A Model of Fickle Capital Flows and Retrenchment

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Capital flows are large.... and fickle

- Capital inflows are large, often exceeding 20% of GDP per year for DM and half of that for EM
- But they are also **fickle**
- **Fickleness:** Foreigners exit at times of local distress (recession/crisis)
- This combination of size and fickleness has made capital flows a perennial source of headaches for policymakers around the world
- And a fertile ground for academic work supporting their regulation (even coordinated by the IMF in 2012!)

Less noticed but as prevalent.... retrenchment

- **Retrenchment:** Local investors (banks) reduce their foreign investments during local crises and use their global liquidity at home
- Obstfeld (2012):
  Figure ... illustrates the example of the United States over the two quarters of intensive global deleveraging following the Lehman Brothers collapse in September 2008.... Gross capital inflows, which in previous years had been sufficient to more than cover even a 2006 net current account deficit of 6 percent of GDP, went into reverse, as foreigners liquidated $198.5 billion in U.S. assets. In addition, the U.S. financed a current account shortfall of $231.1 billion (down sharply from the current account deficit of $371.4 billion over the previous two quarters). Where did the total of nearly $430 billion in external finance come from? It came from U.S. sales of $428.4 billion of assets held abroad....

Fickleness and retrenchment

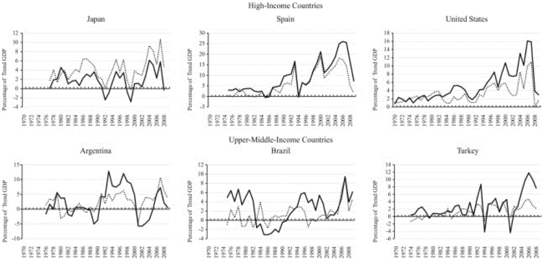


Figure: Source: Broner et al. (2013) based on IMF BOP.

- As Broner et al note: Hard to reconcile with standard macroeconomic models without frictions because shocks (e.g. local productivity) typically affect foreign and domestic investors in parallel.
- Avdjiev et al. (2017): Key role of banks, especially in DM. Sovereigns and reserves play some role in EM.

Our contribution: A model of fickleness and retrenchment

We develop a liquidity-centric model to analyze gross flows and their implications for financial stability & regulation.

Crises: Asset fire sales driven by liquidity shortages.

Banks:

- Unconstrained in local market: Arbitrage capital during local crisis.
- **Fickle in foreign market:** By assumption, sell in foreign crisis. We take this as given (captures asymmetric info/Knightian uncertainty, asymmetric property rights, asymmetric regulation...)

Main result: Retrenchment dominates fickleness

For *symmetric* locations (DM-DM flows):

- **Main result:** Flows **mitigate fire sales** despite their fickleness.
  - Past outflows have higher return than fire-sold fickle inflows (and flows are symmetric)
- **Result:** In uncoordinated equilibrium, planners restrict flows.
  - Liquidity is a public good/external. Fickleness costs are local/internal.

With *asymmetries* in liquidity or returns (DM-EM flows):

- **Reach-for-yield and safety** qualify the normative conclusions.
  - Safety: DM sells insurance to EM and behaves as "venture capitalist"
  - Yield: Creates imbalances in size of flows (and outflows "backfire")

Comparative statics of flows (safe asset scarcity & crisis correlations).

Related literature (multiple and extensive...)

- International risk sharing (mostly frictionless) – different reason for diversification
- Home bias – for us is *contingent* (on crisis) home bias
- Central role of banks / sophisticated intermediaries for flows
- Knightian uncertainty
- Scarcity of safe assets
- Endogenous liquidity creation, fire sales, and limits-to-arbitrage
- Empirical literature on gross capital flows
- ....

Roadmap

Baseline environment: Liquidity shocks

- Three periods, $t \in \{0, 1, 2\}$. Single consumption good.
- Continuum of locations $j \in [0, 1]$.

