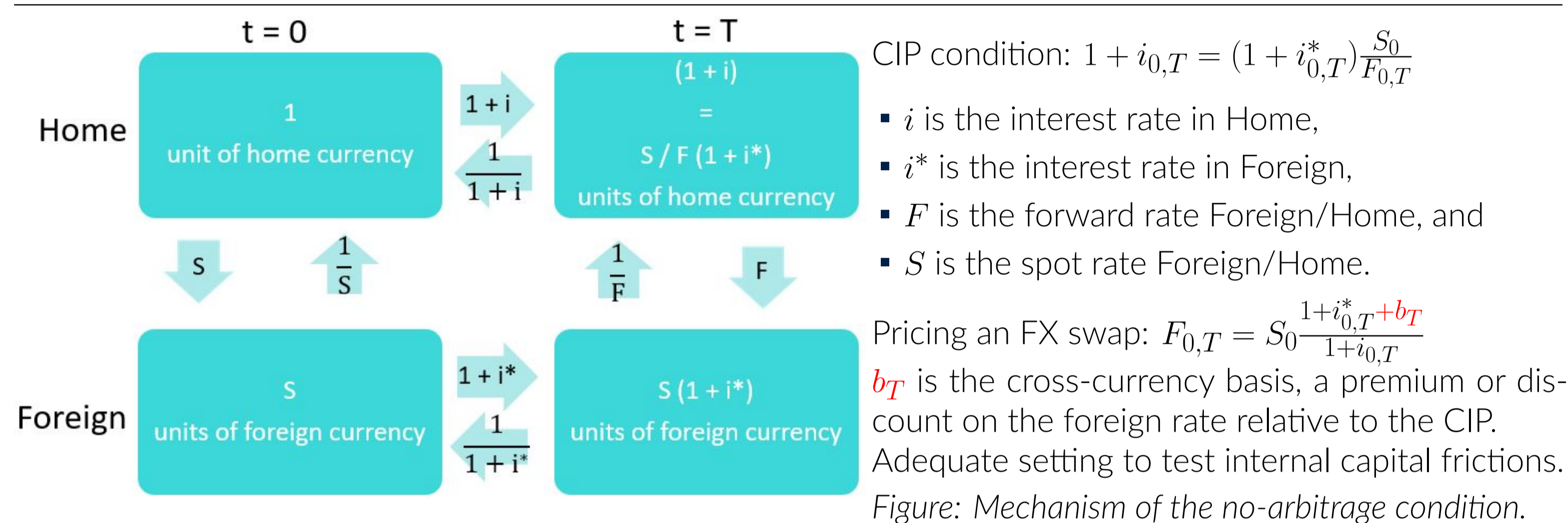


## Can internal capital frictions in intermediaries explain covered interest rate parity deviations?

### Summary

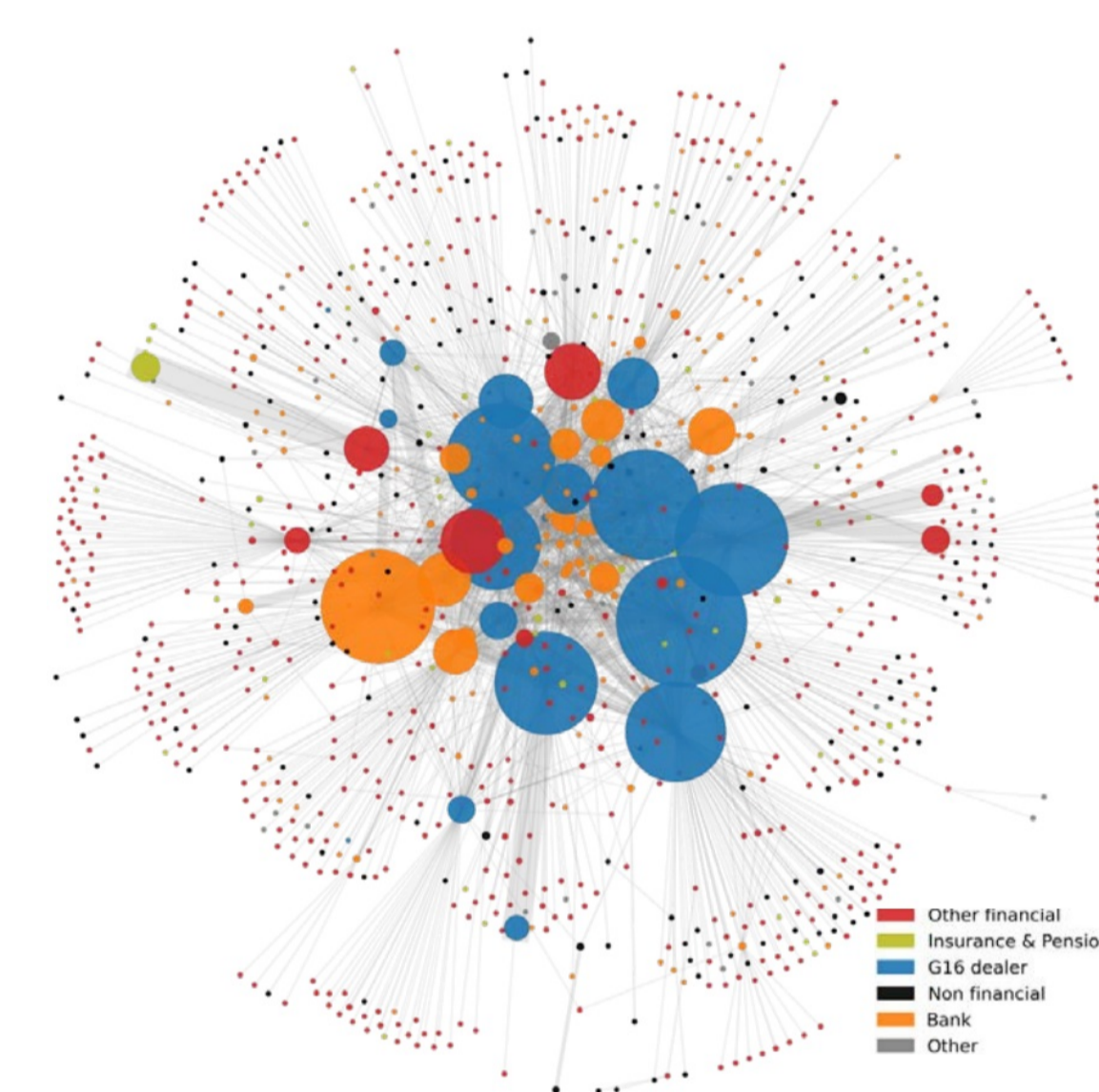
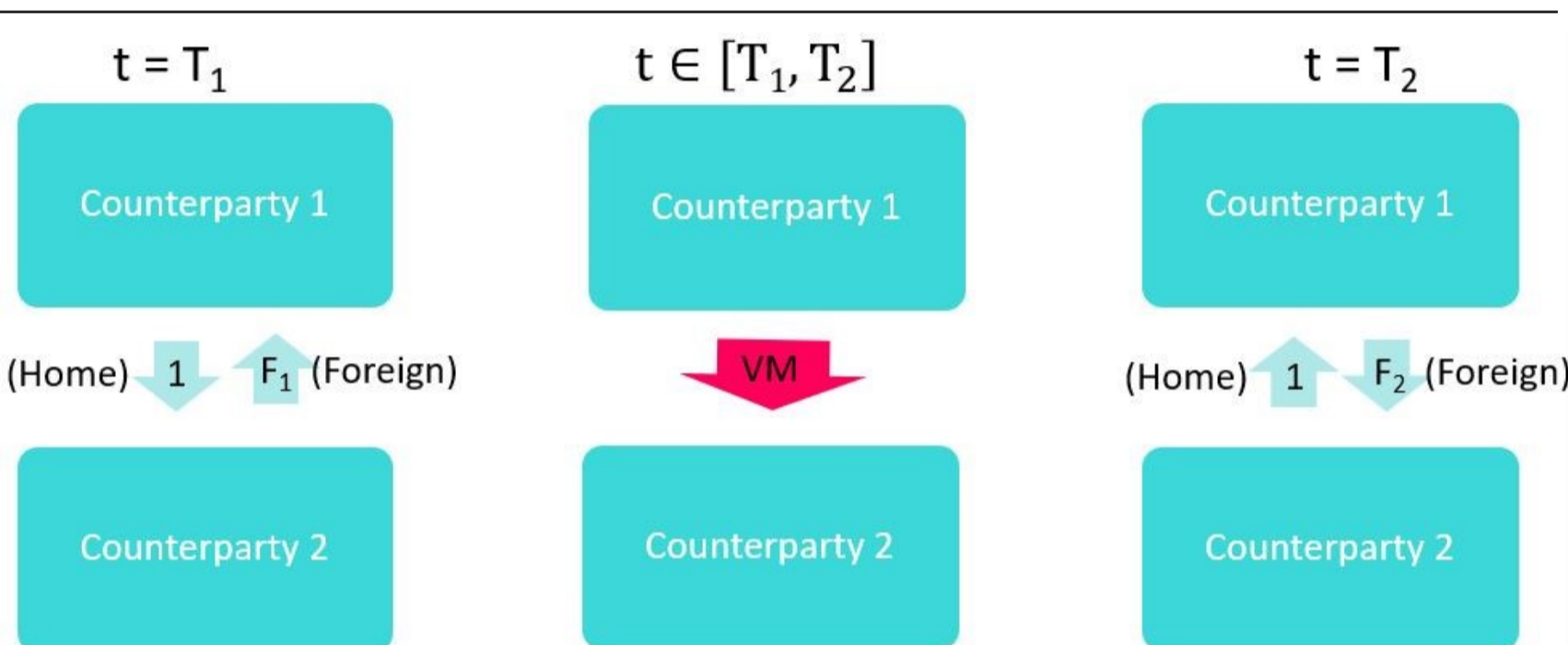
We investigate the role of **internal capital frictions** in explaining **deviations from arbitrage** conditions, in the context of the **covered interest rate parity**. We use changes in the profit and loss statement at different levels (foreign exchange derivatives trading desk, derivatives, fixed income, institution) to identify where the capital constraints bind, marking the limit of the firm within the balance sheet of large banks that intermediate the foreign exchange derivative market.

