Granular Banking Flows and Exchange-Rate Dynamics

5th BIS Workshop on 'Research on Global Financial Stability: The Use of BIS International Banking and Financial Statistics'

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This Paper: Motivation and Questions

- **FX Puzzles**: 'disconnect' between exchange rates and macro fundamentals [Meese & Rogoff 1983]
- **Theory**: financial frictions and financial (UIP) shocks [Gabaix & Maggiori 2015; Itskhoki & Mukhin 2021]

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- **Origins: where do these financial shocks come from?**
- **Causality: What are the causal effects of financial (capital flow) shocks on FX?**
- **Marginality: Which agents’ financial constraints matter most for FX response?**

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- **Approach**: theory and bank-level data to investigate granular origins of financial shocks
- **Identification**: Granular Instrumental Variables (GIVs) for cross-border USD banking flows

[Gabaix & Koijen 2023]

This Paper: Contributions

1. Document **novel facts** on UK-resident global banks' cross-border positions
   - UK is world's largest IFC (~ 20% of global cross-border banking claims)
   - Granularity in UK banks' *gross and net* cross-border positions

$\Rightarrow$ Construct representative and **granular financial shocks** (i.e., GIVs)

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2. Present **new model** of FX determination based on flows in imperfect financial markets
    - Heterogeneous risk-bearing capacity across UK banks, taking positions vs. RoW (incl. funds)
    - Bank-specific and time-varying beliefs about cross-border returns

$\Rightarrow$ Flows by **large banks** play **biggest role** in exchange-rate dynamics

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3. Use GIVs to estimate **causal links** and **structural parameters** in currency markets
   - 1% $\uparrow$ cross-border USD *net* flow by UK banks $\Rightarrow$ persistent $\sim 2\%$ USD/GBP appreciation
   - UK-resident banks' USD-demand is *inelastic*, banks' counterparties' USD-supply is *elastic*

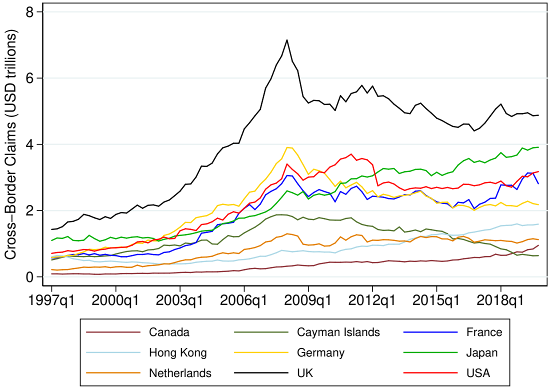
$\Rightarrow$ Banks price most of FX response to shocks, i.e., they are **'marginal' investors**

Our Data

Documenting Granularity in Cross-border Banking

UK as an International Financial Centre (IFC)

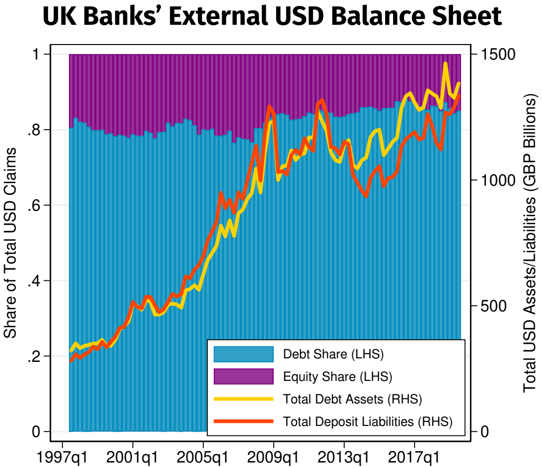
Cross-border banking claims by origin country



Source: BIS Locational Banking Statistics

- UK is world's largest centre for cross-border banking
- UK-based banks' foreign claims $\sim 20\%$ of all cross-border banking claims, $\sim 5\%$ of all intnl. assets
- UK-based banks' foreign claims $\sim 40\%$ UK external position

