Monetary Policy and Global Bank Lending: A Reversal Interest Rate Approach

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EEA Presentation

August 23, 2022

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$\Rightarrow$ How does monetary policy contribute to these benefit and cost?

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Evaluate the model implications in a dynamic general equilibrium setup.

Outline

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Quantity of foreign lending?

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Home bias of country *i*'s banking sector:

$$hb_i \equiv 1 - \frac{\text{Foreign Share of } i\text{'s Portfolio}}{\text{Foreign (from } i\text{'s perspective) Share of the World Portfolio}}$$

- $hb_i = 1 \Rightarrow$ invest only in domestic assets.
- $hb_i = 0 \Rightarrow$ invest proportionally to country *i* vs. the rest of the world.

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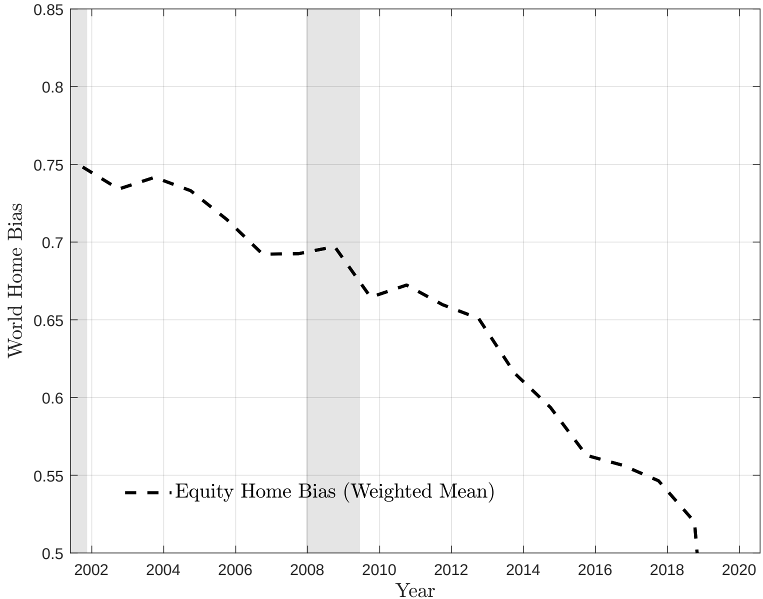
Bank Lending Data. Quarterly frequency from 2001 with over thirty countries.

- BIS Locational Banking Statistics
- IMF International Financial Statistics

Data sources Equity Home Bias

Country-level Bank Home Bias



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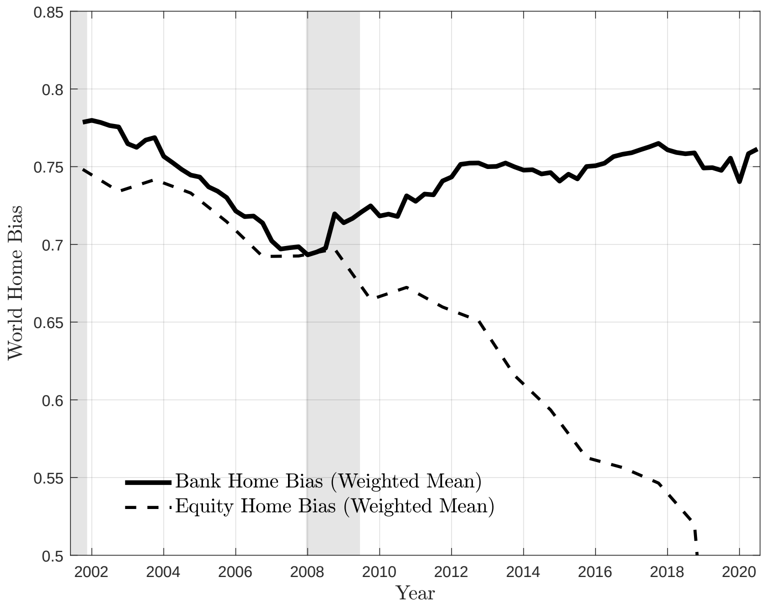

US Bank home bias | Bank home bias and uncertainty | Bank home bias and Profitability

Structural Analysis of Lending Composition

Model

$$\mathbf{y_t} = A_0 + A_1\mathbf{y_{t-1}} + \cdots + A_p\mathbf{y_{t-p}} + \mathbf{u_t} \quad t = 1, \cdots, T,$$

Specification

- four-variable: domestic and foreign uncertainty, bank asset, bank home bias
- five-variable: with asset decomposition
- six-variable: with macro indicators

Identification

- short-run identification
- max-share identification of Uhlig (2003)

Uncertainty Data　SVAR analysis of domestic uncertainty shock　SVAR analysis of domestic uncertainty shock

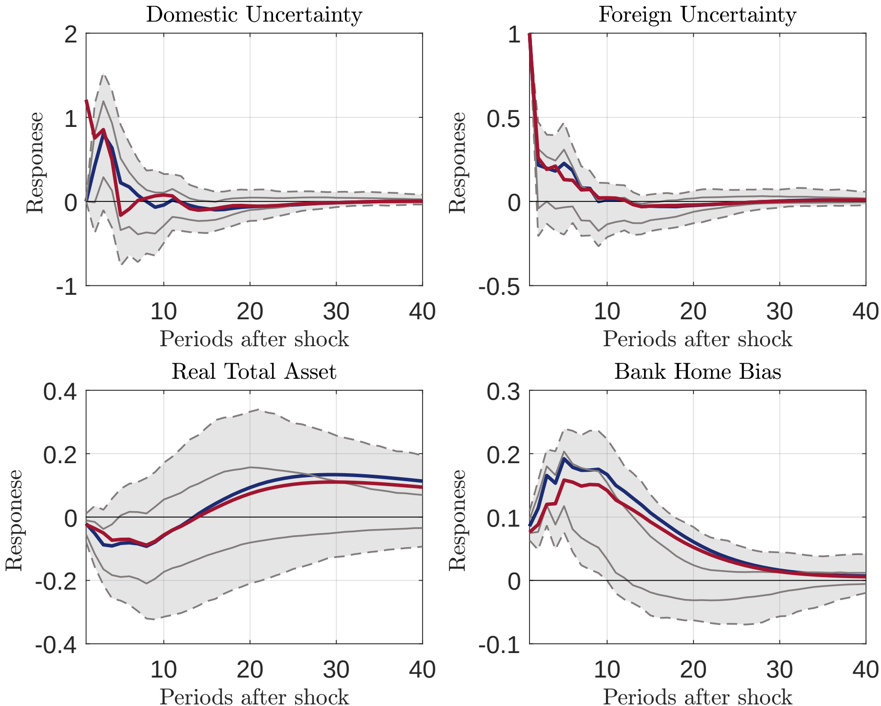

Figure 1: Impulse Response to foreign uncertainty shock.