### The Covered Interest Rate Parity and its Deviations



### Motivation and Review of the Literature

FX swaps / forwards require **variation margins** that imply **internal liquidity** needs. But large banks' treasuries act as a bank within the bank (Funds Transfer Pricing, Tumasyan (2012)) with risk-taking limits, **restricting internal credit lines in case of profit and loss (P&L) drawdowns** - even for an arbitrage trade. This can be a source of slow moving capital (Duffie, 2010).



**FX derivatives market microstructure:** OTC and intermediated by large dealers (2-tier structure: D2D and D2C segments).

- Theory: Search and matching (Weill, 2020) vs information acquisition / leakage (Collin-Dufresne et al., 2019).
  - Empirics: Impact of the financial networks on price formation, e.g. Hau et al. (2021).
  - Recent important changes: e-trading, RFQ, MTF, SI.
- We confirm this structure with large, intermediating dealers. This explains why idiosyncratic shocks to dealers impact CIP deviations.

Figure: Counterparty network in EUR/USD FX forwards (Abad et al., 2016).

**Intermediary Asset Pricing:** Because of financial frictions, prices can move away from fundamentals and arbitrage conditions.

- Theory: Shleifer and Vishny (1997); FX determination and puzzles with an imperfect financial sector: Gabaix and Maggiori (2015), Itskhoki and Mukhin (2021)
  - Empirics on CIP violations after the Great Financial Crisis:
    - Balance-sheet constraints** (LR, LCR, NSFR) on regulated arbitrageurs: Du et al. (2018), Cenedese et al. (2021); also impact unregulated ones: Boyarchenko et al. (2018).
    - Funding segmentation:** Sushko et al. (2016), Rime et al. (2022), Anderson et al. (2021).
    - Margins on funding:** Gârleanu and Pedersen (2011), Augustin et al. (2024).
  - Growing evidence of *within* balance sheet segmentation: theoretically (Coase (1937), He and Xiong (2013)) and empirically, e.g. Mitchell et al. (2007), Duffie (2010), Siriwardane (2019), Siriwardane et al. (2023).
- We study the role of **internal funding** in explaining CIP violations by measuring directly the funding shocks.

Figure: Cross currency basis swap for major currencies (Bloomberg).



### The (UK-)European Market Infrastructure Regulation dataset

EMIR gives the Bank of England access to **all the transactions of derivative contracts** for which (at least) one counterparty is a UK entity. There are 129 fields to report, including date, price, quantity, counterparties, and **value of the contract**. The variation margin is this mark-to-market value of the contract. For **FX forwards** specifically, we have 4 million transactions outstanding, total notional value of USD 40 trillion, covering around 40% of the global market (Bank for International Settlements, 2022).

We use this dataset to investigate the market microstructure for FX forwards and highlight the role of specific large dealers, then use the variation margins on all outstanding contracts of these dealers as internal capital shocks.