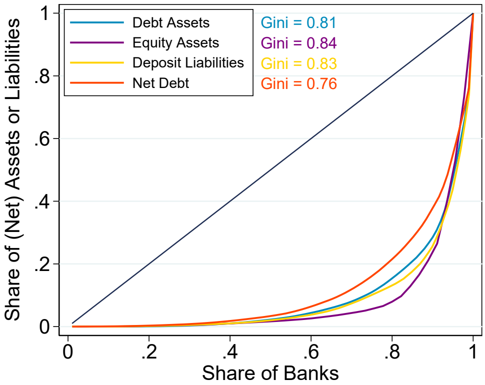
UK Banking System's Gross and Net USD Positions



- Data quarterly from 1997Q1-2019Q3
- Focus on USD positions (nearly 50%)
- Assets: Debt (80%), Equity (20%)
  Liabilities: Deposits
- UK banks' average absolute net USD debt (debt less deposits) position is £66 Billion.
  - Long USD in 2000s, short USD in 2010s
    Consistent with carry trading

UK Banks' Gross and Net USD Positions are Granular

Pareto principle in cross-border banking



Notes: Lorenz curves and Gini coefficients for UK banks' USD debt, equity, deposits, and net debt in 2019:Q3.

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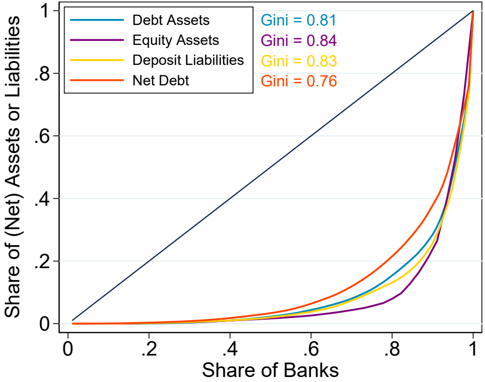

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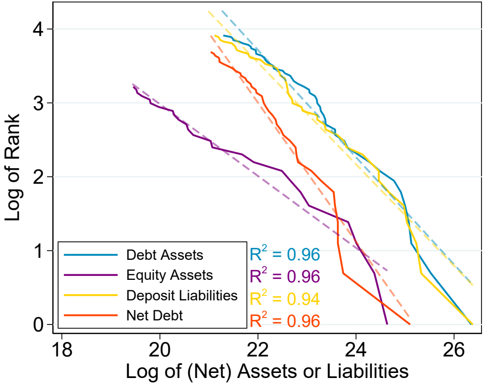
Zipf's law in cross-border banking



Notes: log-rank vs log-size plots and R^2 for UK banks' USD debt, equity, deposits, and net debt in 2019:Q3.

Our Paper and Data vs. Literature

Aldasoro, Beltrán, Grinberg and Mancini-Griffoli (2023)

+ We capture granularity at *bank level*, using data for *largest* banking country in their dataset

⇒ Bank-level is theory-consistent; we require exogeneity at bank level, not country level

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Becker, Schmeling and Schrimpf (2023)

+ We focus on supply/demand elasticities, not just multipliers for US banks' syndicated loans

$\Rightarrow$ We provide insights into structural underpinnings of UIP deviations

Granular International Banking Model

Identifying the Role of Large Banks for FX to Build the GIV

A Granular Gamma Model

Building on Gabaix and Maggiori (2015), UK-resident bank i for each asset class j solves

$$V^j_{i,t} = \max_{Q^j_{i,t}} \; \mathbb{E}_t \left[\exp(b^j_{i,t}) \cdot \left(\frac{R^j_{t+1}}{R_t} \frac{\mathcal{E}_{t+1}}{\mathcal{E}_t} - 1 \right) \right] Q^j_{i,t} \qquad \text{(Value Function / Exp. Carry Trade Return)}$$

$$\text{s.t.} \quad \underbrace{V^j_{i,t}}_{\text{bank value}} \geq \underbrace{\Gamma^j_i Q^j_{i,t}}_{\text{divertable fraction}} \cdot \underbrace{Q^j_{i,t}}_{\text{total claims}} \qquad \text{(Incentive Compatibility)}$$

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Two New Features:

1. Bank-specific constraint $\Gamma_i^j \Rightarrow$ size heterogeneity $Q_{i,t}^{j} = \frac{1}{\Gamma_i^j} \mathbb{E}_t \left[\exp(b_{i,t}^{j}) \cdot \left(\frac{R_{t+1}^{j}}{R_t} \frac{\mathcal{E}_{t+1}}{\mathcal{E}_t} - 1 \right) \right]$

