Heterogeneous Impact of the Global Financial Cycle

Aleksei Oskolkov
University of Chicago, Department of Economics

September 26, 2023

motivation

Capital flows are correlated across countries and pro-cyclical

- in downturns, investors repatriate foreign assets

Asset repatriation in downturns (retrenchment) is more active in rich countries

- higher correlation of flows with aggregates, larger magnitudes of the cyclical component

This paper: proposes a model to explain this heterogeneity and study its implications

model

Multi-country model for aggregate capital flight

Global intermediaries + countries with heterogeneous wealth

- countries issue risky assets
- local savers and global intermediaries trade these assets
- intermediaries issue safe debt to local savers
- local savers face portfolio constraints: must hold safe debt

Main experiment: shock to risk-bearing capacity of global intermediaries

mechanism and key results

Intermediaries seek to sell risky assets in all countries

- rich countries: domestic investors retrench, replace foreign demand
- poor countries: low wealth + unable to issue safe assets $\longrightarrow$ rise in risk premia

Equilibrium implications:

- assets issued in rich countries appreciate $\longrightarrow$ good substitutes for safe assets
- rich countries insure poor ones
- wealth inequality between countries rises in downturns

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

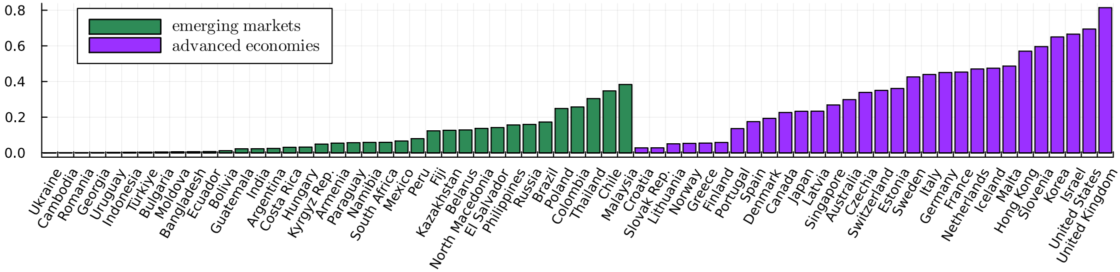
— model

— shock to risk-taking capacity of global intermediaries

outflows from AE vs EM

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

correlation higher in AE



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

correlations

magnitudes larger in AE

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

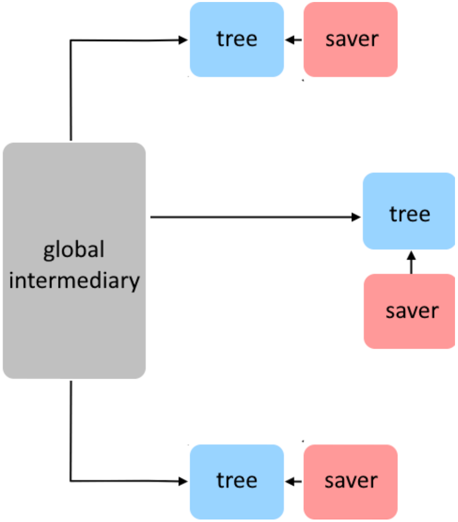
$$\bar{f}_{it} = \alpha_i + \gamma F_t + \beta \mathbb{1}\{i \in \text{AE}\} F_t + \epsilon_{it} \tag{1}$$

Table: dependent variable $\bar{f}_{it}$ is expressed as percentage

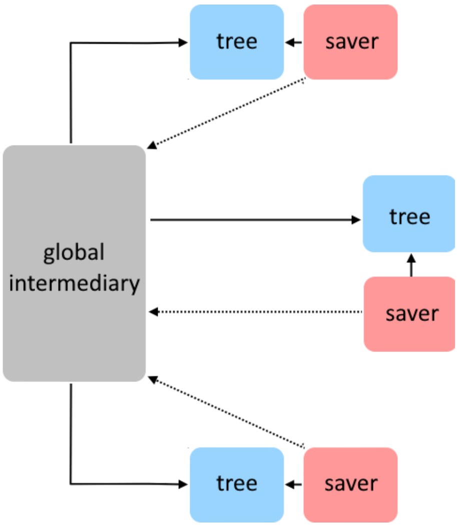
F_t	1.496
	(0.428)
$\mathbb{1}\{i \in \text{AE}\} F_t$	**2.147**
	(0.593)
$R^2 = 0.02$, $N = 6223$	

overall synchronization

model map



model map



regular countries

Countries $i \in [0, 1]$: representative saver with wealth w_{it}

- Lucas tree with price p_{it}, stochastic yield $\nu_t dt + \sigma dZ_{it}$
- allocate share θ_{it} to tree, excess returns dR_{it}
- share $1 - \theta_{it}$ to intermediary's debt, interest rate $r_t dt$
- portfolio constraint

