# The Dollar and Global Financial Collapse

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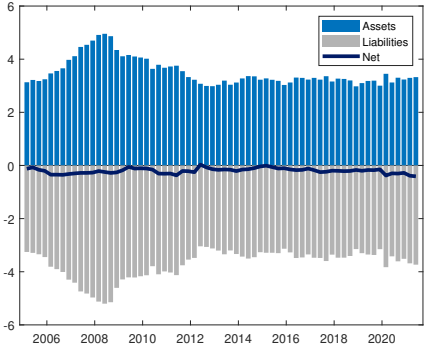
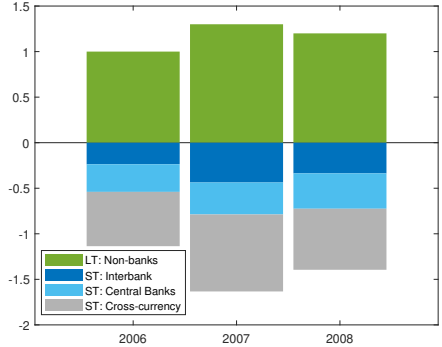
# Facts

1. Non-US global banks **borrow and invest** heavily in **dollars** ($\sim 14\%$ of portfolio)
2. Their short-term funding and long-term assets generate **dollar short-term needs**
3. During a crisis, the **dollar appreciates** and **liquidity shortages** arise.




Dollar assets and liabilities of EU banks ($ trillions)




Net dollar positions of EU banks, by counterparty ($ trillions)

More data

# Motivation

- All banks struggle during a crisis, but especially non-US global banks
  - Why? No easy access to $ from the Fed or stable deposits
- Problem can become **global** (large holdings of US assets by global banks)
- Triggered a **massive Fed intervention (Swap Lines)**
  - $> 500$$bn Swap Lines outstanding, during GFC and Covid-19
  - $> 14$ central banks benefited
  - Fed acting as the **international lender of last resort (ILOLR)**

By country

# This Project

- **Questions**
  - Why are the Fed's swap lines needed and what are their **macro implications**?
  - Are the **incentives of the US** aligned with the rest of the world?
- **Approach:** Stylized and tractable model of the global economy around the GFC
  - Self-fulfilling crises (Bocola & Lorenzoni, 20) + Global Banks (Gabaix & Maggiori, 15)
  - **New:** maturity mismatches in $ in AE + international spillovers
- **Contribution**
  - Macro implications of swap lines and the **Fed as ILOLR**. Bahaj and Reis (21), Cesa-Bianchi et al. (23).
  - Framework to think about $ ↑ during a global crisis. Kekre & Lenel (22), Maggiori (17), Gourinchas et al. (17)

Literature

# Sketch of the model

# Ingredients

- Two countries (EU, US (*)). $t \in \{1, 2\}$
- 1 Tradable good and 1 Non-Tradable (numéraire) in each country.
  - **Exchange rate** $e_t$: quantity of *euros* bought by one *dollar*: $\uparrow e_t \equiv \uparrow \$$
  - Law of one price: $e_t p_t^* = p_t$
- **Agents:** EU and US Households, Global Banks (EU-owned)

# Households

- Endowments of T and NT in both periods.
- EU receive $\Pi$ from banks in $t = 2$.

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- EU receive $\Pi$ from banks in $t = 2$.
- US access to **bonds $B^*$ in dollars** paying $R^*$. EU access to **bonds $B$ in euros** paying $R$.
- US hold preexisting \$ deposits $L^*$ with global banks.

# Banks

- Start $t = 1$ with pre-existing positions *(from Facts 1 & 2)*:
  - **Short-term $ liabilities** $L^*$ to be repaid in $t = 1$
  - **Long-term assets** in $ and in €, with gross returns $A^*$ and $A$ in $t = 2$
- Roll-over $L^*$ with $B$ and $B^*$ bonds to obtain profits $\Pi$ in $t = 2 \quad \Rightarrow \quad R = R^* \dfrac{e_2}{e_1}$ (UIP)

# Banks

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- **Financial friction:** can divert a fraction $\gamma < 1$ of the funds they intermediate, $B + e_1 B^*$.

$$\frac{\Pi}{R} \geq \gamma(B + e_1 B^*) = \gamma e_1 L^* \qquad \text{(IC)}$$

- If households do not provide the funds to roll-over their debt, banks **go bankrupt**.