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Bank i's Demand for j and USD: from first-order approximation and first-differences

$$\Delta q_{i,t}^j = \phi^j \cdot \left(\Delta \mathbb{E}_t [r_{t+1}^j] - \Delta r_t - \Delta e_t + \Delta \mathbb{E}_t [e_{t+1}] \right) + \Delta b_{i,t}^j \quad \text{with elasticity } \phi^j := \frac{1 + \overline{Q}^j \Gamma^j}{\overline{Q}^j \Gamma^j}$$

Equilibrium in Granular Gamma Model

Aggregate USD Demand: using size-weighted sum (subscript S) across banks i

$$\Delta q^j_{S,t} = \phi^j \cdot \Big(\Delta \mathbb{E}_t[r^j_{t+1}] - \Delta r_t - \Delta e_t + \Delta \mathbb{E}_t[e_{t+1}]\Big) + \underbrace{\Delta b^j_{S,t}}_{\substack{\text{demand shock} \\ \Rightarrow \text{ bigger banks play larger role}}}$$

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USD Supply: assume RoW (incl. funds, asset managers...) solve analogous problem

$$\Delta q^j_{R,t} = -\psi^j \cdot \Big(\Delta \mathbb{E}_t[r^j_{t+1}] - \Delta r_t - \Delta e_t + \Delta \mathbb{E}_t[e_{t+1}]\Big) + \underbrace{\Delta \varepsilon^j_t}_{\substack{\text{supply shock} \\ \text{(e.g., U.S. mon. pol.)}}}$$

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Equilibrium FX Dynamics: across asset markets, $j = 1, ..., m$

$$\Delta e_t = \frac{1}{m} \sum_{j=1}^{m} \left(\frac{1}{\phi^j + \psi^j} \Delta b^j_{S,t} - \frac{1}{\phi^j + \psi^j} \Delta \varepsilon^j_t + \Delta \mathbb{E}_t[r^j_{t+1}] \right) - \Delta r_t + \Delta \mathbb{E}_t[e_{t+1}]$$

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$\star$ More price-inelastic intermediaries $\phi^j, \psi^j \downarrow \rightarrow$ larger FX multipliers to shocks $\frac{1}{\phi^j+\psi^j} \uparrow$

GIV Identification from Granular Gamma Model

General Belief Process:

$$\underbrace{\Delta b^j_{i,t}}_{\substack{\text{Beliefs} \\ \text{(e.g. convenience yields)}}} = \underbrace{u^j_{i,t}}_{\substack{\text{exogenous shocks} \\ \text{(e.g. management change)}}} + \underbrace{\lambda^j_i \eta^j_t}_{\substack{\text{common factors } \eta^j_t \text{ with loadings } \lambda^j_i \\ \text{(e.g. Global Financial Cycle)}}} + \underbrace{\theta^j C^j_{i,t-1}}_{\substack{\text{observed controls} \\ \text{(e.g. balance-sheet info)}}}$$

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$$\Delta b^j_{i,t} = u^j_{i,t} + \lambda^j_i \eta^j_t + \theta^j C^j_{i,t-1}$$

Identification Strategy: Extract idiosyncratic moves by large banks by comparing their behaviour (via size-weighted S) with the behaviour of average banks (via equal-weighted E).

- **Relevance**: Idiosyncratic flows by large banks can affect aggregate flows
- **Exogeneity**: Loadings on common factors η^j_t are uncorrelated with size $\lambda^j_{S,t} - \lambda^j_{E,t} = 0$

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$$z^j_t := \Delta q^j_{S,t} - \Delta q^j_{E,t}$$

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Intuition: GIV purges common factors (e.g., mechanical 'exchange-rate valuation effects')