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

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

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

portfolio choice of local savers

Excess returns on tree:

$$dR_{it} = \frac{1}{p_{it}}(\nu_t dt + \sigma dZ_{it} + dp_{it}) - r_t dt \equiv \mu^R_{it} dt + \sigma^R_{it} dZ_{it} + \tilde{\sigma}^R_{it} \cdot dW_t \tag{5}$$

Aggregate shocks dW uncorrelated with local shocks dZ:

$$\theta_{it} = \min\left\{ \bar{\theta}, \frac{\mu^R_{it}}{(\sigma^R_{it})^2 + |\tilde{\sigma}^R_{it}|^2} \right\} \tag{6}$$

intermediaries

Issue debt m_t, invest $(\eta_{it})_i$ in regular country trees, net worth $\hat{w}_t$:

$$d\hat{w}_t = \int_0^1 \eta_{it}\hat{w}_t(dR_{it} + r_t dt)di - m_t r_t dt - \hat{c}_t dt \tag{7}$$

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

$$dR_{it} = \mu_{it}^R dt + \sigma_{it}^R dZ_{it} + \tilde{\sigma}_{it}^R \cdot dZ_t = (\mu_{it}^R - \xi_{it}\sigma_{it}^R)dt + \sigma_{it}^R d\hat{Z}_{it} + \tilde{\sigma}_{it}^R \cdot dW_t \tag{8}$$

intermediary's portfolio choice

Minmax problem: first choose corrections ξ_t, then portfolio and consumption

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

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

model with VAR constraint

$$\eta_{it} = \gamma_t \frac{\mu_{it}^R - \tilde{\sigma}_{it}^R x_t}{(\sigma_{it}^R)^2} \tag{10}$$

market clearing and equilibrium

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

$$1 = \frac{\eta_{it}\hat{w}_t}{p_{it}} + \frac{\theta_{it}w_{it}}{p_{it}} \quad \text{all } i \in [0,1] \tag{11}$$

$$m_t = \int_0^1 w_{it}(1-\theta_{it})di \tag{12}$$

$$\nu_t = \hat{c}_t + \int_0^1 c_{it}di \tag{13}$$

states

Exogenous aggregate shocks: risk-tolerance γ_t, output ν_t:

$$d\gamma_t = (\overline{\gamma} - \gamma_t)\mu_\gamma dt + \sigma_\gamma \cdot dW \tag{14}$$
$$d\nu_t = (\overline{\nu} - \nu_t)\mu_\nu dt + \sigma_\nu \cdot dW \tag{15}$$

Endogenous states: **distribution** $G(\cdot)$ of wealth w, intermediary's net worth $\hat{w}$

equilibrium characterization

Solve for country-specific variables as functions of w and aggregate states

- countries are constrained if $w \leq \tilde{w}(t)$ more
- prices only depend on $r(t)$ and a global factor $\varphi(t) = \gamma(t)\hat{w}(t)$

At $\sigma_\gamma = \sigma_\nu = (0,0)$, enough to track time: excess returns satisfy solution stochastic dynamics

$$\mu_R(w,t) = \sigma_R(w,t)^2 \cdot \max\left\{\frac{p(w,t)}{\varphi(t)+w}, \frac{p(w,t)-\bar{\theta}w}{\varphi(t)}\right\} \tag{16}$$

elastic markets

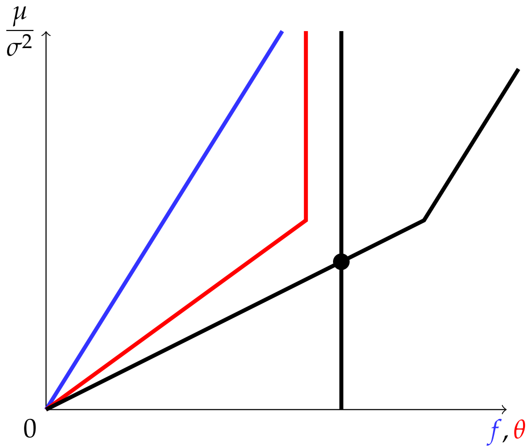


Figure: Supply and demand as functions of μ_R/σ_R^2 for fixed w and p. Supply is vertical. Demand f from global banks in blue, from local savers θ in red.