Liquidation implies: $A^*, A \longrightarrow 0$ and $L^* \longrightarrow 0 \implies \Pi = 0$

# Self-fulfilling crises

# State of the economy: the ER matters

- Using $\Pi$, UIP and roll-over needs, banks operate if:

$$\underbrace{e_1 \frac{A^*}{R^*} + \frac{A}{R}}_{\text{Discounted gross profits}} \geq \underbrace{(1+\gamma) e_1 L^*}_{\text{Roll-over needs + funds at risk}} \qquad \text{(IC)}$$

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- Focus on the case with \$ solvency **but \$ liquidity shortages**:

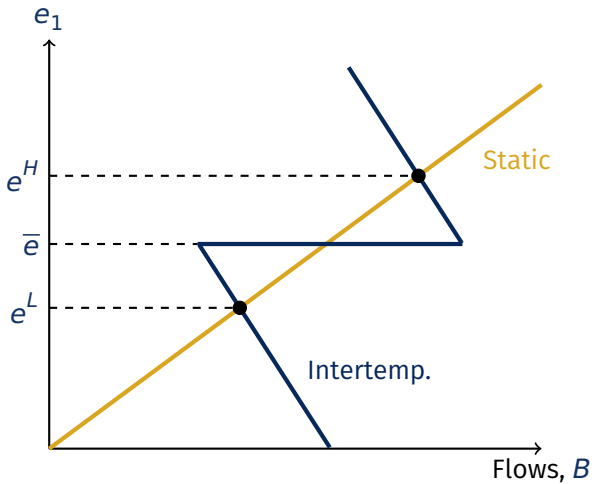
$$\frac{A^*}{R^*} - L^* > 0 \qquad \frac{A^*}{R^*} - (1+\gamma) L^* < 0$$

↑ \$ tightens financial constraint

- Define $\overline{e}$ as the $e_1$ that makes the IC hold with equality. Then,
  - If $e_1 < \overline{e}$: **Banks operate** $\Rightarrow \Pi > 0$, investment materializes.
  - If $e_1 > \overline{e}$: **Banks collapse** $\Rightarrow \Pi = 0$, investment is lost.

# Multiple Equilibria

## Capital Flows and Exchange Rate



# Multiple Equilibria

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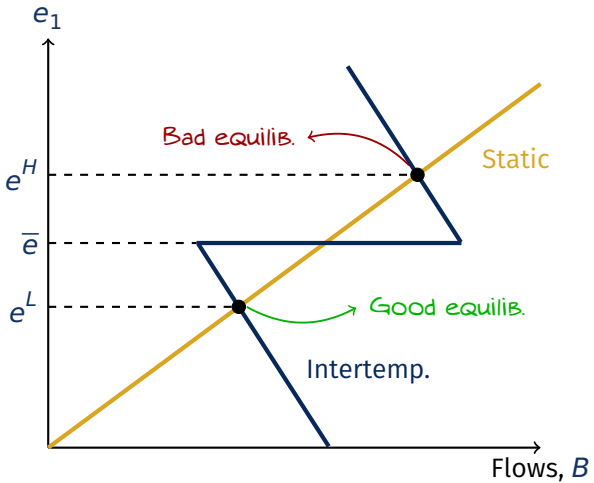

# Self-fulfilling crises

- "Bad" equilibrium (with $e^H$) resembles a **global financial crisis:**

  i) dollar appreciation
  ii) global banks struggling
  iii) ↓ EU Agg. Demand
  iv) ↑ net capital flows to the US

**Self-fulfilling mechanism** defines the equilibrium:

# Numerical example

**Table** Parameter values

| Variable | Description | Value | Notes |
|---|---|---|---|
| $\theta, \theta^*$ | NT preference | 0.9 | G&M (2015) |
| $\beta, \beta^*$ | Discount factors | 0.985 | G&M (2015) |
| $\eta_t$ | EU % T endowm. | [0.45,0.5] | Data |
| $\gamma$ | Financial friction | 0.38 | Multiple Eq. |

For this example: $A^* = .05$, $L^* = .04$, $A = .11$, $L = .075$, $Y_1^N = 2.62$, $Y_1^{*N} = 2.55$, $Y_2^N = Y_2^{*N} = 2.5$.

