

Reduced-form valuation of interest rate swaps

- Valuation of interest rate swaps so far typically in reduced-form.
  $\Longrightarrow$ See Duffie & Singleton (1997); Collin-Dufresne & Solnik (2001); Feldhütter & Lando (2008).
- Two distinct questions: determine fixed rate (inception) and mark-to-market.

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- Given benchmark rate r_t^{B} (e.g. LIBOR); fixed rate set such that $\mathsf{PV}_t^{(m)} = 0$

$$\mathsf{PV}_t^{(m)} = \underbrace{\mathsf{PV}_t \left\{ \sum_{j=1}^{2m} c_{(j/2)}^{(m)} \right\}}_{\text{fixed leg}} + \underbrace{\mathsf{PV} \left\{ \sum_{j=1}^{2m} r_{0.5(j-1)}^{\mathsf{B}} \right\}}_{\text{float leg}} = 0$$

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$$\sum_{j=1}^{2m} \mathbb{E}_0^{\mathbb{Q}} \left[\exp\left(-\int_0^{\frac{j}{2}} R_u du \right) c_{(j/2)}^{(m)} \right] + \sum_{j=1}^{2m} \mathbb{E}_0^{\mathbb{Q}} \left[\exp\left(-\int_0^{\frac{j}{2}} R_u du \right) r_{0.5(j-1)}^{B} \right] = 0$$

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$$c_t^{(m)} = \frac{1 - B_t^{(m)}}{\sum_{j=1}^{2m} B_t^{(j/2)}} \qquad : \qquad B_t^{(j)} = \mathbb{E}_0^{\mathbb{Q}}\left[\exp\left(-\int_0^j R_u du\right)\right]$$

- Ingredients: only RN dynamics for interest rate R_t ($\neq$ risk-free) needed.
  $\Longrightarrow$ What drives swap spreads? **Convenience yields** and **default risk**; demand/supply?

A preferred-habitat model of interest rate swaps

- An arbitrageur chooses portfolio holdings to maximize

$$\max_{x_t^{(\tau)}} \mathbb{E}_t[dW_t] - \frac{a}{2}\mathbb{V}\mathsf{ar}_t\left[dW_t\right]$$

where

$$dW_t = \int_0^\infty x_t^{(\tau)} \left(\frac{dP_t^{(\tau)}}{P_t^{(\tau)}} - c_t dt \right) d\tau + W_t r_t dt \quad : \quad P_t^{(\tau)} = \frac{P_{F,t}^{(\tau)}}{P_{T,t}^{(\tau)}}$$

- Arbitrageurs **hedge** interest rate risk exposure of swaps; only **convergence risk**.
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- Assuming elastic but non-stochastic habitat demand $(K = 0)$ gives

$$\mu_t^{(\tau)} - c_t = \sigma_c A_c(\tau)\eta_t \qquad : \qquad \eta_t \doteq a\sigma_c \int_0^\infty x_t^{(\tau)} A_c(\tau) d\tau$$

- **Summary**: *ER over balance sheet cost c_t adjusts such that arbitrageurs happy to accommodate demand imbalances; "risk-premium" increases in exposure η_t.*

Determinants of swap spreads and model interpretation

- Swap demand is a function of spreads and (exogenous) shocks.
  $\Longrightarrow$ How to think about other determinants: volatility? counterparty risk?
- Given Treasury prices $= P_{T,t}^{(\tau)}$, the model-implied fixed rate is also affine

$$e^{-\tau y_F(\tau)} \doteq P_{F,t}^{(\tau)} = P_{T,t}^{(\tau)} P_t^{(\tau)} = P_{T,t}^{(\tau)} \mathbb{E}_t^{\mathbb{Q}} \left[\exp\left(- \int_t^{t+\tau} c_u du \right) \right]$$

- **Question**: How does the swap rate $y_F(\tau)$ relate to reduced-form models?
  $\Longrightarrow$ Modelling approach similar to Hanson, Malkhozov & Venter (2024).
- **Question**: *Can the model accommodate counterparty risk? Are there any implications on co-movements of prices and quantities to identify supply/demand shocks? Which of these forces is quantitatively more important?*

Counterfactuals and extensions

- Three sets of counterfactuals: demand shifts; market integration; risk aversion.
- Calibrate habitat demand based on estimated demand.
  $\Longrightarrow$ Sample from distribution of demand elasticities to account for heterogeneity.

- **Suggestion**: *How does bonds/swaps substitutability impact spreads? What if arbitrageurs cannot fully hedge interest rate exposure because bonds are scarce?*
  $\Longrightarrow$ *Can answer both questions by* **jointly** *clearing the swap and bond market.*

- A potential approach that keeps tractability: adapt habitat demand such that

$$Q_{jt}^{(\tau)} = \alpha(\tau)\log P_{jt}^{(\tau)} - \gamma(\tau)\log P_{-jt}^{(\tau)} - \theta_{j0}(\tau) - \sum_{k=1}^{K}\theta_{jk}(\tau)\beta_{k,t} \qquad j \in \{S, T\}$$

and allow for arbitrageurs' bond exposure (Greenwood & Vayanos (2014)).
$\Longrightarrow$ Consider then counterfactuals with respect to $\gamma(\tau)$ or bond supply factors.

Conclusion and open questions

- Great paper! New data; lots of novel facts on the interest rate swap market.
- Preferred-habitat model to understand swap spreads; counterfactual analysis.

- Paper (and rich data!) paves the way for a broad set of open questions.

- **Questions**: *How does risk (e.g. interest rate volatility) impact hedging demand? How does counterparty risk come into play? Do demand imbalances in the swap market also impact bond prices? See Duarte (2008) for MBS.*
- **Questions**: *Does dealer/intermediary capital also impact swap spreads (see e.g. Siriwardane (2019) for CDS?). What happens if dealers cannot fully hedge interest rate exposure that arise from swaps?*
- . . . .. a lot of thoughts for future research!