elastic markets

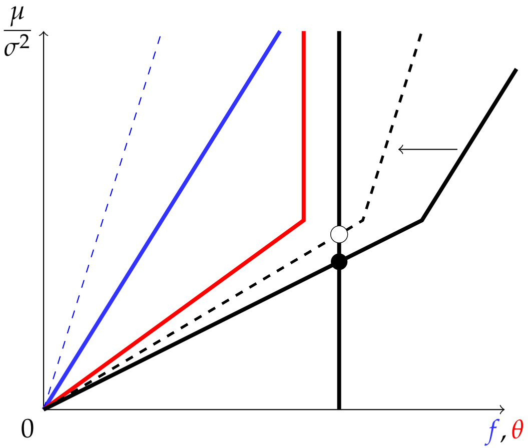


Figure: Supply and demand as functions of μ_R/σ_R^2 for fixed w and p. Supply is vertical. Demand f from global banks in blue, from local savers θ in red.

inelastic markets

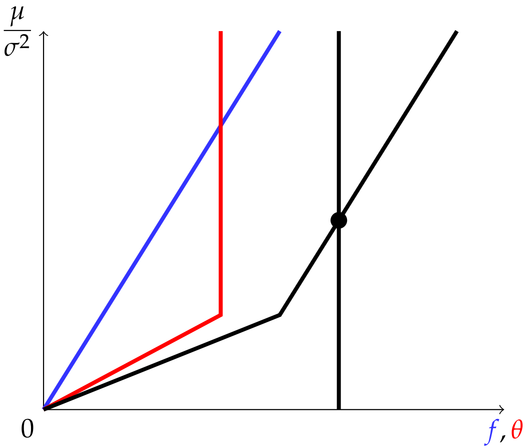


Figure: Supply and demand as functions of μ_R/σ_R^2 for fixed w and p. Supply is vertical. Demand f from global banks in blue, from local savers θ in red.

inelastic markets

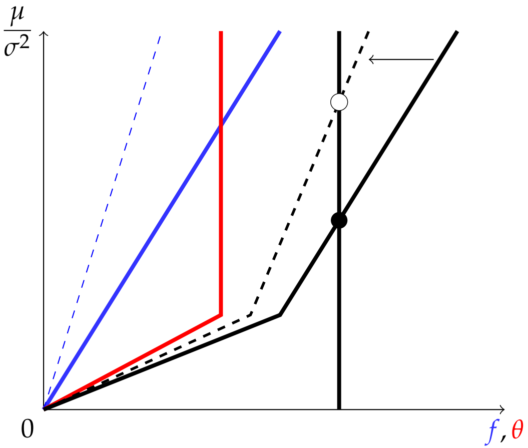


Figure: Supply and demand as functions of μ_R/σ_R^2 for fixed w and p. Supply is vertical. Demand f from global banks in blue, from local savers θ in red.

adding safe assets

Lucas tree in the dominant country, fixed supply q, held by intermediaries

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

$$d\hat{R}_t = \frac{1}{\hat{p}_t}(d\hat{p}_t + \hat{v}_t dt) - r_t dt \tag{17}$$

No risk in dividends, no associated ambiguity

calibration

Calibrate steady state to reproduce aggregates, moments of assets/liabilities ratio:

	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)

estimation

Estimate parameters of aggregate shocks: $(\mu_\gamma, \mu_\nu, \sigma_\gamma, \sigma_\nu)$

Simulate the model, compute moments of first-order deviation $\tilde{M}_t$ and $\tilde{P}_t$

- $\tilde{M}_t$: total external assets
- $\tilde{P}_t$: average risky asset price

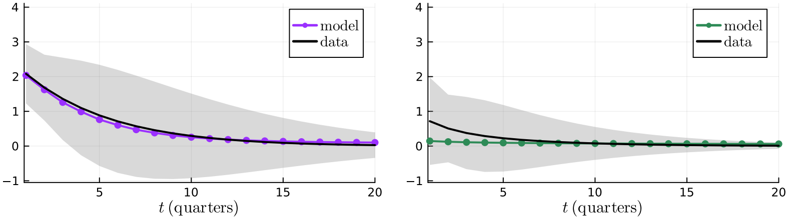
Data: quarterly returns on MSCI ACWI index for $\tilde{P}_t$, total outflows from IMF data for $\tilde{M}_t$

