# Heterogeneous Impact of the Global Financial Cycle

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# global financial cycle

Co-movement in financial flows and asset prices: global components explain > 25% of variation
- asset prices (<u>Miranda-Agrippino et al 2020</u>, <u>Habib Venditti 2019</u> etc)
- capital flows (<u>Barrot Serven 2018</u>, <u>Miranda-Agrippino Rey 2022</u> etc)

Aggregate dynamics: risky asset prices fall, retrenchment in downturns

Heterogeneity: US vs rest of the world, advanced economies (AE) vs emerging markets (EM)

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This paper:
- ▶ AE private flows are better synchronized with the global cycle
- ▶ heterogeneous-country model: exposure to global risk-off, implications for risk-sharing

# heterogeneity and its implications

Private flows in AE are better synchronized with global cycle:

- ▶ outward flows more strongly correlated with aggregates
- ▶ outward flows larger in magnitude (cyclical component)

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Wealth distribution across countries

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Wealth distribution across countries
- ▶ retrenchment in rich countries → quantities adjust
- ▶ low wealth + borrowing constraints in poor countries → prices adjust

Responses in equilibrium
- ▶ risky asset prices in rich countries rise, good substitutes for safe assets
- ▶ rich countries insure intermediaries and poorer countries
- ▶ wealth redistribution: regressive

# literature

Evidence of the global financial cycle:
- ▶ Miranda-Agrippino Rey 2020,2022, Miranda-Agrippino et al 2020, Barrot Serven 2018, Habib Venditti 2019, Cerutti et al 2019

**This paper**: suggest a model to study distributional impact

Evidence of heterogeneous impact:
- ▶ Chari et al 2020, Eguren-Martin et al 2021, Gelos et al 2022, Kalemli-Ozkan 2019

**This paper**: analyze heterogeneity as an equilibrium feature in a model

Retrenchment:
- ▶ Caballero Simsek 2020, Jeanne Sandri 2023

**This paper**: add dynamics and study aggregate shocks

Models of the global financial cycle:
- ▶ Morelli et al 2023, Bai et al 2019, Dahlquist et al 2023, Gourinchas et al 2022, Davis van Wincoop 2021 2023, Farboodi Kondor 2022, Kekre Lenel 2021, Sauzet 2023, Maggiori 2017

**This paper**: explain heterogeneity using retrenchment, study risk-sharing

**outline**

— patterns of synchronization of financial flows

— model

— shock to risk-taking capacity of global intermediaries

— output shocks and differences in responses

# outflows from AE vs EM

- ▶ define gross outflows $a_{it}$ as net acquisition of external assets (country $i$, quarter $t$)
- ▶ extract principal component $f_t$ from $a_{it}$
- ▶ run $a_{it} = \alpha_i + \beta_i f_t + \epsilon_{it}$, compute $R$-squared for every country

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# correlation higher in AE
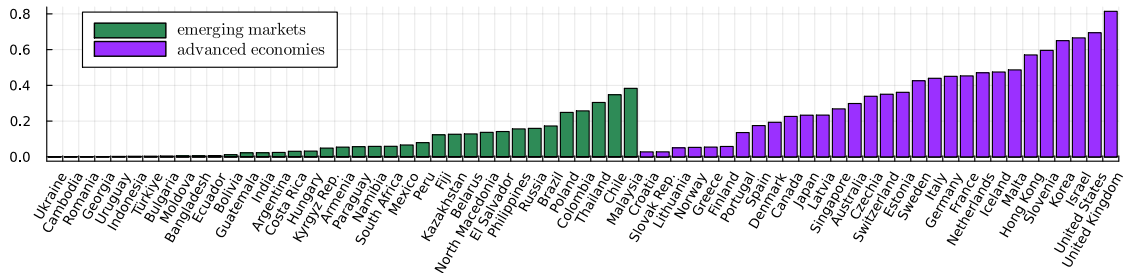


on average, 26% for AE and 10% for EM

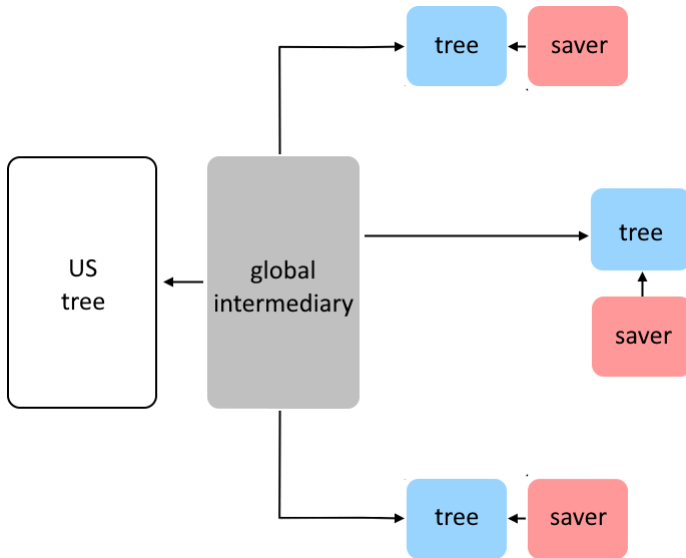correlations

# magnitudes larger in AE

- take **position-adjusted** outflows $\overline{a}_{it} = a_{it}/A_{i,t-1}$
- measure difference in loadings for **position-adjusted** flows:

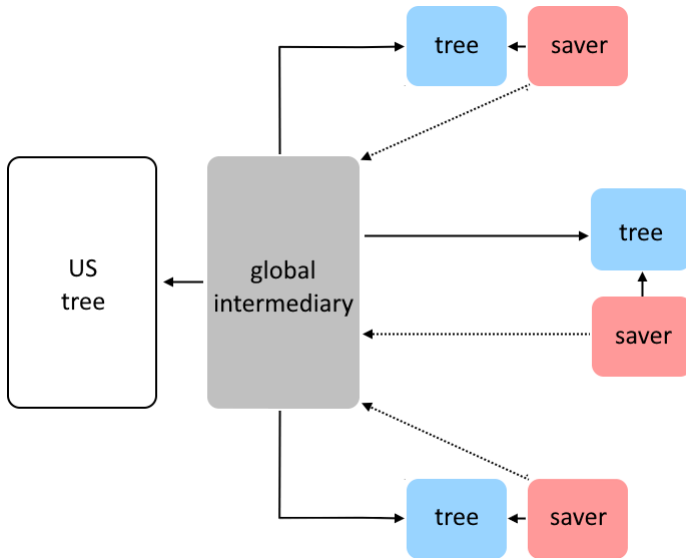$$\overline{a}_{it} = \alpha_i + \gamma f_t + \beta \mathbb{1}\{i \in \text{AE}\}f_t + \epsilon_{it} \tag{1}$$

Table: dependent variable $\overline{a}_{it}$ is expressed as percentage

| | |
|---|---|
| $f_t$ | 1.496 |
| | (0.428) |
| $\mathbb{1}\{i \in \text{AE}\}f_t$ | **2.147** |
| | (0.593) |
| $R^2 = 0.02, N = 6223$ | |

overall synchronization

# model map

# model map

# regular countries

Countries $i \in [0, 1]$: Lucas tree with price $p_{it}$, yield $v_t dt + \sigma dZ_{it}$, representative saver

$$\max_{(c_{it}, \theta_{it})} \mathbb{E} \int_0^\infty e^{-\rho t} \ln(c_{it}) dt \tag{2}$$

$$\text{s.t. } dw_{it} = (r_t w_{it} - c_{it}) dt + \theta_{it} w_{it} dR_{it} \tag{3}$$

$$\theta_{it} \leq \bar{\theta} \tag{4}$$

Wealth $w_{it}$: share $\theta_{it}$ in domestic tree earning $dR_{it}$, lending $1 - \theta_{it}$ to intermediaries at $r_t$:

$$dR_{it} = \frac{1}{p_{it}} (v_t dt + \sigma dZ_{it} + dp_{it}) - r_t dt \tag{5}$$

# regular countries

Countries $i \in [0, 1]$: Lucas tree with price $p_{it}$, yield $\nu_t dt + \sigma dZ_{it}$, representative saver

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<u>Result:</u> denoting $\mu_{it}^R = \mathbb{E}[dR_{it}]/dt$ and $\sigma_{it}^R = \mathbb{E}[dR_{it}^2]/dt$,

$$\theta_{it} = \min \left\{ \bar{\theta}, \frac{\mu_{it}^R}{(\sigma_{it}^R)^2} \right\} \tag{6}$$

## special country

The US is a special country:
- ▶ savers act as intermediaries: invest in other trees, take deposits from other countries
- ▶ US tree is a safe asset

Price of tree $\hat{p}_t$, pays $\hat{v}_t dt$:

$$d\hat{R}_t = \frac{1}{\hat{p}_t}(d\hat{p}_t + \hat{v}_t dt) - r_t dt \tag{7}$$

# intermediaries

Short-term debt $m_t$, positions $(f_{it})_i$ in regular country trees, $\hat{f}_t$ in US tree, net worth $\hat{w}_t$:

$$d\hat{w}_t = \int_0^1 f_{it}\hat{w}_t(dR_{it} + r_t dt)di + \hat{f}_t\hat{w}_t(d\hat{R}_t + r_t dt) - m_t r_t dt - \hat{c}_t dt \tag{8}$$

$$\int_0^1 f_{it}\hat{w}_t di + \hat{f}_t\hat{w}_t = \hat{w}_t + m_t \tag{9}$$

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Consider misspecified processes $d\tilde{Z}_{it} = dZ_{it} + \xi_{it}dt$ for idiosyncratic shocks:

$$dR_{it} = \mu_{it}^Rdt + \sigma_{it}^RdZ_{it} = (\mu_{it}^R - \xi_{it}\sigma_{it}^R)dt + \sigma_{it}^Rd\tilde{Z}_{it} \tag{10}$$

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Consumption rate $\hat{c}_t$, log problem with misspecification costs:

$$\max_{\{\hat{c}_t, m_t, \hat{f}_t, f_t\}_{t\geq 0}} \quad \min_{\{\xi_t\}_{t\geq 0}} \quad \mathbb{E}\int_0^\infty e^{-\hat{\rho}t}\left(\hat{\rho}\ln(\hat{c}_t) + \frac{\gamma_t}{2}\int_0^1 \xi_{it}^2 di\right)dt \qquad \text{s.t. (8), (9), and (10)} \tag{11}$$