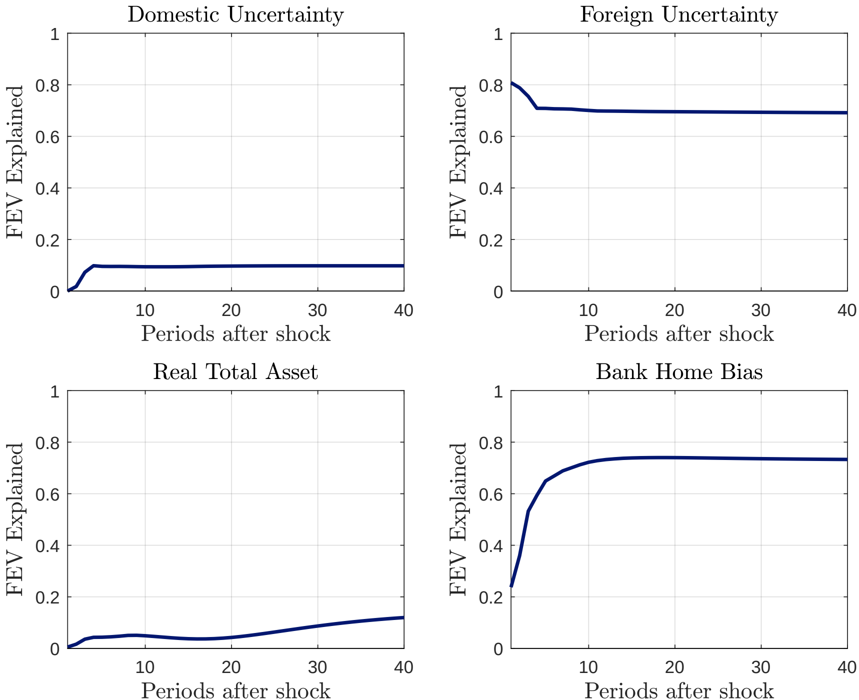

Figure 2: FEVD to foreign uncertainty shock.

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Two countries (i, j), each with a representative bank

- CARA utility, collect domestic deposit
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Balance sheet decomposition of Country i's bank

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- liability: given equity e_i, collect deposit d_i, $\delta = d_i / (d_i + e_i)$

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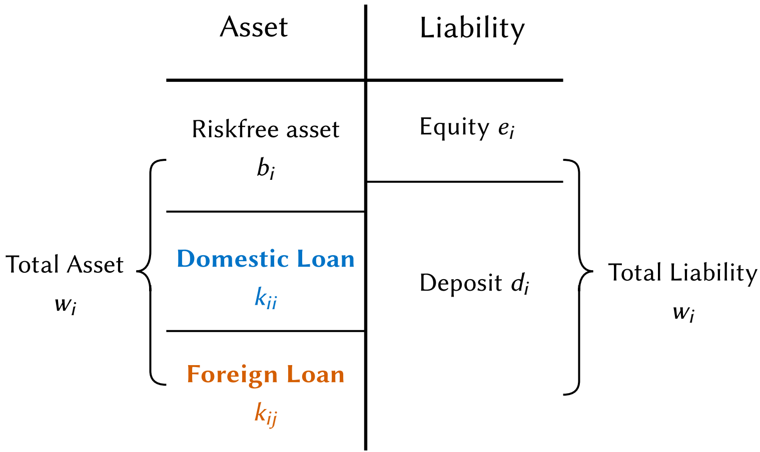

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Riskfree policy rate R^f. Deposit rate $R^d = \left(R^f\right)^{\omega}$ with pass-through elasticity ω.

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Risky returns are endogenous to banks through costly uncertainty management.

Endogenous Risky Returns

Risky loan returns consist of two shocks: TFP and uncertainty

$$R^l_{ii} = R_i + \epsilon_i, \qquad R^l_{ij} = R_j + \epsilon_j.$$

(R_i, R_j): jointly normal, mean (μ_i, μ_j), variance (σ^2_i, σ^2_j), correlation ρ.

(ϵ_i, ϵ_j): normal, zero mean, variance σ^2_ϵ, zero correlation.

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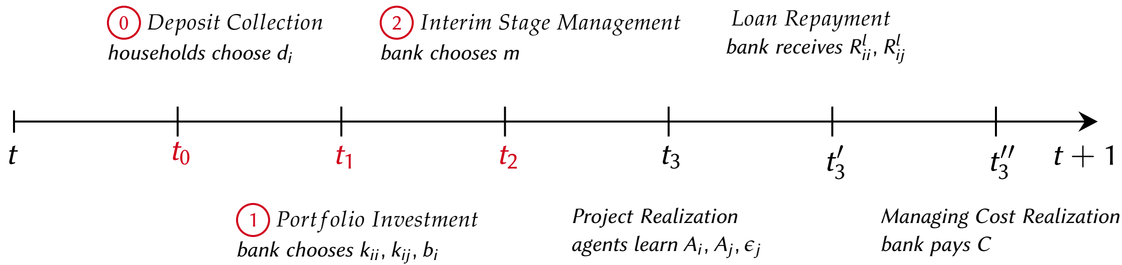
Management of uncertainty

- $R^l_{ii} = R_i$ — ϵ_i eliminated with no cost
- $R^l_{ij} = R_j + \epsilon_j \times \mathcal{P}(\underset{-}{m})$ — ϵ_j decreased by effort m with cost $\mathcal{C}(\underset{+}{m}, \underset{-}{\Delta e_i{}'})$

$\Delta e_i{}' = e_i' - e_i$ is profitability and is affected by policy rate R^f. Expression

Timing



0 Deposit Collection
households choose d_i
2 Interim Stage Management
bank chooses m
Loan Repayment
bank receives R^l_{ii}, R^l_{ij}
t
t_0
t_1
t_2
t_3
t_3'
t_3''
$t+1$
1 Portfolio Investment
bank chooses k_{ii}, k_{ij}, b_i
Project Realization
agents learn A_i, A_j, ϵ_j
Managing Cost Realization
bank pays C

Interim Stage Management

Second stage pins down risky return variance:

- Domestic risky asset: (μ_i, σ_i^2)
- Foreign risky asset: $(\mu_j, \boldsymbol{\sigma_j^2})$, where $\boldsymbol{\sigma_j^2}$ is post management variance

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$$\boldsymbol{\sigma_j^2} = \underbrace{\sigma_j^2}_{\text{① TFP Shock Variance}} + \underbrace{\zeta\left(1 - \psi \mathbb{E}\left[\Delta e_i{}'\right]\right)}_{\text{Reduction via Management}} \times \underbrace{\sigma_\epsilon^2}_{\text{② Uncertainty Shock Variance}}$$

- ζ is overall management efficiency, ψ captures profitability effect
- ζ and ψ come from parameterization of $\mathcal{P}(m)$ and $\mathcal{C}(m, \Delta e_i{}')$ Corollary

$$\Delta e_i{}' = e_i' - e_i \quad e_i' = (R_{ii}^l - R^f)k_{ii} + (\boldsymbol{R_{ij}^l} - R^f)k_{ij} + R^f w - R^d(R^f)d_i$$

Policy Rate and Bank Lending Allocation

Traditional risk premium channel: $R^f \Rightarrow R^l_{ii} - R^f, R^l_{ij} - R^f \Rightarrow k_{ii}, k_{ij}$

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New channels due to uncertainty management: $R^f \Rightarrow \Delta e_i{}' \Rightarrow \boldsymbol{\sigma_j^2} \Rightarrow k_{ii}, k_{ij}$ Expression

1. Monetary policy affects bank profitability via loan-deposit spread
2. Bank profitability alters uncertainty management decisions
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Evaluate the overall effects? Two approaches:

1. Effect on relative preference: *home bias* of bank lending
2. Effect on absolute quantity: *reversal rates* for domestic and foreign lending

Optimal Portfolio Allocation

Portfolio solution is given by

$$k_{ii} \sim \left(\text{CARA-normal Portfolio} \quad + \quad \text{Uncertainty Friction Component} \right)$$