	$\mathbb{V}[\tilde{P}_t]$	$\mathbb{V}[\tilde{M}_t]$	$\mathbb{C}[\tilde{P}_t, \tilde{M}_t]$	$\mathbb{C}[\tilde{P}_t, \tilde{P}_{t-1}]$	$\mathbb{C}[\tilde{M}_t, \tilde{M}_{t-1}]$
data	18.33	24.33	15.93	14.43	20.16
model	16.74	24.25	15.68	16.15	20.38

untargeted responses

Responses of outflows in AE and EM separately:

- compute IRF of average outflows $\overline{f}_{it}^{AE}$ to an innovation in factor F_t in data
- compute IRF of average outflows in AE to a shock to γ in the model
- same for EM



(a) Advanced economies.

(b) Emerging markets.

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

Consider a unanticipated jump in $\gamma(t)$ for illustration:

$$\gamma(t) = \gamma - e^{-\mu_\gamma t}\Delta\gamma \tag{18}$$

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

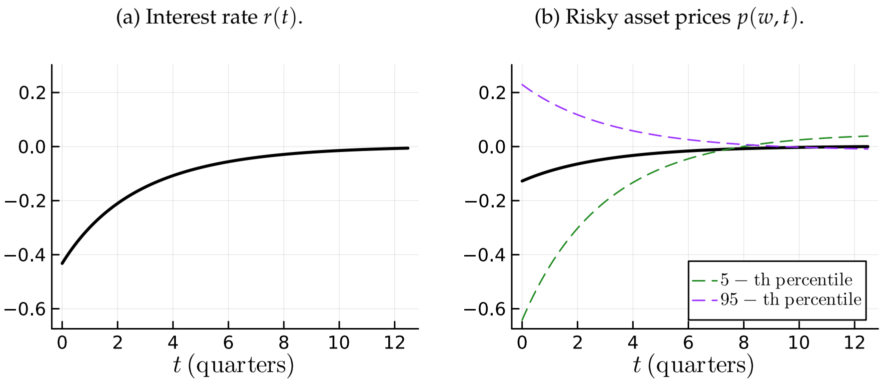


Figure: 5-th percentile of wealth distributions in green, 95-th percentile in purple. quantities

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

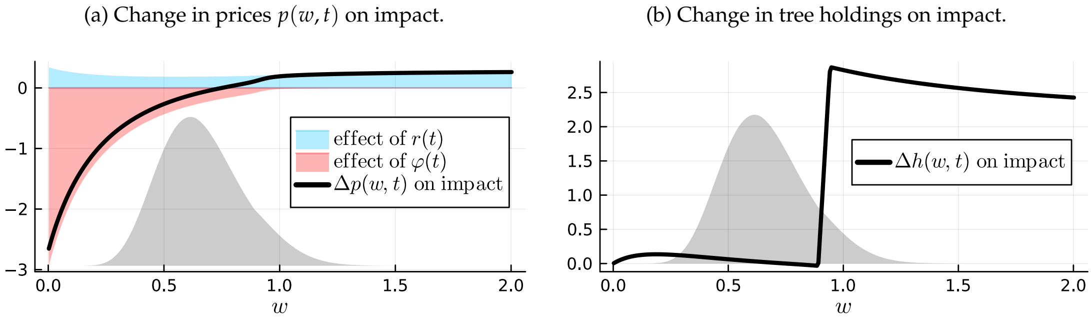


Figure: cross-section of the changes in risky asset prices and domestic asset holdings on impact.

- Chari et al 2020: tail realizations in risk-off move more than median

evidence on prices and flows

Model: relative performance of AE vs EM

AE and EM separately

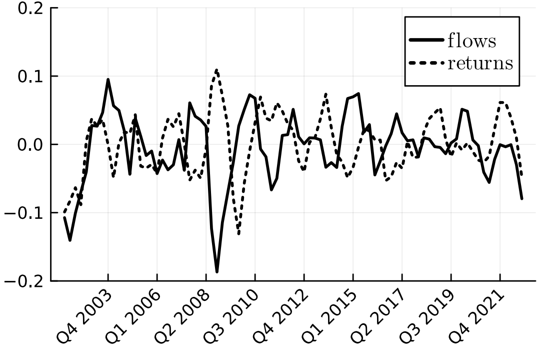
- negatively correlated with aggregate outflows
- negatively correlated with Δ = AE outflows - EM outflows