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<u>Result</u>: constant consumption rate $\hat{c}_t = \hat{\rho}\hat{w}_t$ and

model with VAR constraint

$$f_{it} = \gamma_t \frac{\mu_{it}^R}{(\sigma_{it}^R)^2} \tag{12}$$

## market clearing and equilibrium

Prices $(p_{it})_i$ and $\hat{p}_t$, interest rate $r_t$, wealth distribution, and quantities such that markets clear:

$$\text{tree supply} \longrightarrow 1 = \frac{f_{it}\hat{w}_t}{p_{it}} + \frac{\theta_{it}w_{it}}{p_{it}} \quad \text{all } i \in [0,1] \qquad \longleftarrow \text{total demand} \tag{13}$$

$$\text{liabilities of banks} \longrightarrow m_t = \int_0^1 w_{it}(1-\theta_{it})di \qquad \longleftarrow \text{external savings} \tag{14}$$

$$\text{US tree supply} \longrightarrow q = \frac{\hat{f}_t\hat{w}_t}{\hat{p}_t} \qquad \longleftarrow \text{US tree holdings} \tag{15}$$

Integrating the budget constraints and market clearing:

$$\hat{c}_t + \int_0^1 c_{it}di = \nu_t + q\hat{\nu}_t \tag{16}$$

Exogenous: risk-tolerance $\gamma_t$, later output $\nu_t$ and $\hat{\nu}_t$

Endogenous: **distribution** $G_t(\cdot)$ of wealth $w_{it}$, US net worth $\hat{w}_t$

# equilibrium characterization

Results:

- can solve for all country-specific variables as functions of $(w, t)$
- countries are constrained if $w \leq \tilde{w}(t)$

Figure: excess returns in steady state, $pp$
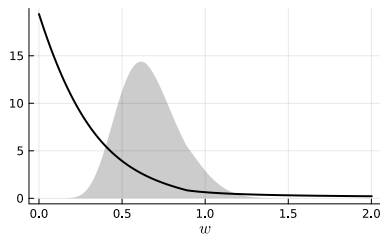
# equilibrium characterization

<u>Results:</u>

- ▶ can solve for all country-specific variables as functions of $(w, t)$
- ▶ prices $p(w, t)$ only depend on $r(t)$, a global factor $\varphi(t) = \gamma(t)\hat{w}(t)$, and the evolution of $w$

Equilibrium excess returns satisfy

$$\frac{\mu_R(w, t)}{\sigma_R(w, t)} = \sigma_R(w, t) \cdot \max \left\{ \frac{p(w, t)}{\varphi(t) + w}, \frac{p(w, t) - \overline{\theta}w}{\varphi(t)} \right\} \tag{17}$$

- ▶ <u>unconstrained countries</u>: total demand is $\gamma(t) \cdot \hat{w}(t) + 1 \cdot w = \varphi(t) + w$
- ▶ <u>constrained countries</u>: residual supply is $p(w, t) - \overline{\theta}w$, demand is $\gamma(t) \cdot \hat{w}(t) = \varphi(t)$
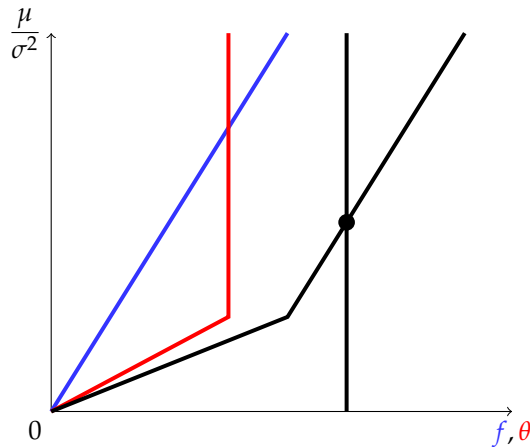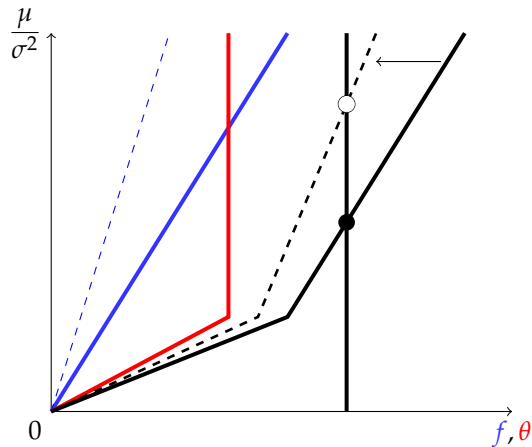
## elastic markets
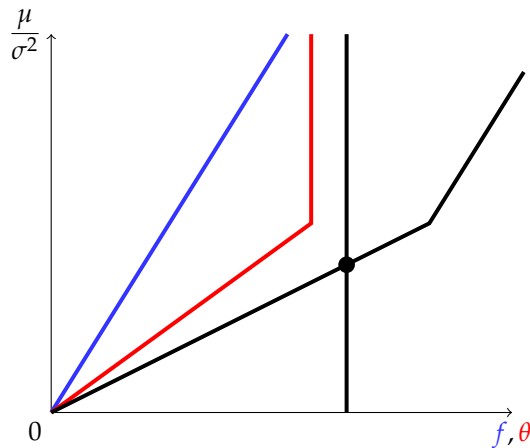


Figure: Supply and demand as functions of $\mu_R/\sigma_R^2$ for fixed $w$ and $p$. Supply is vertical. Demand $f$ from global banks in blue, from local savers $\theta$ in red.

