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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The views expressed here do not necessarily reflect the position of the Bank of England.
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]

Our Questions

- 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?

Approach

- Identification: Granular Instrumental Variables (GIVs) for cross-border USD banking flows [Gabaix & Koijen 2023]
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- **Causality**: What are the causal effects of financial (capital flow) shocks on FX?
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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 (\\(\sim 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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   ➔ **Construct representative and granular financial shocks** (i.e., GIVs)

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

   ➔ **Flows by large banks** play **biggest role** in exchange-rate dynamics

Bippus, Lloyd and Ostry (BoE, Cambridge, CfM)
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   $\Rightarrow$ **Flows by large banks play biggest role** in exchange-rate dynamics

3. Use GIVs to estimate **causal links** and **structural parameters** in currency markets
   - $1\%$ ↑ 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

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

Source: BIS Locational Banking Statistics
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

Bippus, Lloyd and Ostry (BoE, Cambridge, CfM)
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.
UK Banks’ Gross and Net USD Positions are Granular

**Pareto principle in cross-border banking**

- Debt Assets: Gini = 0.81
- Equity Assets: Gini = 0.84
- Deposit Liabilities: Gini = 0.83
- Net Debt: Gini = 0.76

**Zipf’s law in cross-border banking**

- Debt Assets: $R^2 = 0.96$
- Equity Assets: $R^2 = 0.96$
- Deposit Liabilities: $R^2 = 0.94$
- Net Debt: $R^2 = 0.96$

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

**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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⇒ Complementary as funds are banks’ counterparties: funds re-balance while banks segment
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  ⇒ Complementary as funds are banks’ counterparties: funds re-balance while banks segment

**Becker, Schmeling and Schrimpf (2023)**
- We focus on supply/demand elasticities, not just multipliers for US banks’ syndicated loans
  ⇒ 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

$$V_{i,t}^j = \max_{Q_{i,t}^j} \mathbb{E}_t \left[ \exp(b_{i,t}^j) \cdot \left( \frac{R_{t+1}^j}{R_t} \cdot \mathcal{E}_{t+1} \mathcal{E}_t - 1 \right) \right] Q_{i,t}^j$$

(Value Function / Exp. Carry Trade Return)

s.t.

$$V_{i,t}^j \geq \Gamma_i^j Q_{i,t}^j \cdot Q_{i,t}^j$$

(Incentive Compatibility)

1. Bank-specific constraint $\Gamma_j^i \Rightarrow$ size heterogeneity

2. Bank-specific beliefs $b_{i,t}^j \Rightarrow$ larger banks play bigger role for aggregate flows & FX

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

$$\Delta q_{j,i,t} = \phi_j \cdot \left( \Delta \mathcal{E}_{t+1} \left[ r_{j,t} + 1 \right] - \Delta r_t - \Delta e_t + \Delta \mathcal{E}_{t+1} \left[ e_{t+1} \right] \right) + \Delta b_{i,t}^j$$

with elasticity $\phi_j = 1 + \frac{\Gamma_j^i}{Q_{i,t}^j \cdot Q_{i,t}^j}$
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(Incentive Compatibility)

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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with elasticity $\phi^j := \frac{1+Q_j^j}{Q_j^j \Gamma_j}$
Equilibrium in Granular Gamma Model

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

\[
\Delta q^j_{S,t} = \phi^j \cdot \left( \Delta E_t[r^j_{t+1}] - \Delta r_t - \Delta e_t + \Delta E_t[e_{t+1}] \right) + \Delta b^j_{S,t}
\]

demand shock
⇒ bigger banks play larger role
Equilibrium in Granular Gamma Model

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$$

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

$$
\Delta q_{R,t}^j = -\psi_j \cdot (\Delta \mathbb{E}_t [r_{t+1}^j] - \Delta r_t - \Delta e_t + \Delta \mathbb{E}_t [e_{t+1}]) + \Delta e_t^j
$$

supply shock
(e.g., U.S. mon. pol.)
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**Aggregate USD Demand:** using size-weighted sum (subscript $S$) across banks $i$

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

$$\Delta e_t = \frac{1}{m} \sum_{j=1}^{m} \left( \frac{1}{\phi_j + \psi_j} \Delta b_{S,t}^j - \frac{1}{\phi_j + \psi_j} \Delta \varepsilon_t^j + \Delta E_t[e_{t+1}] \right) - \Delta r_t + \Delta E_t[e_{t+1}]$$

**More price-inelastic intermediaries** $\phi_j, \psi_j \downarrow \rightarrow$ larger FX multipliers to shocks

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★ 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:

\[ \Delta b_{i,t}^j = u_{i,t}^j + \lambda_{i}^j \eta_t^j + \theta_{i} C_{i,t-1} \]

Beliefs (e.g. convenience yields) + exogenous shocks (e.g. management change) + common factors \( \eta_t^j \) with loadings \( \lambda_{i}^j \) (e.g. Global Financial Cycle) + observed controls (e.g. balance-sheet info)
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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 \( \eta_t^j \) are uncorrelated with size \( \lambda_{S,t}^j - \lambda_{E,t}^j = 0 \)