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$$k_{ij} \sim \left(\frac{(\mu_j - r^f)}{\alpha\tilde{\sigma}_j{}^2} - \frac{\tilde{\rho}\sigma_i}{\tilde{\sigma}_j}\frac{(\mu_i - r^f)}{\alpha\sigma_i^2} - \frac{\frac{1}{2}\zeta\tilde{\sigma}_\epsilon{}^2}{\tilde{\sigma}_j{}^2} \right)$$

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- As a result, wealth effect introduced: $w_i \Rightarrow \tilde{\sigma}_\epsilon(r^f) \Rightarrow (k_{ii}, k_{ij})$

Result 1: Policy Rates and Home Bias

$$\mathcal{HB}_i = 1 - \frac{\frac{k_{ij}}{w_i}}{\frac{k_{ij}+k_{jj}}{w_i+w_j}} = 1 - \frac{1 + \frac{w_j}{w_i}}{1 + \frac{k_{jj}}{k_{ij}}}$$

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$\Rightarrow \omega < \delta^{-1}$, there exists a unique separating line $\omega^N(w)$ on (w, ω) plane

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- If $\omega > \omega^N(w)$, $R^f \uparrow$ increases home bias.
- If $\omega < \omega^N(w)$, $R^f \uparrow$ reduces home bias.
- On this line, monetary policy does not affect bank home bias.

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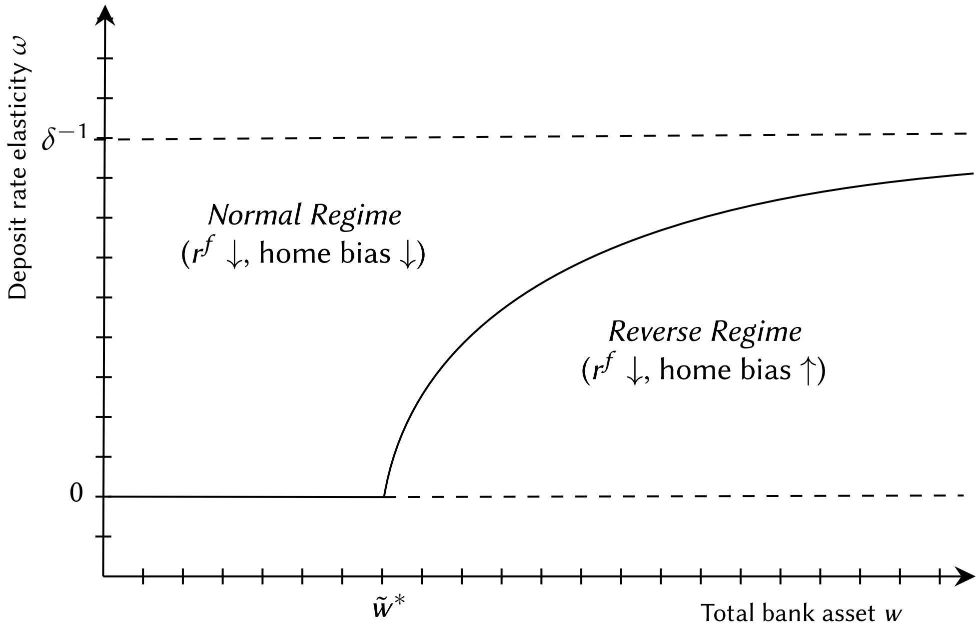
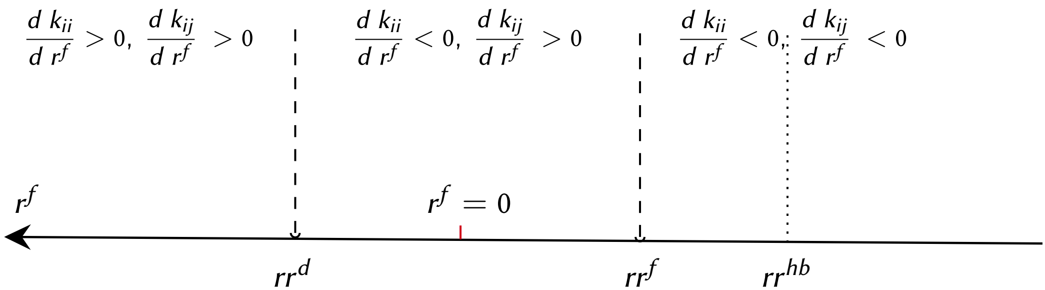


Explanation

Result 2: Reversal Rate Corridor of Lending



- rr^d: reversal rate for domestic lending, -1% by Brunnermeier and Koby (2019)
- rr^f: reversal rate for foreign lending $\Rightarrow$ quantitative number?
- rr^{hb}: reversal rate for home bias $\Rightarrow$ quantitative number?

Outline

Dynamic Bank Problem

$$V_t(e_{i,t}) \equiv \max_{\{\pi_{i,t}, k_{ii,t+1}, k_{ij,t+1}, b_{i,t}\}} u(\pi_{i,t}) + \beta \mathbb{E}_t V_{t+1}(e_{i,t+1})$$

$$\begin{aligned} s.t. \quad & e_{i,t} = R^l_{ii,t} k_{ii,t} + R^l_{ij,t} k_{ij,t} + R^f_{t-1} b_{i,t-1} - R^d_t d_{i,t} && \text{(Evolution of equity)} \\ & e_{i,t} + d_{i,t+1} = w_{i,t} && \text{(Total wealth)} \\ & d_{i,t+1} = \delta w_{i,t} && \text{(Leverage constraint)} \\ & w_{i,t} = \pi_{i,t} + (k_{ii,t+1} + k_{ij,t+1}) + b_{i,t} && \text{(Budget constraint)} \end{aligned}$$

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Ad hoc deposit supply schedule (Bianchi and Bigio, 2021) Complete Setup

$$d_{t+1} = \Theta^d_t \left(\frac{1}{1 + r^d_{t+1}} \right)^{-\varsigma}, \quad \varsigma > 0, \quad \Theta^d_t > 0$$

Incomplete Market Equilibrium

An incomplete market equilibrium under this setup consists of a set of state contingent plans $\{\pi_{i,t}, k_{ii,t+1}, k_{ij,t+1}, b_{i,t}\}_{t=0}^{\infty}$, such that

1. $\{\pi_{i,t}, k_{ii,t+1}, k_{ij,t+1}, b_{i,t}\}_{t=0}^{\infty}$ maximizes the utility of bank i and j.
2. Banks have perfect foresight on the sequence $\{r_t^f\}_{t=0}^{\infty}$.
3. Central bank allows to arbitrary hold or borrow reserves given r_t^f.
4. Deposit market clears at deposit rate $r_t^d = \omega r_t^f$.

Effective Risk Aversion

$$k_{ii,t+1} \sim \left[\frac{\mu_i - R_t^f}{\alpha \gamma_{t+1} \sigma_i^2} - \tilde{\rho} \frac{\mu_j - R_t^f}{\alpha \gamma_{t+1} \sigma_i \tilde{\sigma}_j} + \frac{1}{2} \tilde{\rho} \frac{\zeta_i \tilde{\sigma}_\epsilon^2}{\sigma_i \tilde{\sigma}_j} \right]$$

$$k_{ij,t+1} \sim \left[\frac{\mu_j - R_t^f}{\alpha \gamma_{t+1} \tilde{\sigma}_j^2} - \tilde{\rho} \frac{\mu_i - R_t^f}{\alpha \gamma_{t+1} \sigma_i \tilde{\sigma}_j} - \frac{1}{2} \frac{\zeta_i \tilde{\sigma}_\epsilon^2}{\alpha \tilde{\sigma}_j^2} \right]$$

γ_{t+1}, effective risk aversion parameter à la Angeletos and Calvet (2006):

$$\gamma_t = \gamma_{t+1} R_t^f \left[1 - \mathcal{A}(R_t^f - 1) - \gamma_t \right]$$

With uncertainty management mechanism, $\mathcal{A} \neq 0$, effects of future policy rate on risk aversion becomes ambiguous.