# elastic markets
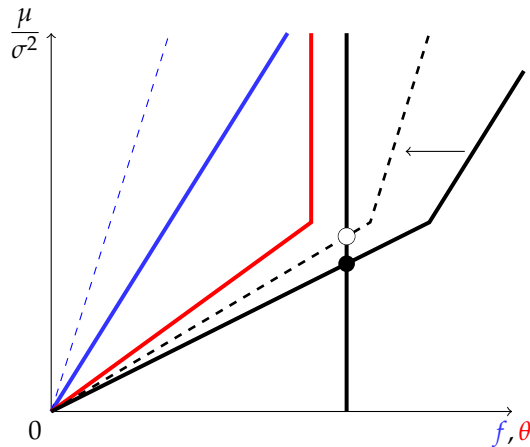


Figure: Supply and demand as functions of $\mu_R/\sigma_R^2$ for fixed $w$ and $p$. Supply is vertical. Demand $f$ from global banks in blue, from local savers $\theta$ in red.

# inelastic markets



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# general equilibrium

Prices $p(w,t)$ and density $g(w,t)$ solve

$$r(t)p(w,t) - \partial_t p(w,t) = y(w,t) + \mu_w(w,t)\partial_w p(w,t) + \frac{1}{2}\sigma_w(w,t)^2 \partial_{ww} p(w,t) \tag{18}$$

$$\partial_t g(w,t) = -\partial_w[\mu_w(w,t)g(w,t)] + \frac{1}{2}\partial_{ww}[\sigma_w(w,t)^2 p(w,t)] \tag{19}$$

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$$\partial_t g(w,t) = -\partial_w[\mu_w(w,t)g(w,t)] + \frac{1}{2}\partial_{ww}[\sigma_w(w,t)^2 p(w,t)] \qquad (19)$$

Risk-adjusted payoff $y(w,t)$:

$$y(w,t) = \nu(t) - \left(\frac{\sigma}{1 - \epsilon(w,t)\theta(w,t)}\right)^2 \max\left\{\frac{1}{w + \varphi(t)}, \frac{1}{\varphi(t)}\left(1 - \frac{\overline{\theta}w}{p(w,t)}\right)\right\} \qquad (20)$$

with wealth elasticity of price $\epsilon(w,t) = w/p(w,t) \cdot \partial_w p(w,t)$

# calibration and estimation

Calibrate steady state to reproduce aggregates, moments of assets/liabilities ratio    targets and fit

Estimate parameters in linearized model:

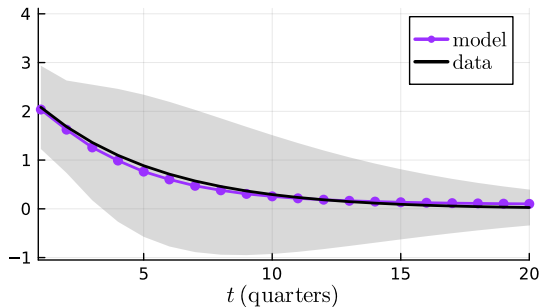$$d\gamma(t) = (\overline{\gamma} - \gamma(t))\mu_\gamma dt + \sigma_\gamma \cdot dW \tag{21}$$

$$d\nu(t) = (\overline{\nu} - \nu(t))\mu_\nu dt + \sigma_\nu \cdot dW \tag{22}$$

Use two-dimensional shock $dW = (dW_1, dW_2)$, two series:
- aggregate position-adjusted outflows (BoP data)
- MSCI for asset prices

# untargeted responses



(a) Advanced economies.

(b) Emerging markets.
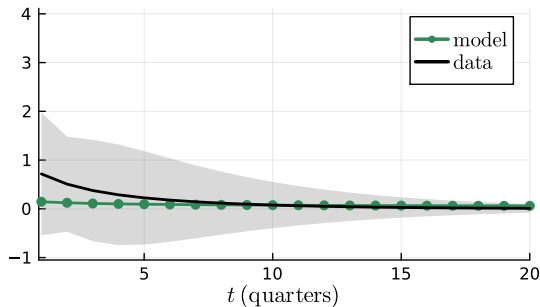
Figure: IRF of $\{\overline{a}_t^{AE}, \overline{a}_t^{EM}\}$ to innovations in $f_t$ (principal component in outflows $a_{it}$)

# shock to risk-tolerance $\gamma(t)$

Unanticipated jump in $\gamma(t)$:

$$\gamma(t) = \gamma - e^{-\mu_\gamma t}\Delta\gamma \tag{23}$$

Immediate effect: hit global factor $\varphi(t) = \gamma(t)\hat{w}(t)$.

Equilibrium effects:
- ▶ time evolution of prices and quantities
- ▶ gains and losses and adjustment in cross-section
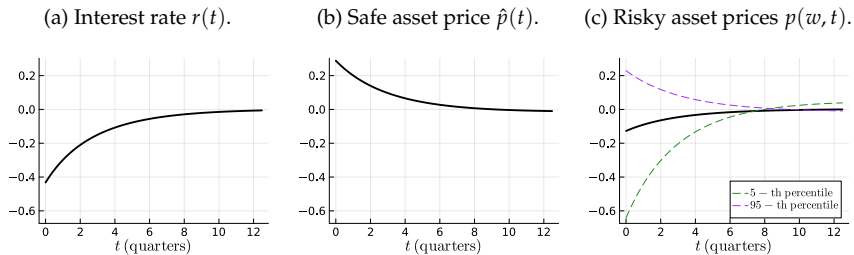
# shock to risk-tolerance $\gamma(t)$: prices

(a) Interest rate $r(t)$.  (b) Safe asset price $\hat{p}(t)$.  (c) Risky asset prices $p(w, t)$.