Uncertainty structure:

- In period 1, aggregate state $s \in S$ is drawn with probability γ_s.
- Then, liquidity shock hits each location with i.i.d. probability π_s.
  - If $\omega^j = g$ ("good") no liquidity shock
  - If $\omega^j = b$ ("bad") liquidity shock.
- States with greater s are associated with greater π_s.

Three types of assets

1. Linear investment technology in period 0 in each location. One unit in period 0 generates R units, but timing depends on liquidity shock:
    - If $\omega^j = g$, then early payoff in period 1.
    - If $\omega^j = b$, then payoff delayed to period 2. In period 1, traded at endogenous price $p_s^j \equiv p_s$ (symmetry). We make parametric assumptions so that there are **fire sales**, $p_s < R$.
2. Risk-free asset that pays 1 unit in period 1.
    - Fixed supply: η units in each location (endowed to local banks).
    - In period 0, traded at an endogenous price q_f.
3. AD securities for aggregate states, that pays one unit in state s.
    - Zero net supply. In period 0, traded at an endogenous price q_s.

Two types of agents

1. "Distressed sellers" with preferences $E\left[\tilde{c}_{2,s}\right]$
   - Endowed with e units of the local risky asset in period 1.
   - Can invest in (nonpledgeable) technology with return λ.
   - We assume λ is large so that they sell endowed assets to reinvest.
   - (Introduces balance-sheet channel and fire sales.)
2. Main agents are "banks" with preferences $E\left[u\left(c_0\right)+c_{1,s}+c_{2,s}\right]$.
   - Endowed with one unit of consumption good in period 0, and all (η) of the safe asset.
   - Choose an investment strategy, $x^{j,j}, \left(x^{j',j}\right)_{j'\neq j}, y, z_s$, subject to:

$$c_0+x^{j,j}+x^{out,j}+yq_f+\sum_s z_s q_s=1+\eta q_f, \text{ where } x^{out,j}=\int_{j'\neq j} x^{j',j}dj'.$$

   - **Fickleness:** If $\omega^{j'}=b$, then banks must sell investments in j'.

Banks' payoff from investment

- Banks collect $x^{out,j}\overline{R}_s$ from foreign investments, where,

$$\overline{R}_s = (1-\pi_s) R + \pi_s p_s < R.$$

- They also collect $y + z_s$ units from other investments.
- If there is no local liquidity shock, they consume immediately:

$$\begin{aligned} c_{1,s}\left(\omega^j = g\right) &= x^{j,j} R + x^{out,j}\overline{R}_s + y + z_s \\ \text{and } c_{2,s}\left(\omega^j = g\right) &= 0. \end{aligned}$$

- If there is a liquidity shock, they reinvest into assets so that:

$$\begin{aligned} c_{1,s}\left(\omega^j = b\right) &= 0, \\ c_{2,s}\left(\omega^j = g\right) &= \left(x^{j,j} p_s + x^{out}\overline{R}_s + y + z_s\right)\frac{R}{p_s}. \end{aligned}$$

Market clearing conditions and equilibrium

- Market clearing for risky asset in period 1 (with liquidity shock):

$$\left(e + x^{in,j} + x^{j,j}\right) p_s = \overbrace{x^{j,j} p_s + x^{out} \overline{R}_s + y + z_s}^{\textbf{cash-in-the-market} \text{ (from local banks)}},$$

where $x^{in,j} = \int_{j' \neq j} x^{j,j'} dj'$.

- Market clearing for the financial assets in period 0,

$$\int_j y^j dj = \eta, \text{ and } \int_j z_s^j dj = 0 \text{ for each } s.$$

- Equilibrium is allocations and prices, $(p_s)_s, q_f, (q_s)_s$ such that...
- Symmetric equilibrium features $x^{out} = x^{in} = x$ and $y = \eta, z_s = 0$.
- **Assume:** $\eta < eR$ (to generate fire sales).