Conclusion

This paper: The role of monetary policy for banks' global lending preference

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⇒ New evidence on banks' cross-border lending allocation

- Panel data documentation of bank home bias patterns
- Identification of the causal effects

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$\Rightarrow$ New evidence on banks' cross-border lending allocation

- Panel data documentation of bank home bias patterns
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$\Rightarrow$ Closed-form analysis of the impact of policy rate on bank lending allocation

- Combine profitability channel of monetary policy with uncertainty management
- Pinpoint the effects of policy rate cut on bank lending composition changes

Conclusion

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⇒ New evidence on banks' cross-border lending allocation

- Panel data documentation of bank home bias patterns
- Identification of the causal effects

⇒ Closed-form analysis of the impact of policy rate on bank lending allocation

- Combine profitability channel of monetary policy with uncertainty management
- Pinpoint the effects of policy rate cut on bank lending composition changes

⇒ Quantitative assessment of lending reallocation consequences

- Quantification of macroeconomic implications and policy experiments

Data

Bank Lending Data Data sources

- BIS Locational Banking Statistics
- IMF International Financial Statistics

Other Data

- Equity Home Bias Data sources
- Uncertainty Data sources
- Banking sector characteristics

Bank Home Bias

- For foreign lending data, we use the Locational Banking Statistics (LBS) dataset from Bank for International Settlements. Our classification of bank is *location-oriented*, instead of nationality-oriented. We proceed to define our *foreign lending* as the *cross-border lending conducted by these banks resides in that country.*
- For domestic lending, we use the variables from IMF International Financial Statistics (IFS) dataset. The entity that classify as bank in this data set is *Other Depository Corporations.* The domestic assets consists of three components: *Claims on Central Bank*, *Claims on Central Government*, and *Claim on Other Sector.*

Back

Equity Home Bias

- For foreign investment, we use data from Coordinated Portfolio Investment Survey (CPIS) dataset developed by IMF. The dataset gives detailed decomposition of each country's foreign equity holding on a yearly basis, and one can specify both the origin and destination of the investment.
- For domestic investment, take country i for example.
  - First, we collect data on the stock market capitalization of country i, which is the total size of its stock market.
  - Second, we compute how much of country i's equity is held by foreign investors. This is done by aggregating over all the other countries' holding of country i's equity.
  - Lastly, we obtain domestic investor's holding of domestic equity as the difference between the two.

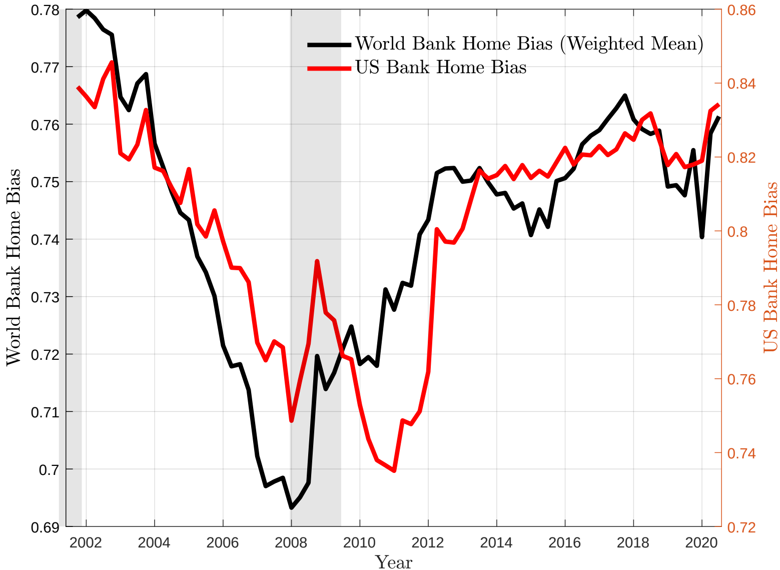
Back

Uncertainty

- **World uncertainty index** is a country-level index based on word-counting method. We take the Uncertainty Index measurement for country *i* as the *domestic uncertainty* indicator. For *foreign uncertainty*, we construct it in two different methods.
  - The first method is to compute directly the weighted world average uncertainty without country *i* as the foreign uncertainty for country *i*.
  - The second method is to regress the total weighted world average uncertainty on country *i*'s uncertainty and take the residual to be the foreign uncertainty to country *i*.
- **Economic policy uncertainty index** is an index based on newspaper coverage of economic policy. The data is available for less countries than World Uncertainty Index, so we keep it as our secondary measure for domestic and world uncertainty.

Back

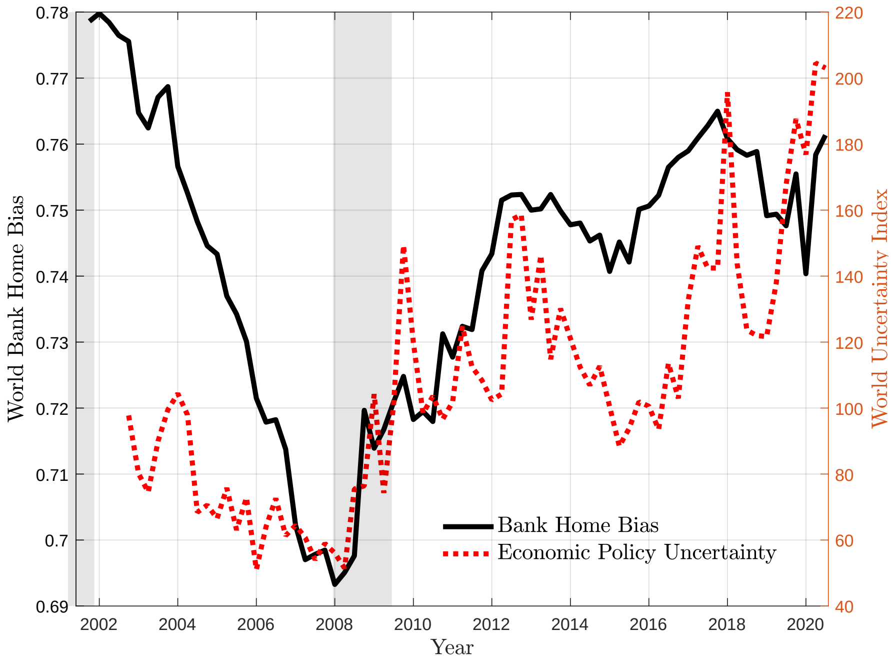
World and US Bank Home Bias



Notes: The dark line displays the average level of bank home bias of the countries in our sample at quarterly frequency. Weights are computed based on the size of their banking sectors' total assets.