Define R_t as returns on MSCI for AE and EM

Table: pairwise correlations

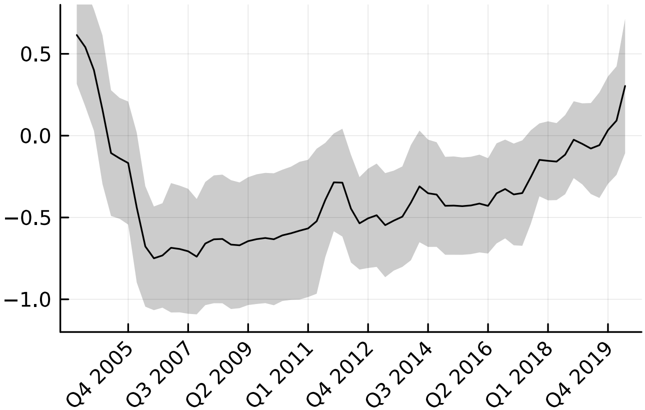
	$\overline{a}_t^{AE} - \overline{a}_t^{EM}$	$R_t^{AE} - R_t^{EM}$
F_t	0.53	-0.28
$\overline{a}_t^{AE} - \overline{a}_t^{EM}$		-0.13

Figure: returns $R_t^{AE} - R_t^{EM}$ and flows $\overline{a}_t^{AE} - \overline{a}_t^{EM}$



relative performance over time

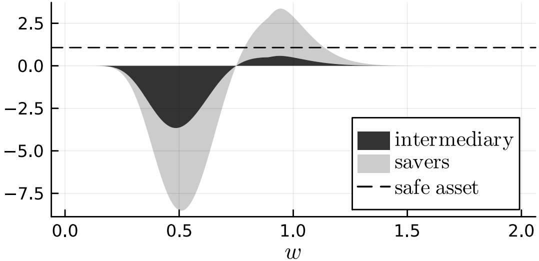
Figure: 5-year rolling-window correlation between $\bar{a}_t^{AE} - \bar{a}_t^{EM}$ and $R_t^{AE} - R_t^{EM}$



AE and EM separately

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

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

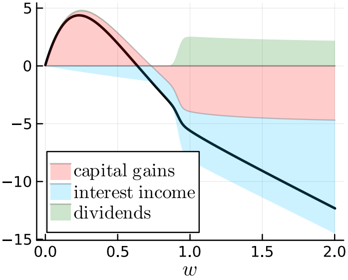


- insurance: AE $\rightarrow$ intermediary $\rightarrow$ EM
- AE and intermediary become **richer**, EM become **poorer**

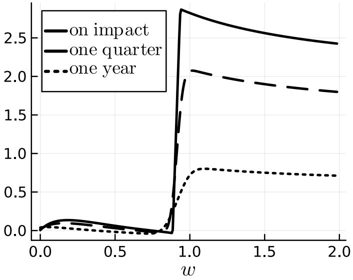
excess returns

shock to $\gamma(t)$: adjustment

(a) Net income components.



(b) Domestic asset holdings.



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

US adjustment

shock to output in ROW and US

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

$$\rho \int_0^1 w dG(w,t) + \hat{\rho}\hat{w}(t) = \nu(t) + q\hat{\nu}(t) \tag{19}$$

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 $(\nu(t), \hat{\nu}(t))$

	fall in $\gamma(t)$	fall in $\nu(t)$ or $\hat{\nu}(t)$
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 $\rightarrow$ dominant $\rightarrow$ poor
- wealth redistribution: regressive

conclusion

Thank you for your attention

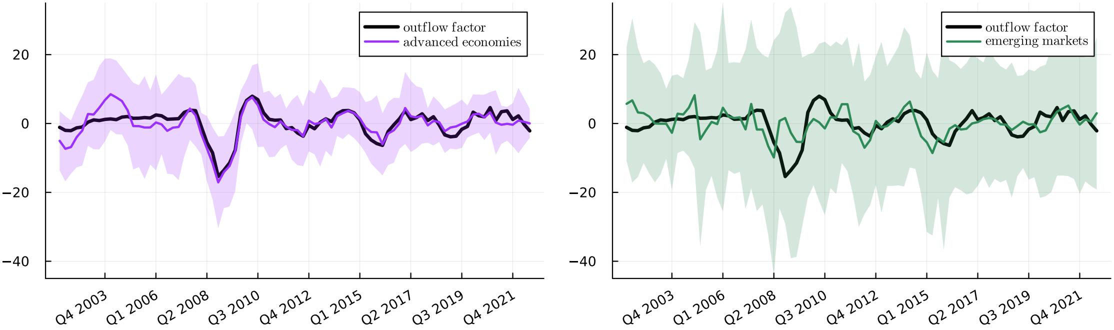
measures of global risk-taking capacity

Table: correlations (95% confidence bands) back

	$\overline{a}_t^{AE}$	$\overline{a}_t^{EM}$	$\overline{a}_t^{AE} - \overline{a}_t^{EM}$
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

premium for aggregate risk

Intermediaries take the following positions:

back

$$\eta_{it} = \gamma_t \frac{\mu_{it}^R - \tilde{\sigma}_{it}^R x_t}{(\sigma_{it}^R)^2} \tag{20}$$