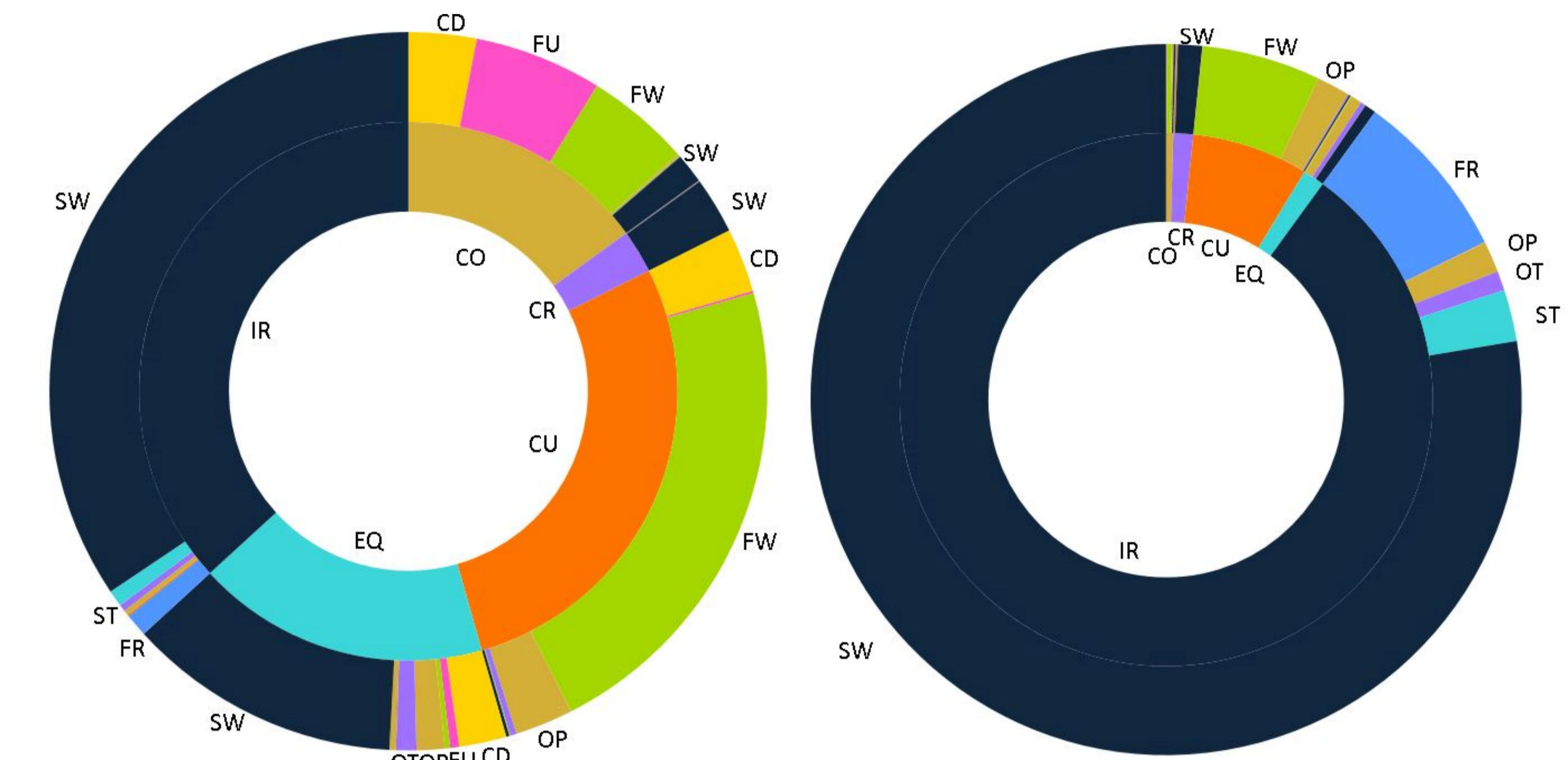