Figure: 5-th percentile of wealth distributions in green, 95-th percentile in purple.

# shock to risk-tolerance $\gamma(t)$: quantities



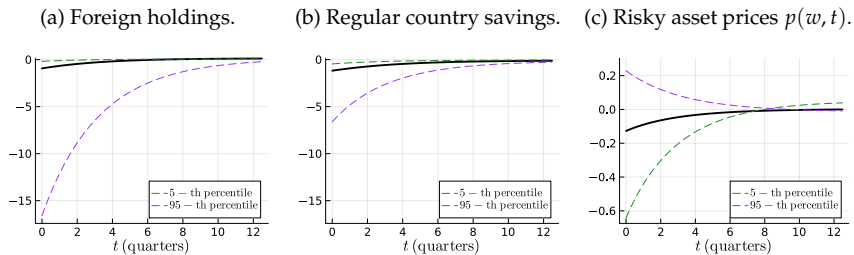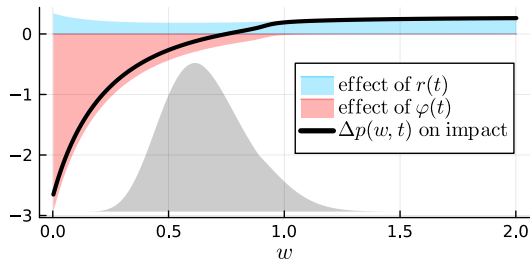(a) Foreign holdings.    (b) Regular country savings.    (c) Risky asset prices $p(w, t)$.

Figure: 5-th percentile of wealth distributions in green, 95-th percentile in purple.

# shock to $\gamma(t)$: prices and holdings

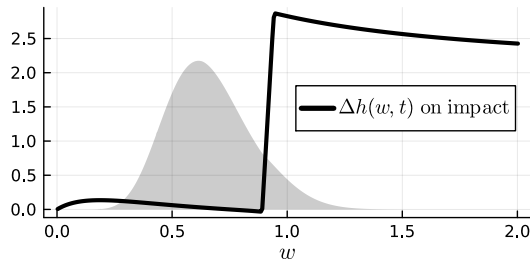(a) Change in prices $p(w,t)$ on impact.

(b) Change in tree holdings on impact.



Figure: cross-section of the changes in risky asset prices and domestic asset holdings on impact.

▶ <u>Chari et al 2020</u>: tail realizations in risk-off move more than median

# evidence on prices and flows

Model: relative performance of AE vs EM
- ▶ negatively correlated with aggregate outflows
- ▶ negatively correlated with $\Delta =$ AE outflows - EM outflows

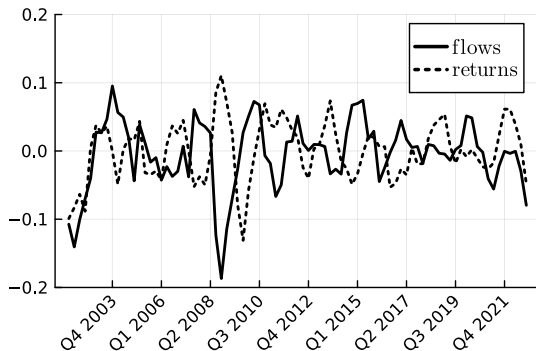## evidence on prices and flows

Model: relative performance of AE vs EM
- ▶ negatively correlated with aggregate outflows
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Define $R_t$ as returns on MSCI for AE and EM

Table: pairwise correlations

|  | $\overline{a}_t^{AE} - \overline{a}_t^{EM}$ | $R_t^{AE} - R_t^{EM}$ |
|---|---|---|
| $f_t$ | 0.53 | -0.28 |
| $\overline{a}_t^{AE} - \overline{a}_t^{EM}$ |  | -0.13 |

Figure: returns $R_t^{AE} - R_t^{EM}$ and flows $\overline{a}_t^{AE} - \overline{a}_t^{EM}$
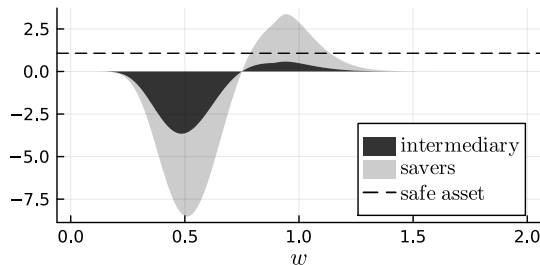
# relative performance over time