Equilibrium features capital flows despite fickleness

- Banks' problem can then be written as,

$$\max_{x^{j,j},x^{out}} u\left(1 - x^{j,j} - x^{out}\right) + x^{j,j} R + \sum_s \gamma_s \left(x^{out} \overline{R}_s + \eta\right) M_s,$$

$$\text{where } M_s \equiv 1 - \pi_s + \pi_s \frac{R}{p_s}.$$

- We define $\mu_s(p_s) \equiv \overline{R}_s M_s = ((1-\pi_s) R + \pi_s p_s)\left(1 - \pi_s + \pi_s \frac{R}{p_s}\right)$.
- **Lemma:** $\mu(p_s) > R$ for each $p_s < R$. Lower p_s implies higher $\mu(p_s)$.

- This implies $x^{j,j} = 0$. There is foreign investment despite fickleness.
- Optimal level of foreign investment satisfies,

$$u'(1-x) = E\left[\overline{R}_s M_s\right] = \sum_s \gamma_s \mu_s(p_s). \tag{1}$$

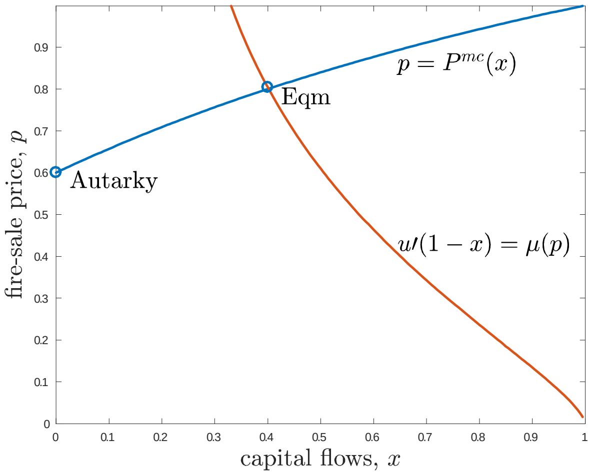
With symmetric flows, retrenchment dominates fickleness

$$p_s = \frac{\eta + x^{out}\overline{R}_s}{e + x^{in}} \implies p_s = P_s^{mc}(x) \equiv \frac{\eta + x(1-\pi_s)R}{e + x(1-\pi_s)}. \qquad (2)$$

- **Lemma:** $P_s^{mc}(x)$ is strictly increasing in x (when $\pi_s < 1$).
- Inflows liquidated at low return, $p_s < \overline{R}_s = (1-\pi_s)R + \pi_s p_s$.
- Gross symmetric flows provide net liquidity despite their fickleness!

- **Proposition:** Equilibrium $(x, (p_s)_s)$ is found by solving Eqs. (1) and (2), and it features greater fire-sale prices than in autarky,

$$p_s \geq p^{aut} = \eta/e.$$


0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
fire-sale price, p
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
capital flows, x
$p = P^{mc}(x)$
Eqm
Autarky
$u\prime(1-x) = \mu(p)$

Flows feature risk premium (despite linear utility)

- $\overline{R}_s = (1 - \pi_s) R + \pi_s p_s$ is strictly decreasing in s.
- $M_s = 1 - \pi_s + \pi_s \frac{R}{p_s}$ is strictly increasing in s.
- Arrow-Debreu price to probability ratios (the SDF) satisfy,

$$\frac{q_s}{\gamma_s} = \frac{M_s}{u'(1-x)}, \text{ and strictly increasing in } s.$$

- Risk-free price satisfies $q_f = \frac{E[M_s]}{u'(1-x)}$. Define $R_f \equiv \frac{1}{q_f}$.
- Risk premium on foreign investment is positive,

$$E\left[\overline{R}_s\right] - R_f = -\frac{cov\left(M_s, \overline{R}_s\right)}{E[M_s]} \geq 0.$$

Roadmap

1. Equilibrium and liquidity creation
2. Regulating capital flows
3. Determinants of gross capital flows
4. Reach for safety and yield

Constrained planner increases capital flows

- Consider (global) constrained planner that can dictate x.
- Planner is utilitarian. Welfare function can be written as,

$$W^j = u(1-x) + (x+e)R + \eta + \overbrace{(\lambda - 1)\, e\overline{R}}^{\text{net production by distressed sellers}}, \text{ where } \overline{R} = (1-\pi)R + \pi p.$$