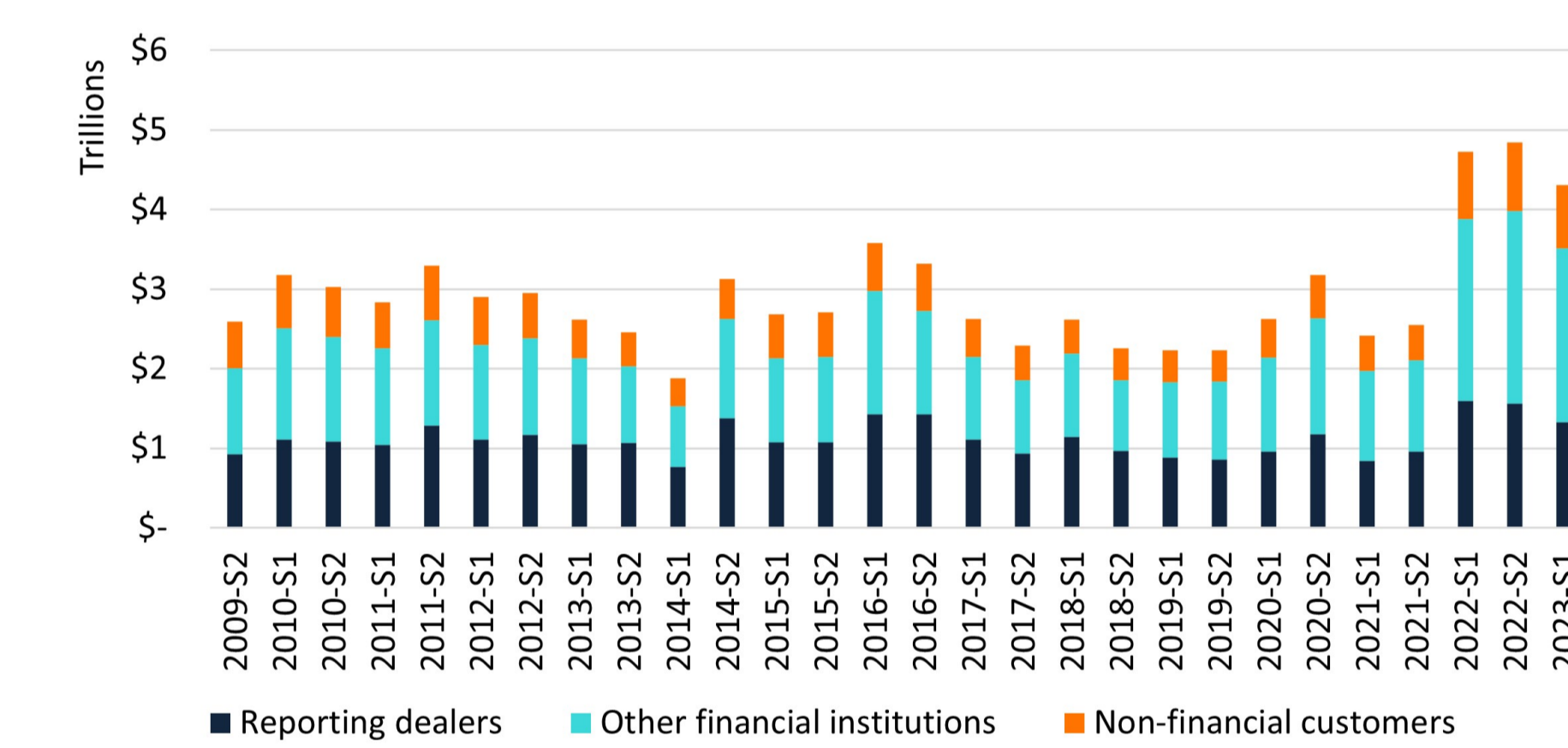