Intuition: GIV purges common factors (e.g., mechanical ‘exchange-rate valuation effects’)
GIV Identification from Granular Gamma Model

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**GIV:** Following Gabaix and Koijen (2022, 2023), we build the GIV

\[ z^j_t := \Delta q^j_{S,t} - \Delta q^j_{E,t} \]
GIV Identification from Granular Gamma Model

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\[ z_t^j := \Delta q_{S,t}^j - \Delta q_{E,t}^j = (\Delta b_{S,t}^j - \Delta b_{E,t}^j) \]

from model
**GIV Identification from Granular Gamma Model**

**General Belief Process:**

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\Delta b_{i,t}^j = u_{i,t}^j + \lambda_j^i \eta_t^j + \theta^j C_{i,t-1}^j
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- **Relevance:** Idiosyncratic flows by large banks can affect aggregate flows
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**GIV:** Following Gabaix and Koijen (2022, 2023), we build the GIV

\[
z_t^j := \Delta q_{S,t}^j - \Delta q_{E,t}^j = (\Delta b_{S,t}^j - \Delta b_{E,t}^j) = (u_{i,t}^j - u_{i,t}^j) + (\lambda_{S,t}^j - \lambda_{E,t}^j) \eta_t^j
\]

from model

\[
= 0 \text{ from exogeneity assumption}
\]
GIV Identification from Granular Gamma Model

General Belief Process:

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- **Relevance**: Idiosyncratic flows by large banks can affect aggregate flows
- **Exogeneity**: Loadings on common factors \( \eta_{i,t}^j \) are uncorrelated with size

\[ \lambda_{S,t}^j - \lambda_{E,t}^j = 0 \]

\( \text{GIV: Following Gabaix and Koijen (2022, 2023), we build the GIV} \)

\[ z_t^j := \Delta q_{S,t}^j - \Delta q_{E,t}^j = (\Delta b_{S,t}^j - \Delta b_{E,t}^j) \]

\[ = (u_{S,t}^j - u_{E,t}^j) + (\lambda_{S,t}^j - \lambda_{E,t}^j) \eta_{i,t}^j \]

\[ = 0 \text{ from exogeneity assumption} \]

**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.)

- Control for unobserved common factors $\eta^j_t$ using principal-component analysis

$\Rightarrow$ Instruments $z^j_t$ must be function of exogenous shocks $u^j_{i,t}$, after including controls $C_{i,t}$ and proxies for common factors $\hat{\eta}^j_t$

Additional Assessments of Exogeneity:

- Show that our GIVs are uncorrelated with proxies for the Global Financial Cycle

- Conduct narrative checks into drivers of GIV...
Narrative Checks into Main Drivers of GIV

Decomposition of net USD-debt 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

- merger
- earnings
- compensation-claim
- computer-failure
- inquiry
- fine
- management-change
- restructure
- strategy-overhaul
- stress-test-failure
- acquisition-opportunities
- scandal
- sell-off
- profits
- losses
- purchase
- legal-action

- 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

\[ \Delta e_t = \sum_{j=1}^{m} M^j z^j t / m + \beta_{controls} s_t + u_t \]

**Panel A: Multipliers for Specific USD Asset and Liability Flows**

<table>
<thead>
<tr>
<th>Asset/ Liability</th>
<th>Multiplier (1/10)</th>
<th>Standard Error</th>
<th>2018 Q1</th>
<th>2018 Q2</th>
<th>2018 Q3</th>
<th>2019 Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt</td>
<td>2.000***</td>
<td>0.358</td>
<td>1.231***</td>
<td>0.198</td>
<td>1.190***</td>
<td>0.208</td>
</tr>
<tr>
<td>Equity</td>
<td>0.423***</td>
<td>0.142</td>
<td>0.251*</td>
<td>0.139</td>
<td>0.277**</td>
<td>0.136</td>
</tr>
<tr>
<td>Deposits</td>
<td>-1.135***</td>
<td>0.346</td>
<td>-0.485***</td>
<td>0.168</td>
<td>-0.443**</td>
<td>0.175</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.201</td>
<td>0.069</td>
<td>0.657</td>
<td>0.648</td>
<td>0.682</td>
<td></td>
</tr>
</tbody>
</table>

**Panel B: Multipliers for Net USD-Debt Flows**

<table>
<thead>
<tr>
<th>Net-Debt (Debt − Deposits)</th>
<th>Multiplier (1/10)</th>
<th>Standard Error</th>
<th>2018 Q1</th>
<th>2018 Q2</th>
<th>2018 Q3</th>
<th>2019 Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.818***</td>
<td>0.378**</td>
<td>0.367**</td>
<td>0.381**</td>
<td>0.275</td>
<td>0.159</td>
<td>0.169</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.069</td>
<td>0.573</td>
<td>0.557</td>
<td>0.570</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control and Component</th>
<th>2018 Q1</th>
<th>2018 Q2</th>
<th>2018 Q3</th>
<th>2019 Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macro Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Bank Controls</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Components</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>5</td>
</tr>
</tbody>
</table>