Here the aggregate risk price is

$$x_t = \frac{\gamma_t \int_0^1 \frac{\mu_{it}^R \tilde{\sigma}_{it}^R}{(\sigma_{it}^R)^2} di}{1 + \gamma_t \int_0^1 \frac{(\tilde{\sigma}_{it}^R)^2}{(\sigma_{it}^R)^2} di} \tag{21}$$

intermediaries with a VAR constraint

Issue short-term riskless liabilities m_t, invest $(\eta_{it})_i$ in regular country trees:

$$d\hat{w}_t = \int_0^1 \eta_{it}\hat{w}_t(dR_{it} + r_t dt)di - m_t r_t dt - \hat{c}_t dt \tag{22}$$

$$\int_0^1 \eta_{it}\hat{w}_t di = \hat{w}_t + m_t \tag{23}$$

$$\int_0^1 \mathbb{V}_t[\eta_{it}(dR_{it} - \tilde{\sigma}_{it}^R \cdot dZ_t)]di \leq \gamma_t \int_0^1 \mathbb{E}_t[\eta_{it}(dR_{it} - \tilde{\sigma}_{it}^R x_t)]di \tag{24}$$

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

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

back

$$\eta_{it} = \gamma_t \frac{\mu_{it}^R - \tilde{\sigma}_{it}^R x_t}{(\sigma_{it}^R)^2} \tag{25}$$

general equilibrium

Shut down aggregate shocks, $\sigma_\gamma = \sigma_\nu = (0, 0)$ back

Given initial conditions, prices $p(w,t)$ and density $g(w,t)$ solve

$$r(t)p(w,t) - \partial_t p(w,t) = y(w,t) + \mu_w(w,t)\partial_w p(w,t) + \frac{1}{2}\sigma_w(w,t)^2 \partial_{ww} p(w,t) \tag{26}$$

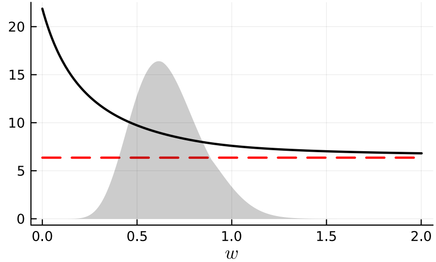
$$\partial_t g(w,t) = -\partial_w[\mu_w(w,t)g(w,t)] + \frac{1}{2}\partial_{ww}[\sigma_w(w,t)^2 p(w,t)] \tag{27}$$

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

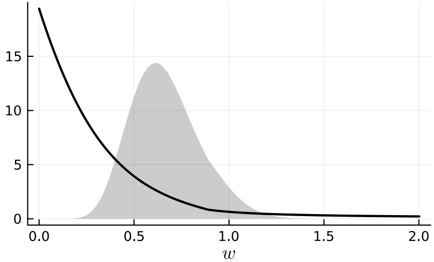
$$y(w,t) = \nu(t) - \left(\frac{\sigma}{1-\epsilon(w,t)\theta(w,t)}\right)^2 \max\left\{\frac{1}{w+\varphi(t)}, \frac{1}{\varphi(t)}\left(1 - \frac{\bar{\theta}w}{p(w,t)}\right)\right\} \tag{28}$$

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

steady state



(a) Dividend to price ratio and r



(b) Elasticity of μ_R / σ_R to φ

back

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

(a) Regular country savings.

(b) Risky asset prices $p(w,t)$.