- Planner maximizes this subject to market clearing, $p = \frac{\eta + x(1-\pi)R}{e + x(1-\pi)}$.
- **Proposition:** Planner chooses greater (x, p) than (x^{eq}, p^{eq}) iff,

$$\overbrace{\frac{e\lambda + x^{eq}(1-\pi) + x^{eq}\pi\left(R/p^{eq}\right)}{e + x^{eq}}}^{\text{average marginal utility of sellers}} > \overbrace{\frac{R}{p^{eq}}}^{\text{marginal utility of buyers}}.$$

- In the limit $\lambda \to \infty$ (strong balance sheet effects) $x > x^{eq}, p > p^{eq}$.

Absent coordination, planners restrict capital flows

- Now consider *local* planners that set policies in decentralized fashion.
- Suppose $\lambda \to \infty$ so local planners' objective is to raise local price, p^j.
- Planners can ban capital inflows ($b^j = 1$) or allow them ($b^j = 0$).
- **Coordinated solution: Free capital flows** (as it raises $p^j \equiv p$)
- Equilibrium in which fraction $B \in [0, 1)$ of locations ban capital flows,

$$p^{ban} = \frac{\eta + (1 - B)\, x^{ban} \overline{R}^{free}}{e},$$

$$p^{free} = \frac{\eta + (1 - B)\, x^{free} \overline{R}^{free}}{e + Bx^{ban} + (1 - B)\, x^{free}},$$

- Since $p^{ban} > p^{free}$, **unique Nash equilibrium is to ban flows.**
- Intuition: **Liquidity is a public good**. Individual planners internalize fickleness cost of inflows but not liquidity benefits of outflows.

Roadmap

A tractable special case: The "beta" model

- Three aggregate states, $s \in \{1, 2, 3\}$, that feature,

$$\begin{array}{ccc} \pi_1 = 0 & \pi_2 = \pi & \pi_3 = 1 \\ \gamma_1 = \beta(1-\pi) & \gamma_2 = 1-\beta & \gamma_3 = \beta\pi \end{array}.$$

  - $s = 2$ is the i.i.d. state, $s \in \{1, 3\}$ represents correlated state.
  - π is the unconditional likelihood of shocks, β captures correlations.

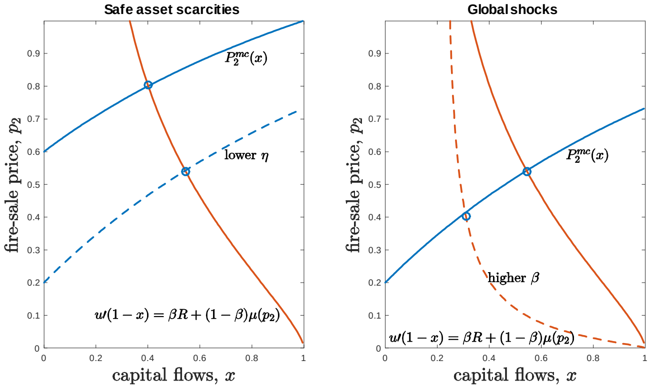
- We have $\mu_1(p_1) = \mu_3(p_3) = R$ and thus outflows satisfy,

$$u'(1-x) = E\left[\overline{R}_s M_s\right] = \beta R + (1-\beta)\mu_2(p_2).$$

- Equilibrium pair, (p_2, x), is found by solving this together with,

$$p_2 = P_2^{mc}(x) = \frac{\eta + x(1-\pi)R}{e + x(1-\pi)}.$$

- We explore safe asset scarcities (η) and global shocks (β)...



- Lower η (pre-GFC) increases x, reduces $p_2, p_3, E\left[\overline{R}_s\right], R_f$.
- Greater β (post-GFC) reduces $x, p_2, E\left[\overline{R}_s\right], R_f$. Less liquidity and worse fire sales even if the global shock is not realized.