**Table** Targeted variables

| Variable | Description | Target | Model |
|---|---|---|---|
| $\frac{A^*}{A^* + Y_2^{*N}}$ | US output loss | 2.2% | 2.1% |
| $\frac{A}{A + Y_2^N}$ | EU output loss | 1.8% | 4.3% |
| $\frac{e^H - e^L}{e^L}$ | ER depreciation | 12.5% | 12.6% |
| | \$ shortage (%) | 15% | 15% |
| $R^*$ | US interest rate | 1.013 | 1.013 |
| $R$ | EU interest rate | 1.015 | 1.015 |

# Lending of Last Resort

# Intervention by the ECB

- **Main idea:** Central Bank can rule out the pessimistic expectations, if it commits to provide the required liquidity to banks, **even if the ER is high.**
- Follow Bocola & Lorenzoni (2020): CB transfers NT goods to banks, financed with linear taxes $\tau$ on households' NT endowment, $Y^N$.

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- Follow Bocola & Lorenzoni (2020): CB transfers NT goods to banks, financed with linear taxes $\tau$ on households' NT endowment, $Y^N$.
- ECB transfers euros to cover banks' \$ liquidity needs,

$$\underbrace{\tau \cdot Y^N}_{\text{Transfer}} = \underbrace{e_1 \cdot L^*}_{\text{\$ debt}} = f(e_1)$$

- Assume **limited fiscal/monetary capacity:** $\tau < \overline{\tau}$. Intervention is **not feasible** if

$$\underbrace{\overline{\tau} \cdot Y^N}_{\substack{\text{Max} \\ \text{Transfer}}} \quad < \quad \underbrace{e_1^H \cdot L^*}_{\substack{\text{\$ debt} \\ \text{during crisis}}}$$

Liq. operations

# Intervention by the ECB

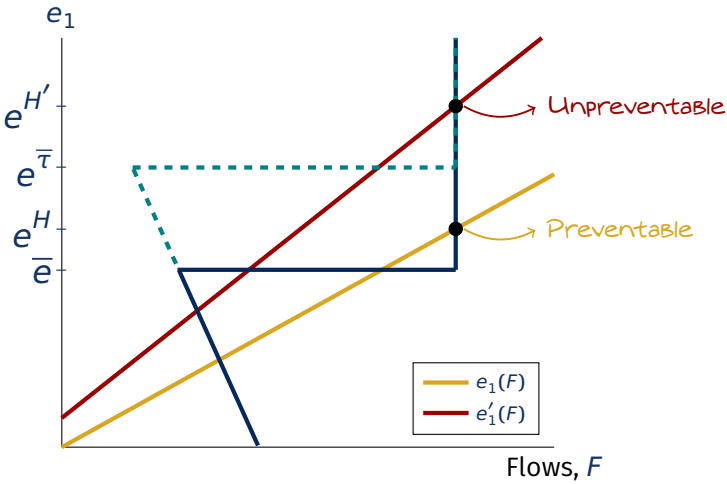


**Figure** Intervention by ECB

# Intervention by the Fed (Swap Lines)

- Similar intervention, but with tax on US HH. Same **limited fiscal capacity:** $\tau^* < \overline{\tau}$.
- Fed transfers \$ to cover banks' \$ liabilities,

$$\tau^* Y^{*N} = L^* \neq f(e_1)$$

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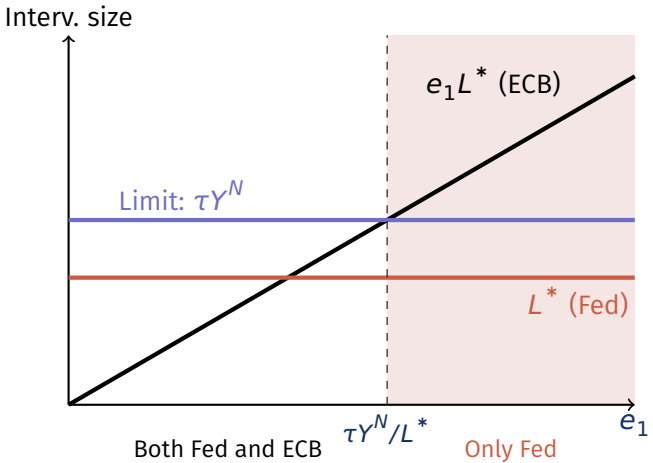
**Take away**