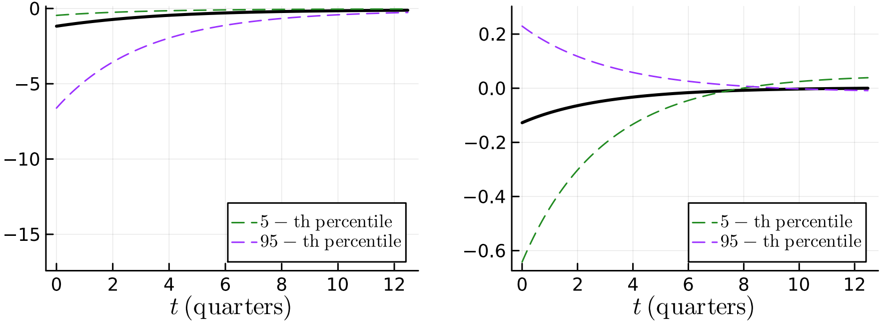


Figure: 5-th percentile of wealth distributions in green, 95-th percentile in purple. back

US adjustment

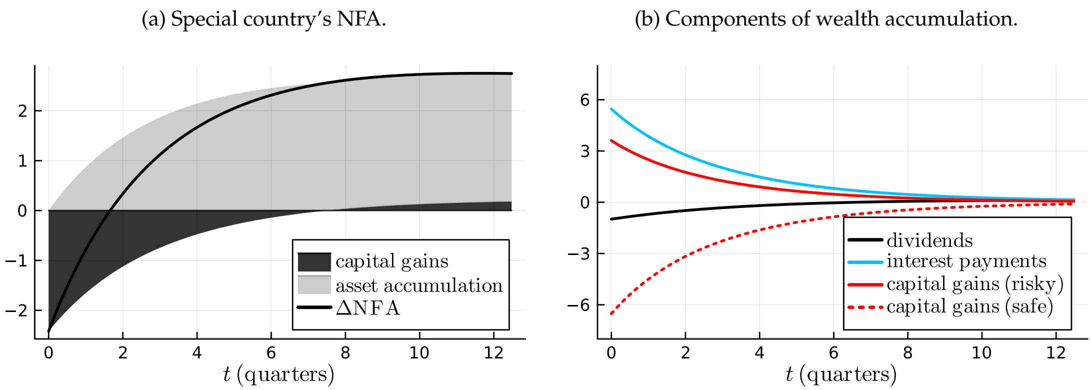


Figure: Responses of the special country's NFA and components of net income, percent of GDP.

back

equilibrium with aggregate shocks

Given the process for excess returns

$$dR(w,\mathcal{S}) = \mu_R(w,\mathcal{S})dt + \sigma_R(w,\mathcal{S})dZ + \tilde{\sigma}_R(w,\mathcal{S}) \cdot dW \tag{29}$$

In equilibrium, excess returns satisfy

back

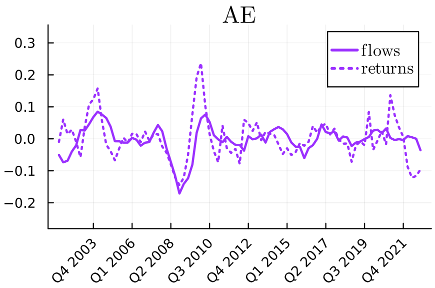
$$\begin{aligned}\mu_R(w,\mathcal{S}) = x(\mathcal{S}) \cdot \tilde{\sigma}_R(w,\mathcal{S}) + \\ \sigma_R(w,\mathcal{S})^2 \cdot \max\left\{ \frac{p(w,\mathcal{S})(\sigma_R(w,\mathcal{S})^2 + |\tilde{\sigma}_R(w,\mathcal{S})|^2) - wx(\mathcal{S}) \cdot \tilde{\sigma}_R(w,\mathcal{S})}{\varphi(\mathcal{S})(\sigma_R(w,\mathcal{S})^2 + |\tilde{\sigma}_R(w,\mathcal{S})|^2) + w\sigma_R(w,\mathcal{S})^2}, \frac{p(w,\mathcal{S}) - \bar{\theta}w}{\varphi(\mathcal{S})} \right\}\end{aligned} \tag{30}$$

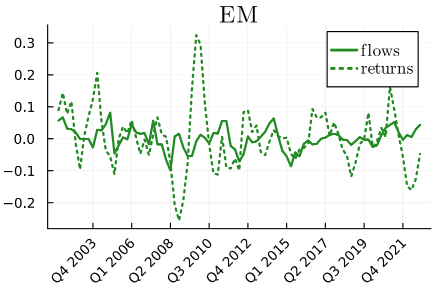
Here $x(\mathcal{S})$ is the aggregate risk premium

$$x(\mathcal{S}) = \frac{\gamma \int_0^1 \frac{\mu_R(w,\mathcal{S})\tilde{\sigma}_R(w,\mathcal{S})}{(\sigma_R(w,\mathcal{S}))^2} dG(w,\mathcal{S})}{1 + \gamma \int_0^1 \frac{|\tilde{\sigma}_R(w,\mathcal{S})|^2}{(\sigma_R(w,\mathcal{S}))^2} dG(w,\mathcal{S})} \tag{31}$$