Accounting for Threats to Identification

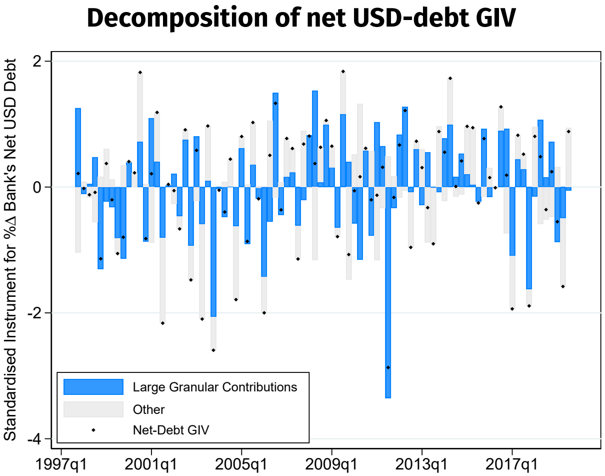
- Incl. bank and macro controls $C_{i,t}$ (e.g., balance-sheet info., asset returns, FX exp.) Details
- Control for unobserved common factors η_t^j using principal-component analysis Details

$\Rightarrow$ Instruments z_t^j must be function of exogenous shocks $u_{i,t}^j$, after including controls $C_{i,t}$ and proxies for common factors $\hat{\eta}_t^j$

Additional Assessments of Exogeneity:

- Show that our GIVs are uncorrelated with proxies for the Global Financial Cycle Details
- Conduct narrative checks into drivers of GIV...

Narrative Checks into Main Drivers of GIV



- Observe banks that explain large share of GIV (here: $> 20\%$ of a s.d.)
- Small number (~ 10) of large banks
- Use (confidential) bank-level info to conduct check using *FT* archives
- *What news is associated with the banks that explain largest moves in GIV in given quarter?*

Narrative Checks into Main Drivers of GIV

Main Narratives composing net USD-debt GIV

- *What news is associated with the banks that explain largest moves in GIV in given quarter?*
- Findings reveal many events that are unlikely to be systematically related to macro outlook or possible confounders

Empirical Results

Estimating the Causal Links and Structural Parameters

Multipliers for Cross-Border Flows on USD/GBP FX Dynamics

$$\Delta e_t = \sum_{j=1}^{m} M^j z_t^j/m + \beta controls_t + u_t$$

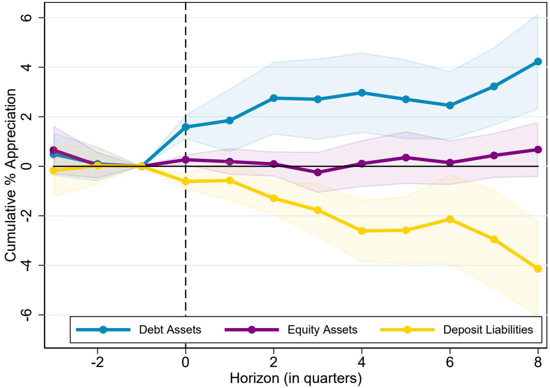
PANEL A: Multipliers for Specific USD Asset and Liability Flows				
z_t^j/m: Debt (Assets)	2.000***	1.231***	1.190***	1.585***
	(0.358)	(0.198)	(0.208)	(0.253)
z_t^j/m: Equity (Assets)	0.423***	0.251*	0.277**	0.265**
	(0.142)	(0.139)	(0.136)	(0.112)
z_t^j/m: Deposits (Liabilities)	-1.135***	-0.485***	-0.443**	-0.610***
	(0.346)	(0.168)	(0.175)	(0.167)
Adjusted R^2	0.201	0.657	0.648	0.682
PANEL B: Multipliers for Net USD-Debt Flows				
z_t^{net}: Net-Debt	0.818***	0.378**	0.367**	0.381**
(Debt $-$ Deposits)	(0.275)	(0.159)	(0.169)	(0.189)
Adjusted R^2	0.069	0.573	0.557	0.570
Macro Controls	No	Yes	Yes	Yes
Bank Controls	No	No	Yes	Yes
Components	No	No	No	5

Notes: ***, **, * denote 1, 5 and 10% significance, using Newey-West standard errors with 12 lags.