Figure: 5-year rolling-window correlation between $\bar{a}_t^{AE} - \bar{a}_t^{EM}$ and $R_t^{AE} - R_t^{EM}$
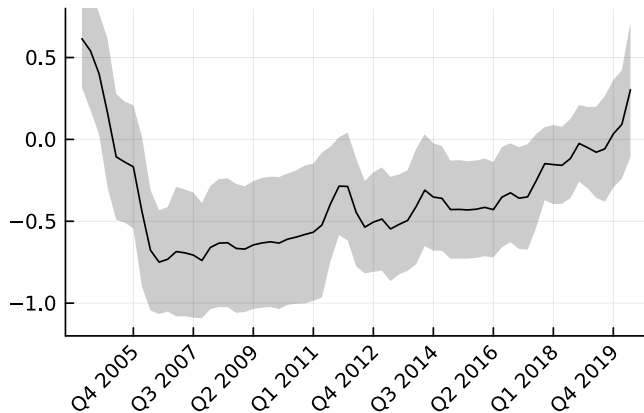


AE and EM separately

# shock to $\gamma(t)$: loss-sharing

Figure: gains and losses on impact in percent of global GDP, weighted by density
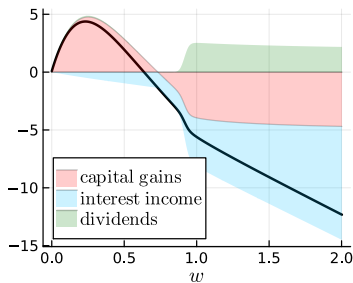


- ▶ insurance: AE → intermediary → EM
- ▶ AE and intermediary become **richer**, EM become **poorer**
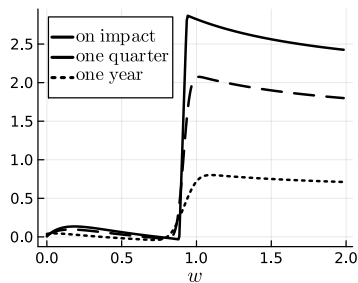
excess returns

# shock to $\gamma(t)$: adjustment



(a) Net income components.

(b) Domestic asset holdings.

▶ rich countries sell trees back to finance consumption and accumulate savings

## shock to output in ROW and US

IES = 1: shocks to $\gamma(t)$ do not destroy wealth, no swings in aggregate consumption:

$$\rho \int_0^1 w dG(w,t) + \hat{\rho}\hat{w}(t) = \nu(t) + q\hat{\nu}(t) \tag{24}$$

Shock to $\nu(t)$ or $\hat{\nu}(t)$?

▶ interest rate rises, all prices fall, more so in poor countries                  prices

▶ loss distribution very similar for shocks to $\nu(t)$ and $\hat{\nu}(t)$                  losses

# signed responses

Table: Summarized qualitative facts about negative shocks to $\gamma(t)$ and $(\nu(t), \hat{v}(t))$

|                                      | fall in $\gamma(t)$ | fall in $\nu(t)$ or $\hat{v}(t)$ |
|--------------------------------------|:-------------------:|:--------------------------------:|
| interest rate                        | -                   | +                                |
| safe asset                           | +                   | -                                |
| risky assets, rich countries         | +                   | -                                |
| risky assets, poor countries         | -                   | -                                |
| retrenchment flows, rich countries   | +                   | 0                                |
| retrenchment flows, poor countries   | 0                   | 0                                |

# conclusion

Domestic demand in richer countries is more elastic due to size and portfolio constraints

- ▶ sudden stops lead to retrenchment that stabilizes prices
- ▶ assets issued by richer countries are endogenously safer
- ▶ wealth transfers: rich → dominant → poor
- ▶ wealth redistribution: regressive

**conclusion**

Thank you for your attention

## measures of global risk-taking capacity

Table: correlations (95% confidence bands) <span style="border:1px solid #999;border-radius:8px;padding:1px 6px;font-size:smaller;">back</span>

|  | $\overline{a}_t^{AE}$ | $\overline{a}_t^{EM}$ | $\overline{a}_t^{AE} - \overline{a}_t^{EM}$ |
|---|---|---|---|
| principal component $f_t$ | 0.86 | 0.34 | **0.53** |
|  | (0.08) | (0.23) | (0.15) |
| VIX (negative) | 0.42 | 0.16 | **0.13** |
|  | (0.19) | (0.17) | (0.15) |
| asset price factor, Miranda-Agrippino Rey 2020 | 0.27 | 0.03 | **0.15** |
|  | (0.20) | (0.11) | (0.10) |
| intermediary factor, He et al 2017 | 0.19 | -0.17 | **0.26** |
|  | (0.24) | (0.21) | (0.14) |
| treasury basis, Jiang et al 2021 | 0.27 | 0.00 | **0.17** |
|  | (0.13) | (0.10) | (0.09) |

# synchronization

Figure: average outflows $\bar{a}_t^{AE}$ and $\bar{a}_t^{EM}$ and outflow factor $f_t$
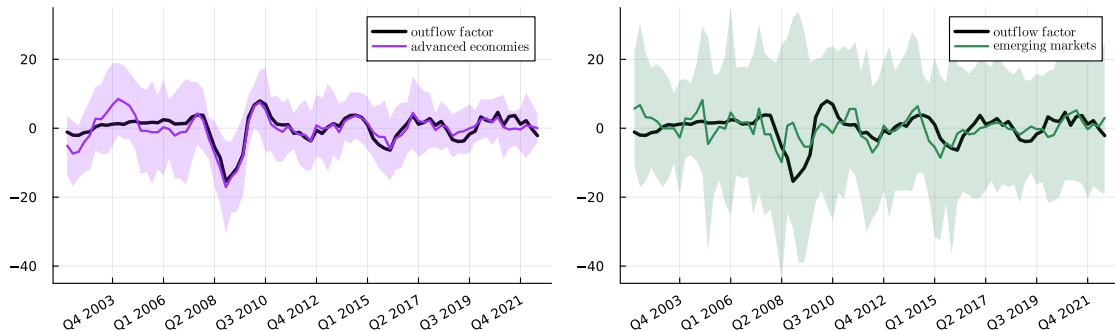