Figure: Distributions of all outstanding derivative contracts in the UK for a given day (8 April 2024). LHS: Open positions (24 million); RHS: notional values (USD 782 trillion). **Asset classes** (inner circle) - CO: Commodity and emission allowances; CR: Credit; CU: Currency; EQ: Equity; IR: Interest Rate. **Contract types** (outer circle) - CD: Financial contracts for difference; FR: Forward rate agreements; FU: Futures; FW: Forwards; OP: Option; SB: Spreadbet; SW: Swap; ST: Swaption; OT: Other.

### Identification Strategy and First Results



There are **significant changes in the mark-to-market values** of outstanding derivative contracts of large dealers, leading to sizable variation margins. These are internal liquidity shocks that can prevent intermediaries from arbitraging CIP deviations away in currencies in which they are dominant.

Figure: Gross market value of outstanding contracts (FX forwards, FX swaps and currency swaps, BIS, S1-2023).

Given the market structure of FX derivatives with dominant intermediaries, and the large P&L shocks on the balance sheets of these intermediaries, we want to test our hypothesis of slow moving internal capital explaining CIP deviations and thus map the limits of the firm through this regression:

$$\Delta b_{i,t} = \sum_{j \in \mathbb{J}} \beta_j \times \sum_{d(i) \in \mathbb{D}(i)} \omega_{d(i)} \Delta P \& L_{d(i),j,t-1} + controls_t + \epsilon_{i,t}$$

- $b_{i,t}$  is the basis swap at time  $t$  in currency pair  $i$ ,
- $\mathbb{J}$  is the partition of the dealers' balance sheets into the foreign exchange derivatives trading desk, all the other derivatives, all the other fixed income activities, and the rest of the institution,
- $\mathbb{D}(i)$  is the set of the main dealers in currency pair  $i$ ,
- $\omega_{d(i)}$  is the weight of dealer  $d(i)$  in currency pair  $i$  (degree / share of total notionals)
- $P \& L_{d(i),j,t}$  is the profit and loss statement of dealer  $d(i)$  at level  $j$ .

Because of endogeneity concerns, we want to use a Granular Instrumental Variables (Gabaix and Koijen, 2020)-type approach by orthogonalizing the shocks (removing the equally-weighted effect of CIP deviation changes) and focusing on P&L shocks unrelated to the currency pair of interest.

### References

J. Abad, I. Aldasoro, C. Aymanns, M. D'Errico, L. Fache Rousová, P. Hoffmann, S. Langfield, M. Neychev, and T. Roukny. Shedding light on dark markets: First insights from the new EU-wide OTC derivatives dataset. *ESRB Occasional Paper Series*, 11, September 2016.