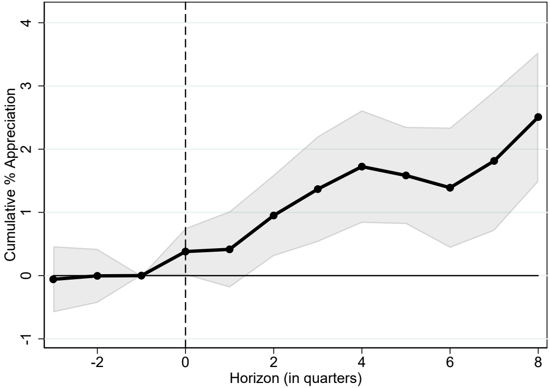
Dynamic Effects of Flows on USD/GBP FX Dynamics

$$e_{t+h} - e_{t-1} = \sum_{j=1}^{m} M_h^j \frac{z_t^j}{m} + \beta_h controls_t + u_{t+h}$$

By Asset Class



Net USD-Debt



Notes: 95% confidence bands from Newey-West s.e. with 12 lags

UK-Bank Demand and ROW Supply Elasticities for USD with 2SLS

USD SUPPLY FROM ROW: $\Delta q^{net}_{S,t} = \psi^{net}\Delta e_t + \beta^{net}_{\phi_R} controls_t + u_t$				
2nd Stage				
Δe_t	0.821***	1.793**	1.804**	2.037**
	(0.294)	(0.719)	(0.767)	(0.824)
1st-Stage F-stat.	8.85	34.22	30.94	32.66
USD DEMAND FROM UK-RESIDENT BANKS: $\Delta q^{net}_{E,t} = -\phi^{net}\Delta e_t + \beta^{net}_{\phi} controls_t + u_t$				
2nd Stage				
Δe_t	-0.402***	-0.854**	-0.888**	-0.538*
	(0.138)	(0.377)	(0.368)	(0.321)
1st-Stage F-stat.	8.85	34.22	27.81	33.71
Macro Controls	No	Yes	Yes	Yes
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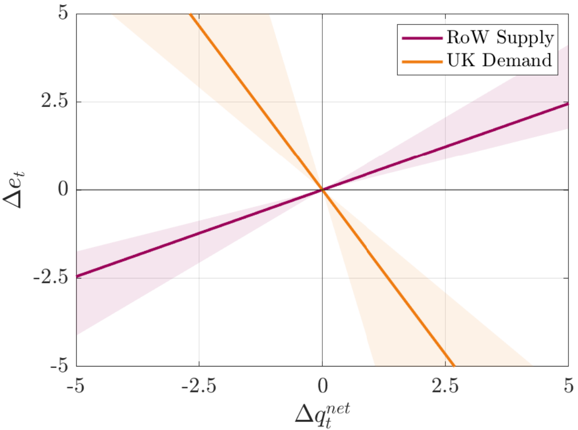
Inelastic UK-Bank Demand and Elastic ROW-'Fund' Supply for USD

Estimated Supply and Demand Curves for USD



Notes: Shaded areas denote Newey-West one standard deviation error bands (12 lags).

- UK-Bank USD demand ϕ^{net} is price-inelastic while ROW USD supply ψ^{net} is price-elastic

$\Rightarrow$ Decomposing $M^{net} = \frac{1}{\phi^{net}+\psi^{net}}$, that $\phi^{net} < \psi^{net}$ implies that banks price most of FX response, i.e., are marginal

$\Rightarrow$ US monetary policy + global financial cycle can weigh heavily on USD/GBP FX

$\Rightarrow$ At odds with micro-foundations underpinning the Gamma model

- We propose alternative constraint $V_{i,t}^j \geq (\Gamma_i^j Q_{i,t}^j)^{\gamma_i^j} \cdot Q_{i,t}^j$, where γ_i^j mediates degree of moral hazard

Drivers of Inelastic Demand: The Role of Banks' Constraints

$$\Delta e_t = M z_t^{net} + \delta \left(z_t^{net} \times Cap_{S,t-1} \right) + \vartheta Cap_{S,t-1} + \beta_M^j C_t^j + u_t$$

	(1)	(2)	(3)	(4)
	DEP. VAR.: % change nominal USD/GBP, Δe_t			
z_t^{net}	0.760***	0.350**	0.337**	0.363**
	(0.219)	(0.144)	(0.145)	(0.167)
$z_t^{net} \times Cap_{S,t-1}$	-0.598*	-0.480**	-0.488**	-0.413**
	(0.319)	(0.207)	(0.212)	(0.188)
$Cap_{S,t-1}$	-0.001	-0.000	-0.005	-0.004
	(0.004)	(0.003)	(0.005)	(0.004)
Macro Controls	No	Yes	Yes	Yes
Bank Controls	No	No	Yes	Yes
Components	No	No	No	5