evidence: AE and EM separately

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

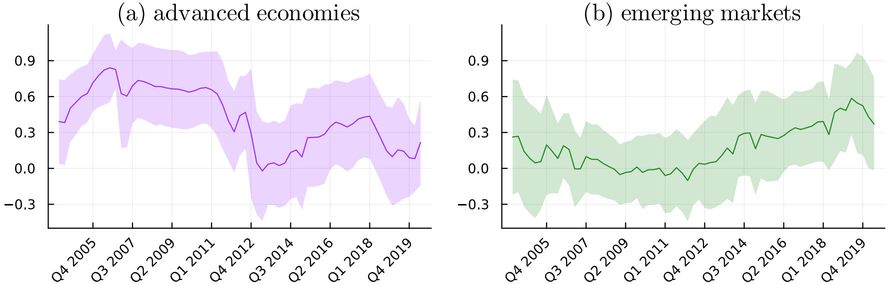




back

evidence: AE and EM separately

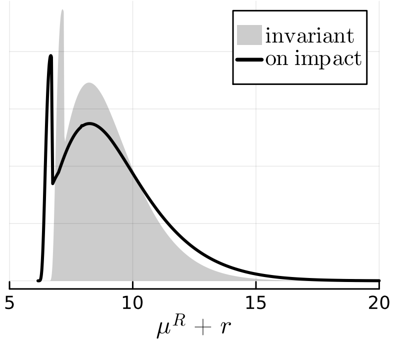
Figure: R_t^{AE} and $\bar{a}_t^{AE}$ on the left, R_t^{EM} and $\bar{a}_t^{EM}$ on the right



back

distribution of required returns

Figure: required excess returns. back



output shocks: price responses

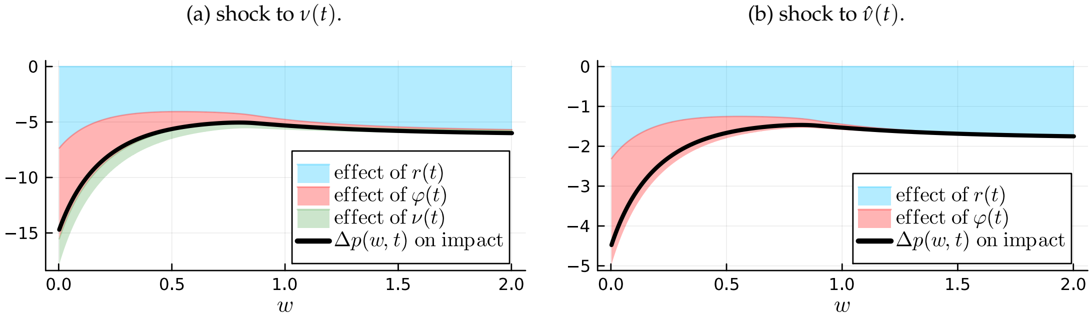


Figure: cross-section of the changes in risky asset prices on impact.

- interest rate rises, asset prices fall everywhere $\rightarrow$ 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

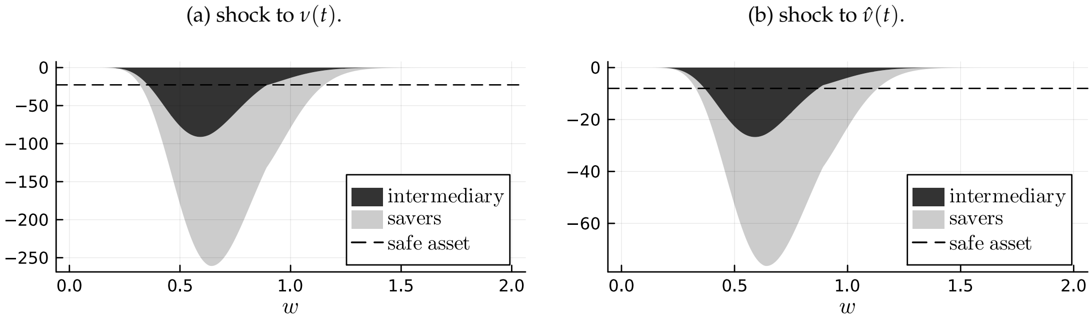


Figure: gains and losses on impact in percent of global GDP, weighted by density.

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

back