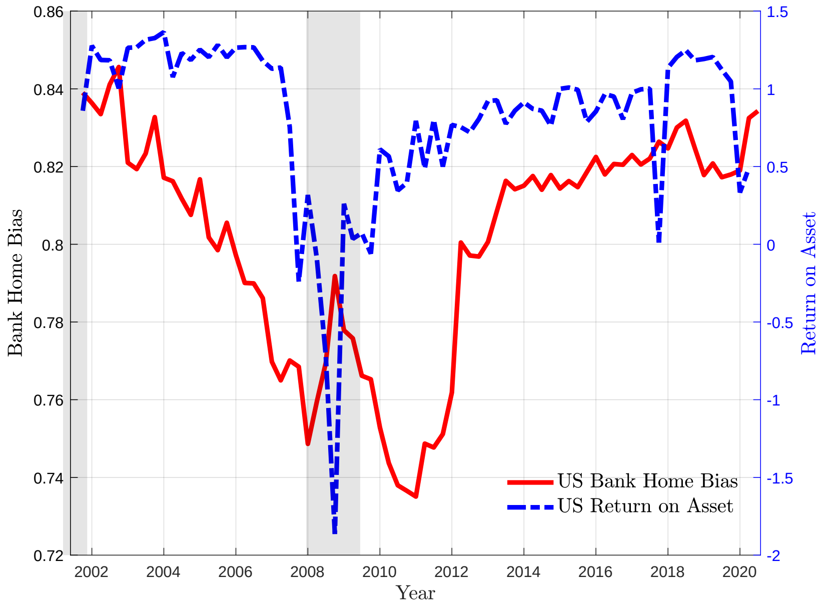
Return

Bank Home Bias and Uncertainty



Note: Red dash line is lagged by 4 quarters.

Bank Home Bias and Profitability



Notes: The blue dash line shows the return on equity of banks, provided by Federal Reserve Bank of New York.

Foreign Uncertainty Shock

Specification

- four-variable: domestic and foreign uncertainty, bank asset, bank home bias
- five-variable: with asset decomposition
- six-variable: with macro indicators

Identification

- short-run identification
- max-share identification of Uhlig (2003)

Improvement

- Uncertainty measurement
  - Uncertainty as TFP shock variances/risks or as noises
  - purged TFP from uncertainty measure?

Return

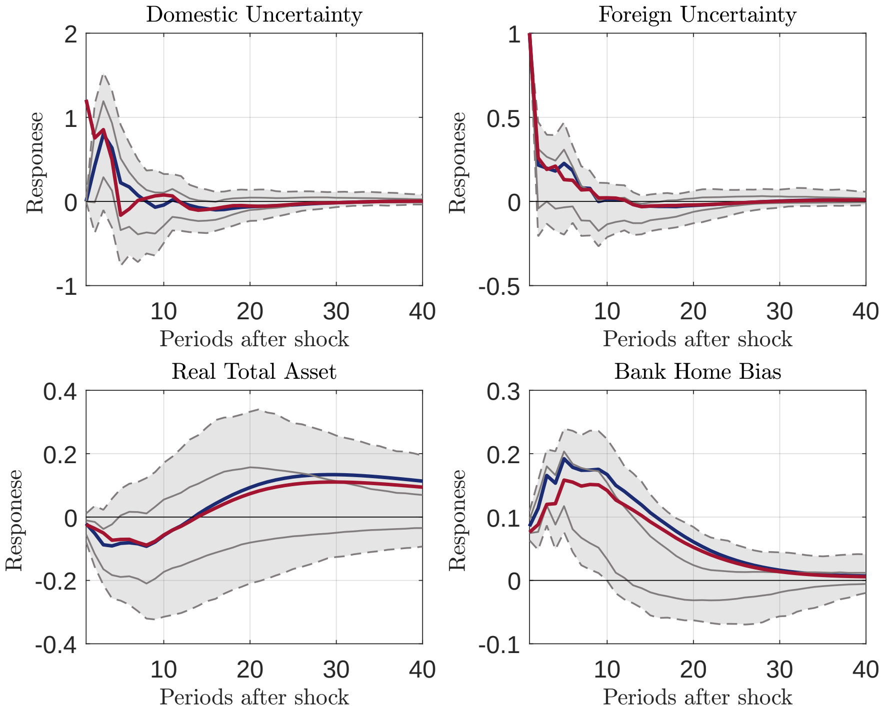


Figure 3: Impulse Response to foreign uncertainty shock.

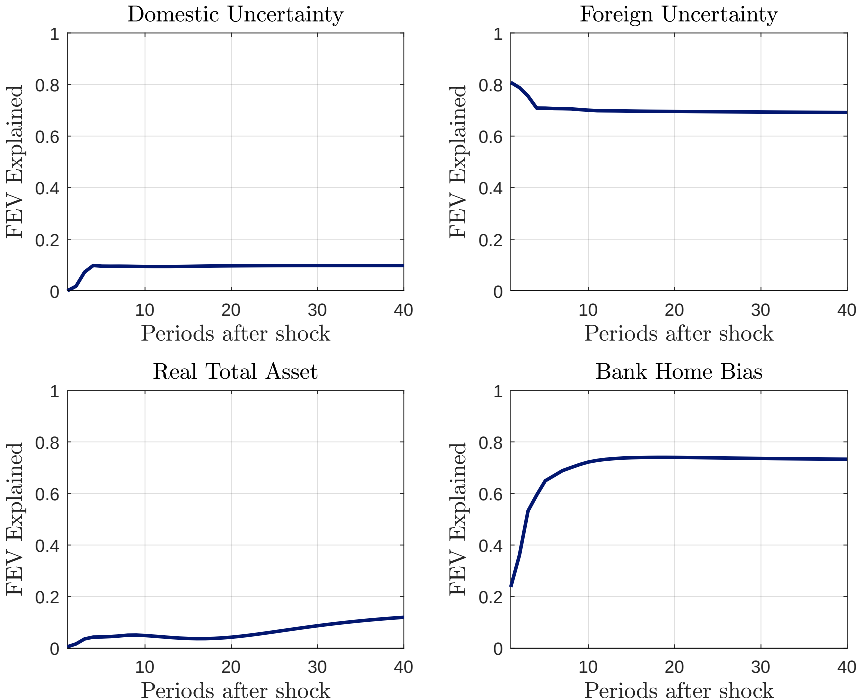


Figure 4: FEVD to foreign uncertainty shock.

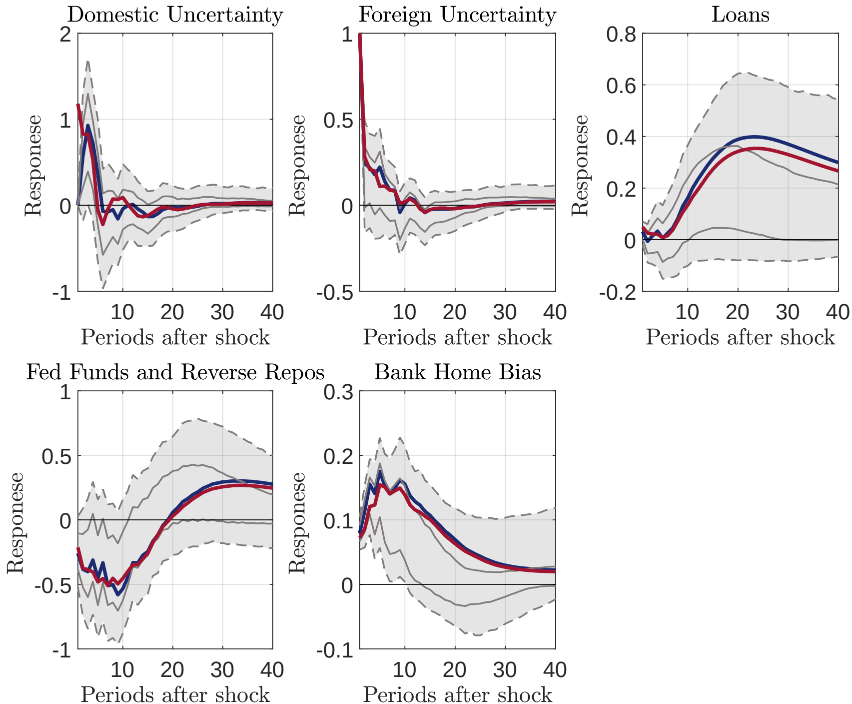


Figure 5: Impulse Response to foreign uncertainty shock.