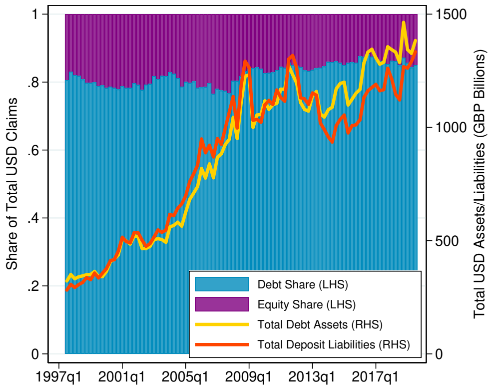
Notes: ***, **, * denote 1, 5 and 10% significance, using Newey-West standard errors with 12 lags.

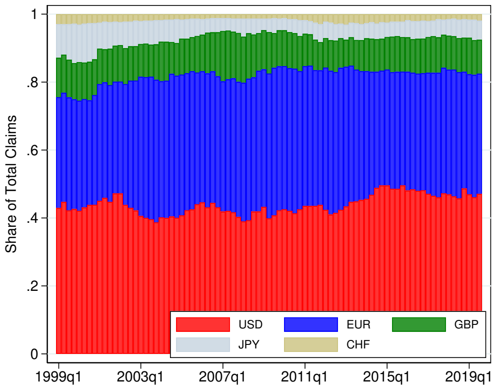
Conclusion

- $\star$ Document **granularity** in banks' gross and net cross-border currency positions
- $\star$ Reflect this in new model, where **large banks play biggest role in FX determination**
- $\star$ Use model to derive novel **granular financial shocks**—GIVs for USD capital flows
- $\star$ GIVs reveal that (net) flows have **significant and persistent causal effects** on exchange rates
  - 1% $\uparrow$ cross-border USD net flow by UK banks $\Rightarrow \sim 2$% USD/GBP appreciation
- $\star$ UK-resident banks' USD-demand is **inelastic**...
  - ... while banks' counterparties' average USD-supply is elastic
  - $\Rightarrow$ Suggests UK-resident banks have marginal role in USD/GBP market
- $\star$ ...in part linked to banks' **risk-bearing capacity**
  - Effects of (net) flows twice as large when banks' capital ratios are 1 s.d. below average
  - $\Rightarrow$ Role for domestic prudential policy in contributing to stable FX

Appendix

Decomposing UK-Based Banks' Cross-Border Claims and Liabilities





Notes: Total USD-denominated cross-border claims by asset class (debt and equity) and total liabilities.

Notes: UK-resident banks' total cross-border claims by currency.

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Details on Controls

Macro Controls:

- VIX
- 3-month UK and US interbank interest rates
- 6-month and 10-year UK and US government bond yields
- 3-month UK and US realised equity returns
- UK and US corporate bond index yields
- Survey forecasts for 3-month-ahead USD/GBP exchange rate

Bank-Level Controls:

- log(Total Assets)
- Capital Ratio
- Liquid-Asset Ratio
- Core Deposits Ratio
- Commitment share
- International share

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Proxies for Unobserved Common Factors via PCA

Panel Regression: of flows on time fixed effects and controls to extract residuals $\hat{\zeta}^j_{i,t}$.

$$\Delta q^j_{i,t} = \theta^j_t + \theta^j C^j_{i,t-1} + \zeta^j_{i,t}$$

Factor Analysis: Proxy common factors $\hat{\eta}^j_{k,t}$ for $k = 1, ..., K$ by performing principle-component analysis on the residuals $\hat{\zeta}^j_{i,t}$ across banks i.

Intuition: Principle component captures the common variation across banks' flows in period t that banks load on heterogeneously—since include time fixed effects—and are not related to observable controls.

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GIV Uncorrelated with Global Financial Cycle

DEP. VAR.: Δz_t^{net}				
vix_t	-0.000			-0.000
	(0.000)			(0.000)
GFC_t		0.001		0.001
		(0.001)		(0.002)
$r_{6M,t}^{us}$			-0.000	-0.000
			(0.001)	(0.001)
Observations	88	86	88	86
Adjusted R^2	-0.01	-0.01	-0.01	-0.03

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