- *Assume* $Y^N = Y^{*N}$. ***Only the Fed can eliminate the "bad" equilibrium*** *if*

$$\underbrace{e_1^H L^*}_{\substack{\text{Liq. needs} \\ \text{in euros}}} > \underbrace{\overline{\tau} Y^N}_{\substack{\text{Maximum} \\ \text{intervention}}} > \underbrace{L^*}_{\substack{\text{Liq. needs} \\ \text{in dollars}}}$$

# Intervention by the Fed (Swap Lines)

**Figure** Intervention by Fed and ECB



# Winners and Losers

- Consequences of a collapse:
  - Loss of productive investment projects $A^*$ and $A$ (US and EU NT goods in $t = 2$)
  - Loss of EU loses banks' profits $\Pi$ and $L^*$ (not repaid)

1. NT sector: both countries lose, $\downarrow C_2^{*N}$ and $\downarrow C_2^N$

2. T sector: **US consumes more** and **EU less**, $\uparrow C_t^{*T}$ and $\downarrow C_t^T$
   - Global crisis $\Rightarrow \uparrow$ capital flows to the US and stronger dollar
   - Relative prices in US go down, $\uparrow e_t = \uparrow \dfrac{p_t}{p_t^*}$

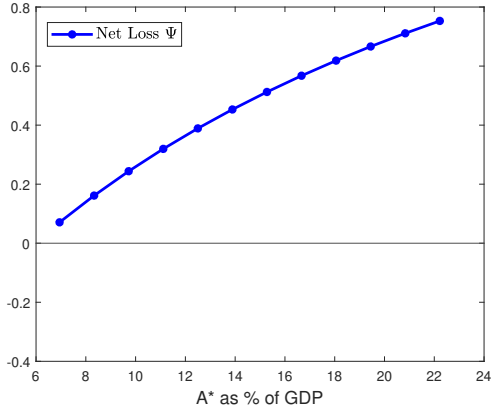
- **EU impacted negatively** (always) but **US faces a trade-off**

Full expressions

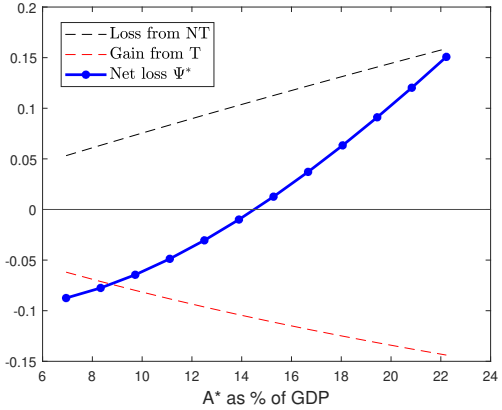
# Winners and Losers

## Welfare losses as a function of $A^*$

**(a)** For the EU




**(b)** For the US



# Conclusions

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- **Self-fulfilling expectations** about the exchange rate can lead to **global financial crises** due to the exposure of large global banks to dollar shortages.
- **Foreign CBs can do little** to eliminate bad equilibrium (e.g. € weaker during a crisis)
- **Fed** can provide $ liquidity, but **faces a trade-off**
  - During a crisis, US households can benefit from a stronger dollar...
  - ...but they lose investments in productive US assets if banks collapse

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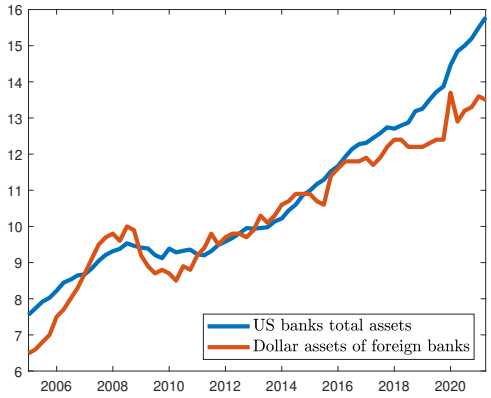
- **Foreign CBs can do little** to eliminate bad equilibrium (e.g. € weaker during a crisis)
- **Fed** can provide $ liquidity, but **faces a trade-off**
  - During a crisis, US households can benefit from a stronger dollar...
  - ...but they lose investments in productive US assets if banks collapse
- Also in the paper
  - How can these imbalances arise?
  - Moral Hazard problem: Fed vs ECB vs Global Banks

# Thank you!

# More data

Back

- Non-US global banks have a large footprint in dollar banking.