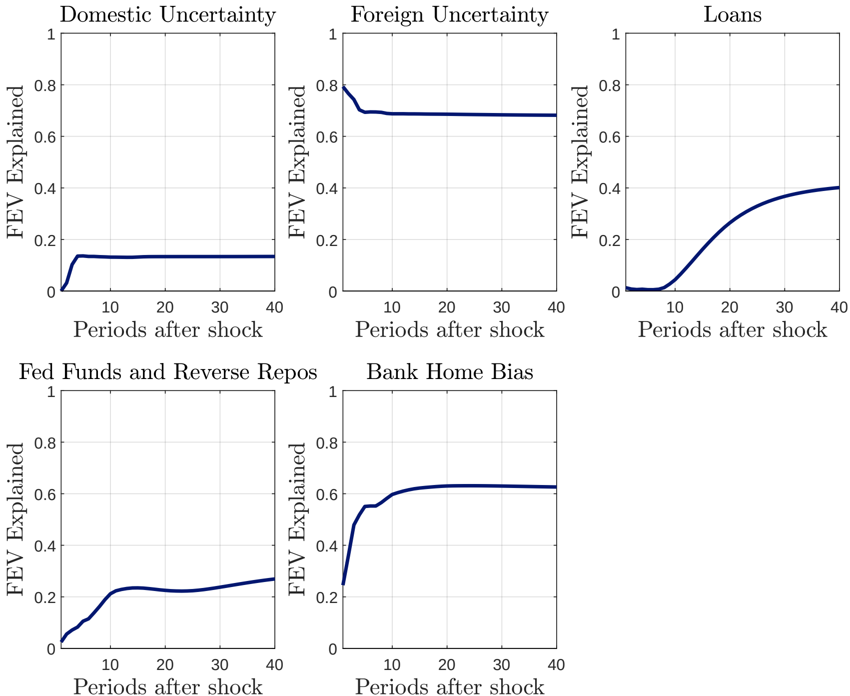
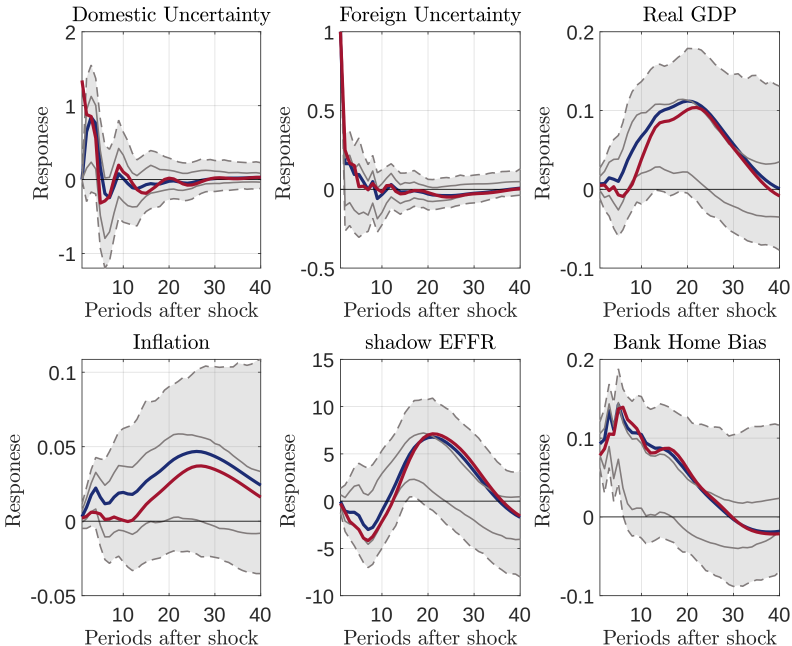


Figure 6: FEVD to foreign uncertainty shock.



Notes: Blue line is from short run identification. Red line is from max share identification.

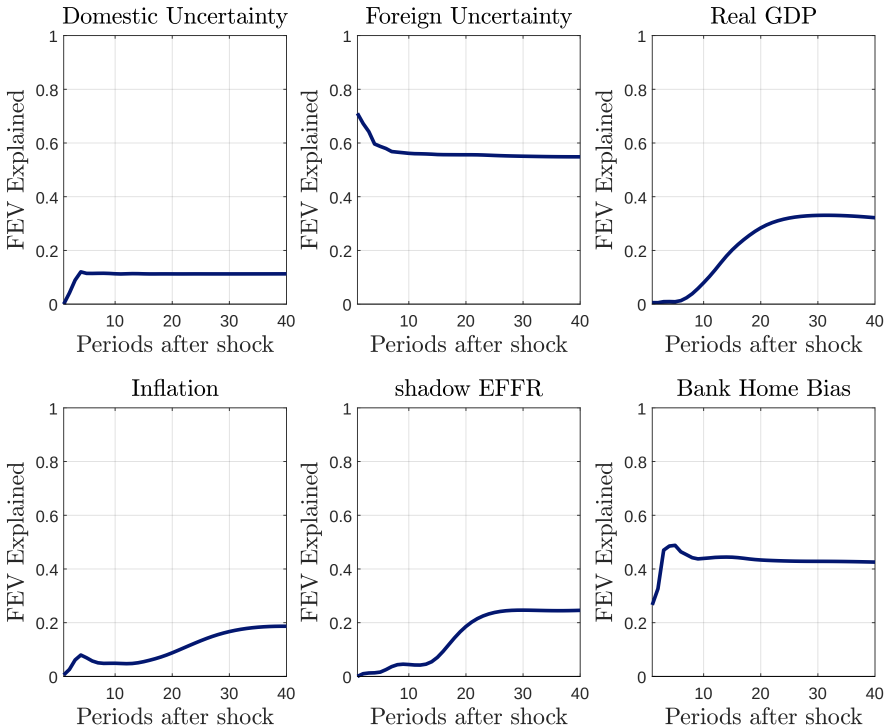


Figure 7: FEVD to foreign uncertainty shock

Domestic Uncertainty Shock

Specification

- six-variable: with macro indicators

Return

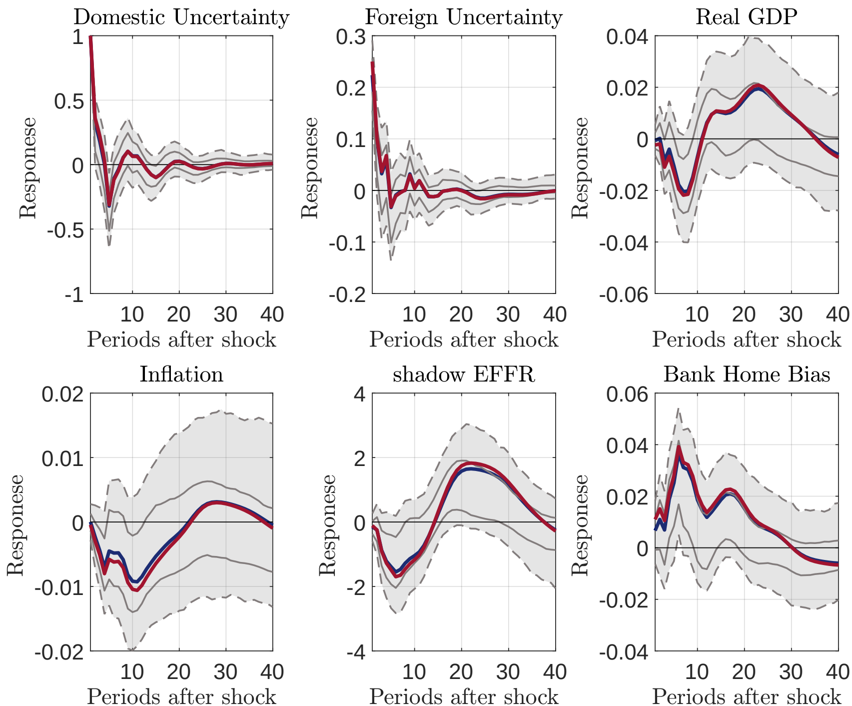


Figure 8: Impulse Response to foreign uncertainty shock.