**Notes:** ***, **, * denote 1, 5 and 10% significance, using Newey-West standard errors with 12 lags.
Dynamic Effects of Flows on USD/GBP FX Dynamics

\[ e_{t+h} - e_{t-1} = \sum_{j=1}^{m} M^j_{h_1} z^j_{t_1} + \beta_h \text{controls} + u_{t+h} \]

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:** \( \Delta q_{S,t}^{net} = \psi_{net} \Delta e_t + \beta_{\phi R}^{net} controls_t + u_t \)

<table>
<thead>
<tr>
<th>2nd Stage</th>
<th>( \Delta e_t )</th>
<th>0.821***</th>
<th>1.793**</th>
<th>1.804**</th>
<th>2.037**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( (0.294) )</td>
<td>( (0.719) )</td>
<td>( (0.767) )</td>
<td>( (0.824) )</td>
<td></td>
</tr>
</tbody>
</table>

| 1st-Stage F-stat. | 8.85 | 34.22 | 30.94 | 32.66 |

**USD DEMAND FROM UK-RESIDENT BANKS:** \( \Delta q_{E,t}^{net} = -\phi_{net} \Delta e_t + \beta_{\phi}^{net} controls_t + u_t \)

<table>
<thead>
<tr>
<th>2nd Stage</th>
<th>( \Delta e_t )</th>
<th>-0.402***</th>
<th>-0.854**</th>
<th>-0.888**</th>
<th>-0.538*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( (0.138) )</td>
<td>( (0.377) )</td>
<td>( (0.368) )</td>
<td>( (0.321) )</td>
<td></td>
</tr>
</tbody>
</table>

| 1st-Stage F-stat. | 8.85 | 34.22 | 27.81 | 33.71 |

| 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.
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 $\phi^{net}$ is price-inelastic while ROW USD supply $\psi^{net}$ is price-elastic
- 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
- US monetary policy + global financial cycle can weigh heavily on USD/GBP FX
- 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 $\gamma_i^j$ mediates degree of moral hazard
Drivers of Inelastic Demand: The Role of Banks’ Constraints

\[ \Delta e_t = M z_{net}^t + \delta (z_{net}^t \times Cap_{S,t-1}) + \vartheta Cap_{S,t-1} + \beta^j M^j C_t^j + u_t \]

<table>
<thead>
<tr>
<th></th>
<th>Dep. Var.: % change nominal USD/GBP, ( \Delta e_t )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>( z_{net}^t )</td>
<td>0.760***</td>
</tr>
<tr>
<td></td>
<td>(0.219)</td>
</tr>
<tr>
<td>( z_{net}^t \times Cap_{S,t-1} )</td>
<td>-0.598*</td>
</tr>
<tr>
<td></td>
<td>(0.319)</td>
</tr>
<tr>
<td>( Cap_{S,t-1} )</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
</tr>
<tr>
<td>Macro Controls</td>
<td>No</td>
</tr>
<tr>
<td>Bank Controls</td>
<td>No</td>
</tr>
<tr>
<td>Components</td>
<td>No</td>
</tr>
</tbody>
</table>

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

★ Document **granularity** in banks’ gross and net cross-border currency positions

★ Reflect this in new model, where **large banks play biggest role in FX determination**

★ Use model to derive novel **granular financial shocks**—GIVs for USD capital flows

★ GIVs reveal that (net) flows have **significant and persistent causal effects** on exchange rates
  - 1% ↑ cross-border USD net flow by UK banks ⇒ ∼ 2% USD/GBP appreciation

★ UK-resident banks’ USD-demand is **inelastic**...
  - ... while banks’ counterparties’ average USD-supply is elastic
    ⇒ Suggests UK-resident banks have marginal role in USD/GBP market

★ ...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
    ⇒ Role for domestic prudential policy in contributing to stable FX
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.

Bippus, Lloyd and Ostry (BoE, Cambridge, CfM)
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
**Proxies for Unobserved Common Factors via PCA**

**Panel Regression:** of flows on time fixed effects and controls to extract residuals \( \hat{\zeta}_{i,t}^j \).

\[
\Delta q_{i,t}^j = \theta_t^j + \theta^j C_{i,t-1}^j + \hat{\zeta}_{i,t}^j
\]

**Factor Analysis:** Proxy common factors \( \hat{\eta}_{k,t}^j \) for \( k = 1, \ldots, K \) by performing principle-component analysis on the residuals \( \hat{\zeta}_{i,t}^j \) 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.
### GIV Uncorrelated with Global Financial Cycle

**Dep. Var.:** $\Delta z_{t}^{net}$

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate 1</th>
<th>Estimate 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>$vix_{t}$</td>
<td>-0.000</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>$GFC_{t}$</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>$r^{us}_{6M,t}$</td>
<td></td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.001)</td>
</tr>
</tbody>
</table>

- Observations: 88 86 88 86
- Adjusted $R^2$: -0.01 -0.01 -0.01 -0.03

Bippus, Lloyd and Ostry (BoE, Cambridge, CfM)

Granular Banking Flows and Exchange-Rate Dynamics

December 2023