Alyssa G. Anderson, Wenxin Du, and Bernd Schlusche. Arbitrage Capital of Global Banks. *Finance and Economics Discussion Series 2021-032*, Board of Governors of the Federal Reserve System (U.S.), May 2021.

Patrick Augustin, Mikhail Chernov, Lukas Schmid, and Dongho Song. The Term Structure of Covered Interest Rate Parity Violations. *The Journal of Finance*, 79(3):2077–2114, 2024.

Bank for International Settlements. Triennial Central Bank Survey of foreign exchange and Over-the-counter (OTC) derivatives markets in 2022. Technical report, 2022.

Nina Boyarchenko, Thomas M. Eisenbach, Pooja Gupta, Or Shachar, and Peter Van Tassel. Bank-intermediated arbitrage. Staff Report 858, 2018.

Gino Cenedese, Pasquale Della Corte, and Tianyu Wang. Currency Mispricing and Dealer Balance Sheets. *The Journal of Finance*, 76(6):2763–2803, 2021.

Ronald H. Coase. The Nature of the Firm. *Economica*, 4(16):386–405, 1937.

Pierre Collin-Dufresne, Peter Hoffmann, and Sebastian Vogel. Informed Traders and Dealers in the FX Forward Market. *mimeo*, December 2019.

Wenxin Du, Alexander Tepper, and Adrien Verdelhan. Deviations from Covered Interest Rate Parity. *The Journal of Finance*, 73(3):915–957, 2018.

Darrell Duffie. Presidential Address: Asset Price Dynamics with Slow-Moving Capital. *The Journal of Finance*, 65(4):1237–1267, 2010.

Xavier Gabaix and Ralph S. J. Koijen. Granular Instrumental Variables. Working Paper 28204, National Bureau of Economic Research, December 2020.

Xavier Gabaix and Matteo Maggiori. International Liquidity and Exchange Rate Dynamics. *The Quarterly Journal of Economics*, 130(3):1369–1420, 2015.

Nicolae Gârleanu and Lasse Heje Pedersen. Margin-based Asset Pricing and Deviations from the Law of One Price. *The Review of Financial Studies*, 24(6):1980–2022, 04 2011.

Harald Hau, Peter Hoffmann, Sam Langfield, and Yannick Timmer. Discriminatory Pricing of Over-the-Counter Derivatives. *Management Science*, 67(11):6660–6677, 2021.

Zhiguo He and Wei Xiong. Delegated asset management, investment mandates, and capital immobility. *Journal of Financial Economics*, 107(2):239–258, 2013.

Oleg Itskhoki and Dmitry Mukhin. Exchange Rate Disconnect in General Equilibrium. *Journal of Political Economy*, 129(8):2183–2232, 2021.

Mark Mitchell, Lasse Heje Pedersen, and Todd Pulvino. Slow Moving Capital. *American Economic Review*, 97(2):215–220, May 2007.

Dagfinn Rime, Andreas Schrimpf, and Olav Syrstad. Covered Interest Parity Arbitrage. *The Review of Financial Studies*, 35(11):5185–5227, 05 2022.

Andrei Shleifer and Robert W. Vishny. The Limits of Arbitrage. *The Journal of Finance*, 52(1), 1997.

Emil Siriwardane. Limited Investment Capital and Credit Spreads. *The Journal of Finance*, 74(5):2303–2347, 2019.

Emil Siriwardane, Aditya Sunderam, and Jonathan Wallen. Segmented Arbitrage. SSRN 3960980, November 2023.

Vladyslav Sushko, Claudio Borio, Robert Neil McCauley, and Patrick McGuire. The failure of covered interest parity: FX hedging demand and costly balance sheets. BIS Working Papers 590, Bank for International Settlements, October 2016.

Hovik Tumasyan. Revisiting Funds Transfer Pricing. SSRN 2257081, February 2012.

Pierre-Olivier Weill. The Search Theory of Over-the-Counter Markets. *Annual Review of Economics*, 12(Volume 12, 2020):747–773, 2020.