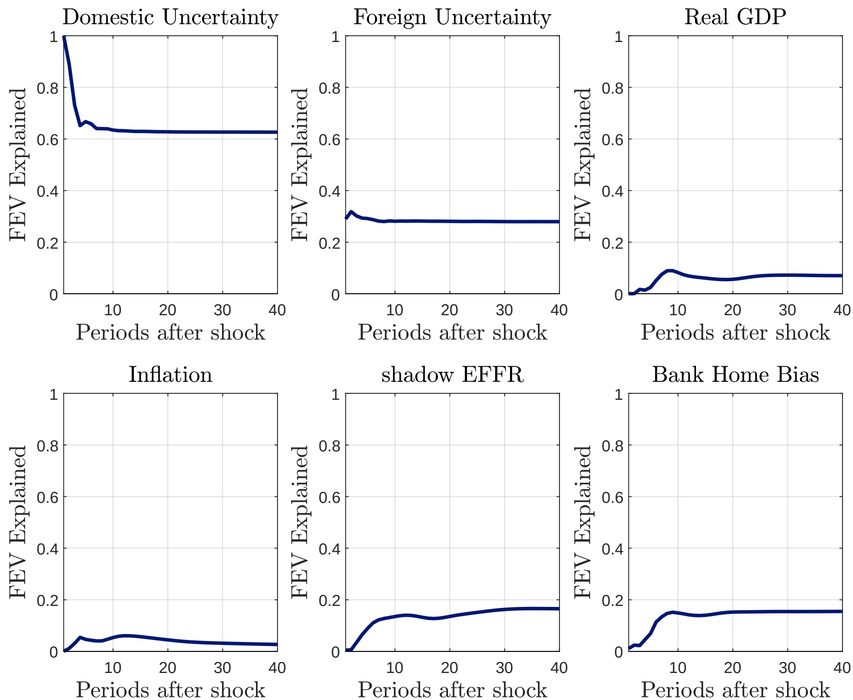


Figure 9: FEVD to foreign uncertainty shock.

Summary of Results

- foreign uncertainty shock is a strong driver of bank home bias, inducing significant increase in bank home bias. The forecast error variance decomposition (FEVD) shows that it explains up to half of the FEVD of bank home bias.
- The results are robust to adding macro variables and balance sheet variables.
- When applying the same identification method to domestic uncertainty shock, however, the response of bank home bias is not significant

Back

Second Stage Problem

Given investment portfolio, bank chooses managing effort m^*.

$$m^* = \arg\max_m \mathbb{E}\left[u\left(\epsilon_j \left(\mathcal{P}\left(\underset{-}{m}, \underset{-}{k_{ij}} \right) \right) k_{ij} - \mathcal{C}\left(\underset{+}{m}, \underset{+}{k_{ij}}, \underset{-}{\Delta \tilde{e}_i{}'} \right) \right) | \mathcal{I} \right] .$$

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Benefit of managing: m reduces the impact of uncertainty

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Benefit of managing: m reduces the impact of uncertainty

Cost of managing: m induces an operational cost to be financed

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- expected profit $\Delta \tilde{e}_i{}' = \tilde{e}_i{}' - e_i$ decreases cost (Brunnermeier and Koby (2019), Heider et al. (2017), Gropp et al. (2018))
- shadow price of a constraint at interim stage (Enders et al. (2011))

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- shadow price of a constraint at interim stage (Enders et al. (2011))

$\Rightarrow$ Solve for m^* under general elasticity parametrization of $\mathcal{P}$ and $\mathcal{C}$.

Parameterization

Portfolio Investment

Bank solves the maximization problem with CARA utility:

$$\max_{\{k_{ii}, k_{ij}, b_i\}} \mathbb{E}\left[u(e_i')|\mathcal{I}\right]$$

$$s.t. \quad w_i = k_{ii} + k_{ij} + b_i \qquad \text{(Budget constraint)}$$

$$e_i' = R_{ii}^l k_{ii} + \boldsymbol{R_{ij}^l} k_{ij} + R^f b_i - R^d d_i \qquad \text{(Next period equity)}$$

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Profitability

$\Delta e_i'$ is profitability defined as

$$\Delta e_i' = e_i' - e_i = \underbrace{(1 - \omega\delta) w_i r^f}_{\text{risk-free profit}} + \underbrace{(R_i - R^f) k_{ii}}_{\text{risky domestic profit}} + \underbrace{(R_j - R^f) k_{ij}}_{\text{risky foreign profit}}$$

Return

Portfolio Result

$$k_{ii} = \left(1 - \tilde{\rho}^2\right)^{-1} \left(\frac{(\mu_i - r^f)}{\alpha \sigma_i^2} - \frac{\tilde{\rho}\tilde{\sigma}_j}{\sigma_i} \frac{(\mu_j - r^f)}{\alpha \tilde{\sigma}_j{}^2} + \frac{\tilde{\rho}\tilde{\sigma}_j}{\sigma_i} \frac{\frac{1}{2}\zeta \tilde{\sigma}_\epsilon{}^2}{\tilde{\sigma}_j{}^2} \right),$$

$$k_{ij} = \left(1 - \tilde{\rho}^2\right)^{-1} \left(\frac{(\mu_j - r^f)}{\alpha \tilde{\sigma}_j{}^2} - \frac{\tilde{\rho}\sigma_i}{\tilde{\sigma}_j} \frac{(\mu_i - r^f)}{\alpha \sigma_i^2} - \frac{\frac{1}{2}\zeta \tilde{\sigma}_\epsilon{}^2}{\tilde{\sigma}_j{}^2} \right)$$

Return

Parameter Explained

Recall the role of monetary policy rate in expected profitability Return

$$\mathbb{E}\left[\Delta \tilde{e}_i' | \mathcal{I}\right] = \underbrace{(1 - \omega\delta) w_i r^f}_{\text{risk-free profit}} + \underbrace{\theta(\mu_i - r^f) k_{ii}}_{\text{risky domestic profit}} + \underbrace{\theta(\mu_j - r^f) k_{ij}}_{\text{risky foreign profit}}$$

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Attenuation of uncertainty friction: $\tilde{\sigma}_\epsilon^2 = \sigma_\epsilon^2\left[1 - \psi(1-\omega\delta)w_i r^f\right]$ Analysis

- higher r^f implies higher risk-free earning, uncertainty management becoming less costly