Volatility of in-group averages: $std(\bar{a}_t^{AE}) = 4.5\%$ vs $std(\bar{a}_t^{EM}) = 3.5\%$

back

## intermediaries with a VAR constraint

Issue short-term riskless liabilities $m_t$, invest $(f_{it})_i$ in regular country trees, $\hat{f}_t$ in the US tree:

$$d\hat{w}_t = \int_0^1 f_{it}\hat{w}_t(dR_{it} + r_t dt)di + \hat{f}_t\hat{w}_t(d\hat{R}_t + r_t dt) - m_t r_t dt - \hat{c}_t dt \tag{25}$$

$$\int_0^1 f_{it}di + \hat{f}_t = \hat{w}_t + m_t \tag{26}$$

$$\int_0^1 \mathbb{V}_t[f_{it}dR_{it}]di \leq \gamma_t \int_0^1 \mathbb{E}_t[f_{it}dR_{it}]di \tag{27}$$

Net worth $\hat{w}_t$, consumption rate $\hat{c}_t$, log utility

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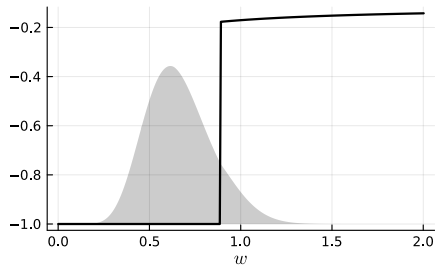<u>Result</u>: constant consumption rate $\hat{c}_t = \hat{\rho}\hat{w}_t$ and <span style="float:right">back</span>

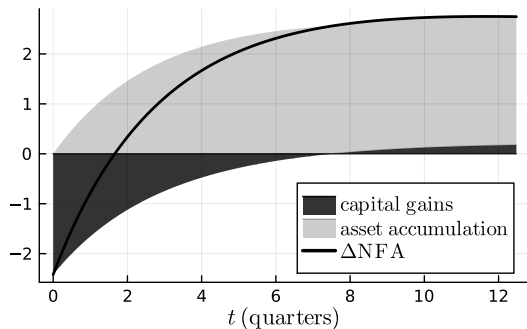$$f_{it} = \gamma_t \frac{\mu_{it}^R}{(\sigma_{it}^R)^2} \tag{28}$$

# steady state
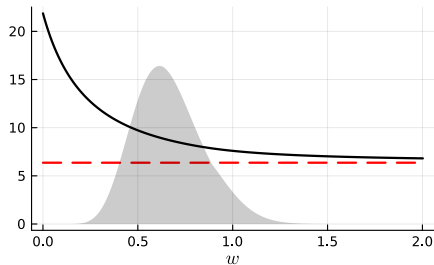


(a) Dividend to price ratio and $r$

(b) Elasticity of $\mu_R / \sigma_R$ to $\varphi$

# US adjustment



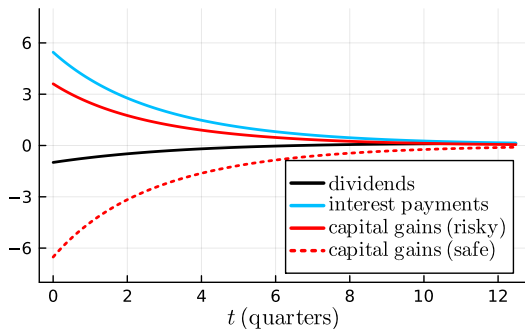(a) Special country's NFA.

(b) Components of wealth accumulation.

Figure: Responses of the special country's NFA and components of net income, percent of GDP.

back

## calibration

Table: steady-state calibration. ( back )

|  | model | target | source |
|---|---|---|---|
| **aggregates:** | | | |
| US wealth share | 31.5% | 32.3% | Credit Suisse 2022 |
| US output share | 23.7% | 22.8% | World Bank |
| average risk premium | $2.62pp$ | $2.5pp$ | Gourinchas Rey 2022 |
| emerging market premium | $2.22pp$ | $2.3pp$ | Adler Garcia-Macia 2018 |
| **external assets to external liabilities:** | | | |
| mean | 1.071 | 1.075 | IFS (IMF) |
| standard deviation | 0.686 | 0.685 | IFS (IMF) |
| q25 | 0.614 | 0.621 | IFS (IMF) |
| q50 | 0.849 | 0.877 | IFS (IMF) |
| q75 | 1.285 | 1.249 | IFS (IMF) |