Roadmap

The model with a special location

- Consider an infinitesimal special location with parameters (R^*, η^*).
- When $x^{in,*} > 0$, no-arbitrage (for foreign banks) implies,

$$1 = \sum_s \overline{R}_s^* q_s = \sum_s \overline{R}_s q_s, \text{ where } \overline{R}_s^* = (1 - \pi_s) R^* + \pi_s p_s^*.$$

- Local banks choose c_0^* and $l_s^* = x^{out,*} \overline{R}_s + y^* + z_s^* - \eta^*$. Optimality:

$$\frac{q_s}{\gamma_s} = \frac{M_s^*}{u'(c_0^*)} = \frac{M_s}{u'(c_0)}, \text{ where } M_s^* = 1 - \pi_s + \pi_s \frac{R^*}{p_s^*}.$$

- Local asset prices satisfy (when $\lambda \to \infty$),

$$p_s^* = \frac{\eta^* + l_s^*}{e + x^{in,*}}.$$

- **Proposition:** There exists an equilibrium, $x^{in,*}, c_0, (l_s^*)_s, (p_s^*)_s$.
- We define outflows as, $\overline{x}^{out,*} = \sum_s q_s l_s^* = 1 - c_0^*$.

Reach-for-safety flows are a mixed bag for stability

- First suppose $R^* = R$, analyze $\eta^* \neq \eta$. Autarky: $p_s^* = \min\left(R, \frac{\eta^*}{e}\right)$.
- **Proposition:** Suppose $\eta^* > eR > \eta$ (e.g., the U.S.). With free flows:
  - Same fire-sale prices as regular locations, $p_s^* = p_s < R$,
  - Greater inflows than outflows,

$$x^{in,*} = x + (e + x)(\Lambda - 1) > \overline{x}^{out,*} = x$$

  - Riskier (more leveraged) outflows than other locations,

$$l_s^* = \underbrace{x\overline{R}_s\Lambda}_{\text{makes leveraged investment in risky assets}} - \overbrace{(\eta^* - \eta\Lambda)}^{\text{sells safe assets}},$$

  where $\Lambda = \frac{x+q_f\eta^*}{x+q_f\eta} > 1$ denotes the leverage ratio of outflows.
- Destabilizing flows for locations with $\eta^* > eR$, stabilizing for $\eta^* < \eta$.
- Asset suppliers are "venture capitalists" as in Gourinchas-Rey (2007).

Reach-for-yields flows are destabilizing for receivers

- Now suppose $\eta^* = \eta$, analyze $R^* > R$ (high-yielding EMs).
- The equilibrium tuple, $\left(p_s^*\right)_s, c_0^*$, is determined by solving,

$$\sum_{s \in S} q_s \left(\left(1 - \pi_s\right) R^* + \pi_s p_s^* \right) = \sum_{s \in S} q_s \left(\left(1 - \pi_s\right) R + \pi_s p_s \right), \quad (3)$$

$$\frac{1 - \pi_s + \pi_s \frac{R^*}{p_s^*}}{u'\left(c_0^*\right)} = \frac{1 - \pi_s + \pi_s \frac{R}{p_s}}{u'\left(c_0\right)} \text{ for each } s. \quad (4)$$

- **Proposition:** With free capital flows:
  - More severe fire-sales than regular locations, $p_s^*/p_s < 1$ for each s,
  - Precaution by purchasing insurance, p_s^*/p_s is strictly increasing in s,
  - Precaution by accumulating assets, but backfires, $x^{in,*} > \overline{x}^{out,*} > x$.

Conclusion: Fickle flows, retrenchment, and global liquidity

Model of flows to analyze fickleness vs diversification/retrenchment.

- **Retrenchment dominates fickleness**: Fickle flows mitigate crises.
- Regulating capital flows: Coordination is necessary since liquidity is a public good. Fickleness exacerbates the coordination problem.

Asymmetries generate other rationales for flows than diversification:

- **Reach for safety**: Safe asset-driven imbalances. Mixed bag.
- **Reach for yield:** Return-driven imbalances. Exacerbate crises.

Positive implications consistent with some recent trends in gross flows.

Long Appendix. In particular, see:

- Endogenize fickleness via Knightian uncertainty
- An alternative model with distress banks (closer to Kiyotaki-Moore / Holmstrom-Tirole)