Parameter Explained

Recall the role of monetary policy rate in expected profitability Return

$$\mathbb{E}\left[\Delta\tilde{e}_i'|\mathcal{I}\right] = \underbrace{(1-\omega\delta)w_i r^f}_{\text{risk-free profit}} + \underbrace{\theta(\mu_i - r^f)k_{ii}}_{\text{risky domestic profit}} + \underbrace{\theta(\mu_j - r^f)k_{ij}}_{\text{risky foreign profit}}$$

Variance reduction for foreign investment: $\tilde{\sigma}_j^2 = \sigma_j^2 - \zeta_i\psi\theta(\mu_j - r^f)\sigma_\epsilon^2$ Analysis

- uncertainty management has economy of scale for foreign investment

Parameter Explained

Recall the role of monetary policy rate in expected profitability Return

$$\mathbb{E}\left[\Delta\tilde{e}_i'|\mathcal{I}\right] = \underbrace{(1-\omega\delta)w_i r^f}_{\text{risk-free profit}} + \underbrace{\theta(\mu_i - r^f)k_{ii}}_{\text{risky domestic profit}} + \underbrace{\theta(\mu_j - r^f)k_{ij}}_{\text{risky foreign profit}}$$

Generalized correlation structure: Analysis

$$\tilde{\rho} = \frac{\left(\rho\sigma_i\sigma_j - \frac{1}{2}\zeta_i\psi\theta(\mu_i - r^f)\sigma_\epsilon^2\right)}{\sigma_i\tilde{\sigma}_j}.$$

- endogenous cost reduction mechanism changes the effective correlation of returns between domestic and foreign assets

Return

Attenuation of uncertainty friction

$$\tilde{\sigma}_\epsilon^2 = \sigma_\epsilon^2 (1 - \psi(1 - \omega\delta) w_i r^f)$$
$$\frac{d\tilde{\sigma}_\epsilon^2}{dR^f} = -\sigma_\epsilon^2 \psi (1 - \omega\delta) w_i < 0$$

- The derivative of this channel of effect with respect to interest rate is always negative, meaning that the higher the interest rate, the lower the effective uncertainty variance.
- Higher interest rate implies higher interest rate margin as long as $\omega < \delta^{-1}$, which implies higher profitability and thus lower cost of management.

Return

Variance reduction for foreign investment

$$\tilde{\sigma}_j^2 = \sigma_j^2 - \zeta_i \psi \theta (\mu_j - r^f) \sigma_\epsilon^2$$
$$\frac{d\tilde{\sigma}_j^2}{dr^f} = \zeta_i \psi \theta \sigma_\epsilon^2 > 0$$

- The derivative of this channel of effect with respect to interest rate is always positive, meaning that the higher the interest rate, the higher the effective fundamental variances.
- Higher interest rate implies lower risk premium for the foreign asset, which leads to less expected profits and less cost reduction.

Return

Change in correlation structure

$$\tilde{\rho} = \frac{(\rho\sigma_i\sigma_j - \frac{1}{2}\zeta_i\psi\theta(\mu_i - r^f)\sigma_\epsilon^2)}{\sigma_i(\sigma_j^2 - \zeta_i\psi\theta(\mu_j - r^f)\sigma_\epsilon^2)^{\frac{1}{2}}}$$

$$\frac{d\tilde{\rho}}{dr^f} = \frac{(\sigma_i(\sigma_j^2 - \zeta_i\psi\theta(\mu_j - r^f)\sigma_\epsilon^2)^{\frac{1}{2}})\frac{1}{2}\zeta_i\psi\theta\sigma_\epsilon^2}{(\sigma_i(\sigma_j^2 - \zeta_i\psi\theta(\mu_j - r^f)\sigma_\epsilon^2)^{\frac{1}{2}})^2}$$

$$- \frac{(\rho\sigma_i\sigma_j - \frac{1}{2}\zeta_i\psi\theta(\mu_i - r^f)\sigma_\epsilon^2)\sigma_i\frac{1}{2}(\sigma_j^2 - \zeta_i\psi\theta(\mu_j - r^f)\sigma_\epsilon^2)^{-\frac{1}{2}}\zeta_i\psi\theta\sigma_\epsilon^2}{(\sigma_i(\sigma_j^2 - \zeta_i\psi\theta(\mu_j - r^f)\sigma_\epsilon^2)^{\frac{1}{2}})^2}$$

$$= \frac{((\sigma_j^2 - \zeta_i\psi\theta(\mu_j - r^f)\sigma_\epsilon^2))\sigma_i\frac{1}{2}\zeta_i\psi\theta\sigma_\epsilon^2 - (\rho\sigma_i\sigma_j - \frac{1}{2}\zeta_i\psi\theta(\mu_i - r^f)\sigma_\epsilon^2)\sigma_i\frac{1}{2}\zeta_i\psi\theta\sigma_\epsilon^2}{(\sigma_i(\sigma_j^2 - \zeta_i\psi\theta(\mu_j - r^f)\sigma_\epsilon^2)^{\frac{1}{2}})^2(\sigma_j^2 - \zeta_i\psi\theta(\mu_j - r^f)\sigma_\epsilon^2)^{\frac{1}{2}}}$$

$$= \frac{\left(\sigma_j^2 - \zeta_i\psi\theta(\mu_j - r^f)\sigma_\epsilon^2 - \rho\sigma_i\sigma_j + \frac{1}{2}\zeta_i\psi\theta(\mu_i - r^f)\sigma_\epsilon^2\right)\sigma_i\frac{1}{2}\zeta_i\psi\theta\sigma_\epsilon^2}{(\sigma_i(\sigma_j^2 - \zeta_i\psi\theta(\mu_j - r^f)\sigma_\epsilon^2)^{\frac{1}{2}})^2(\sigma_j^2 - \zeta_i\psi\theta(\mu_j - r^f)\sigma_\epsilon^2)^{\frac{1}{2}}}$$

The effect of monetary policy rate on $\tilde{\rho}$ depends on the sign of

$$\left(\sigma_j^2 - \zeta_i \psi \theta (\mu_j - r^f) \sigma_\epsilon^2 - \rho \sigma_i \sigma_j + \frac{1}{2} \zeta_i \psi \theta (\mu_i - r^f) \sigma_\epsilon^2 \right).$$

With symmetric mean return assumption, it can be simplified to

$$\left(\sigma_j (\sigma_j - \rho \sigma_i) - \frac{1}{2} \zeta_i \psi \theta (\mu - r^f) \sigma_\epsilon^2 \right).$$

The effect is not constant and depends on the size of the monetary policy rate. Return

Complete Setup

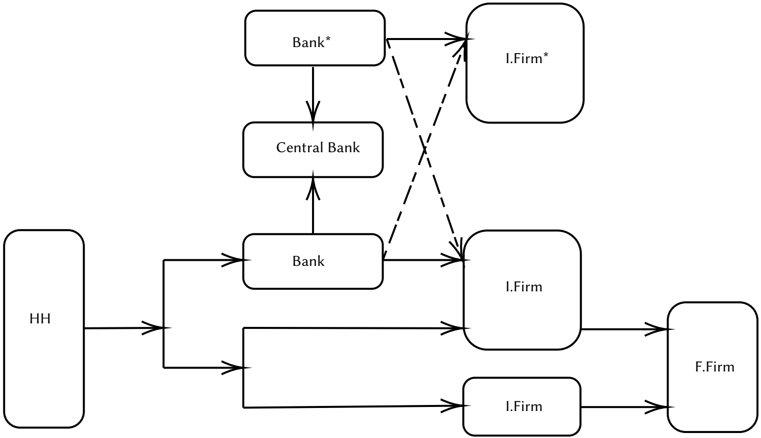

Figure 10: Illustration of the Economy.

Return