**evidence: AE and EM separately**
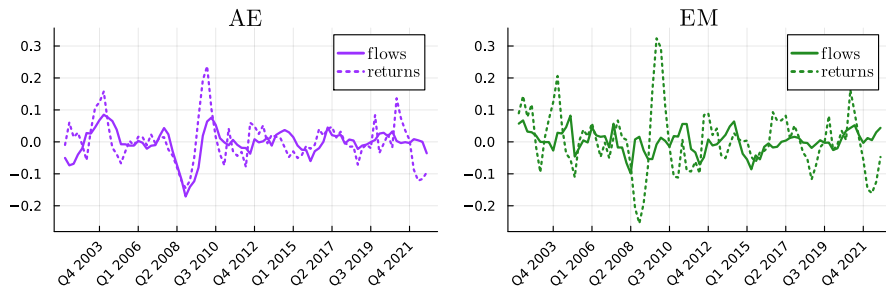
Figure: $R_t^{AE}$ and $\bar{a}_t^{AE}$ on the left, $R_t^{EM}$ and $\bar{a}_t^{EM}$ on the right
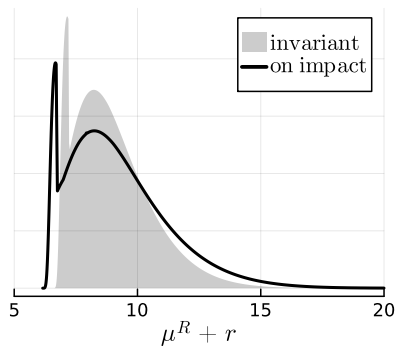


back

# evidence: AE and EM separately

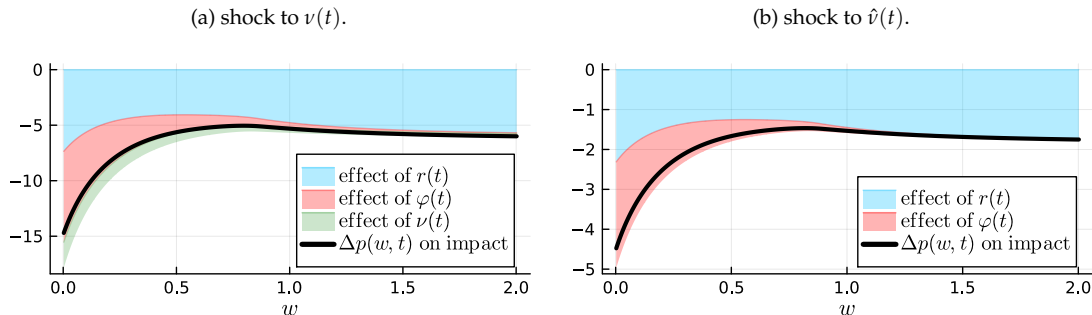Figure: $R_t^{AE}$ and $\bar{a}_t^{AE}$ on the left, $R_t^{EM}$ and $\bar{a}_t^{EM}$ on the right



(a) advanced economies     (b) emerging markets
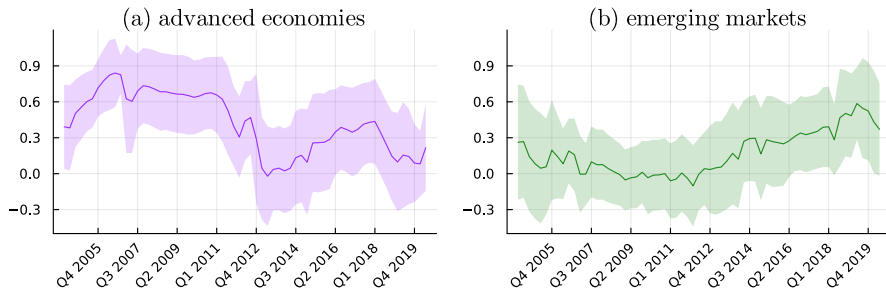
back

# distribution of required returns

Figure: required excess returns.



$\mu^R + r$

# output shocks: price responses



(a) shock to $\nu(t)$.  (b) shock to $\hat{v}(t)$.

Figure: cross-section of the changes in risky asset prices on impact.

- ▶ interest rate rises, asset prices fall everywhere → wealth and consumption fall
- ▶ prices react to both $r(t)$ and $\varphi(t)$ in EM, only react to $r(t)$ in AE

back

# output shocks: distribution of losses



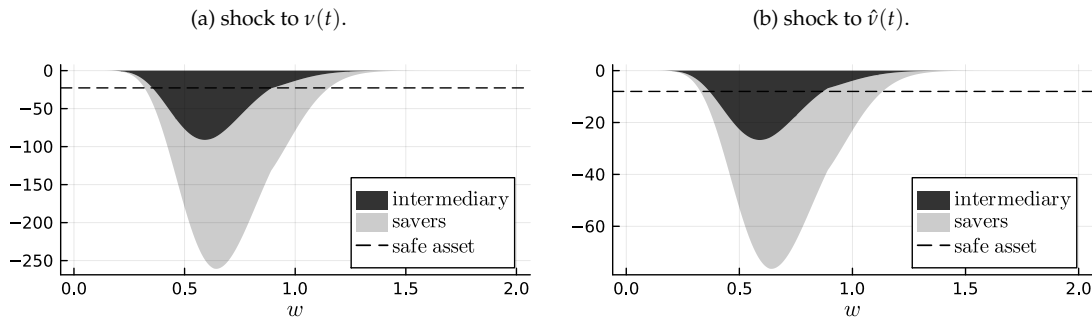(a) shock to $\nu(t)$.

(b) shock to $\hat{v}(t)$.

Figure: gains and losses on impact in percent of global GDP, weighted by density.

▶ loss distributions very similar for shocks of US and ROW origin