Dollar cross-border foreign currency claims
and US banks' total assets ($ trillions)

# More data

Back

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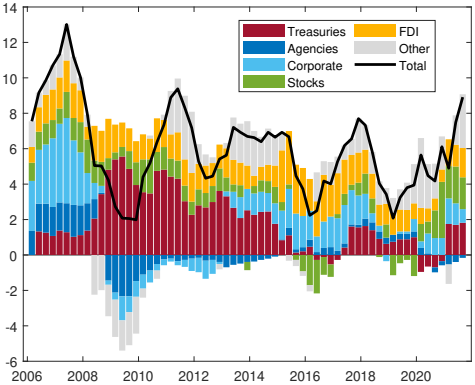
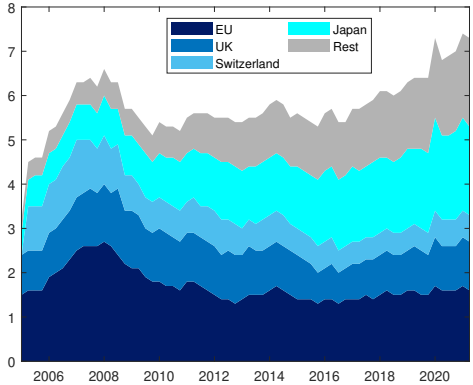



Purchases of US assets by foreigners (% of GDP)

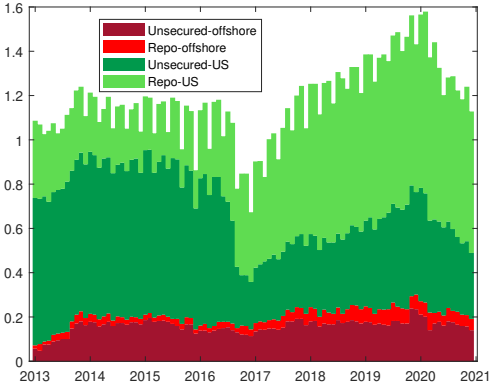



Foreign claims on US counterparties ($ trillions)

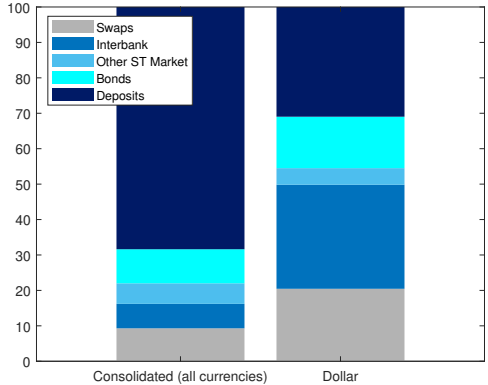
# More data

Back

- Dollar funding of non-US global banks is short-term and fragile.




Money Market Funds funding ($ trillions)




Funding Structure of non-US global banks, 2017 (%)

# US prime money funds' assets, mid-2008

Back

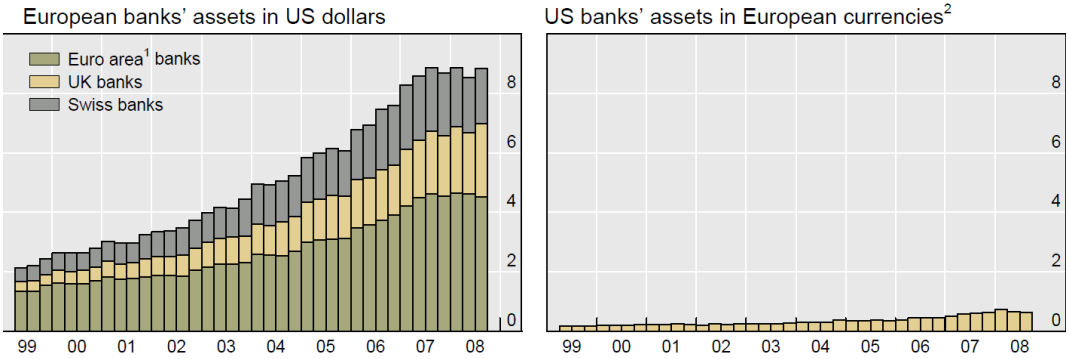
| Fund | Non-US banks (%) | EU banks (%) | Net assets ($ bill.) |
|---|---|---|---|
| Fidelity Cash Reserves | 63 | 51 | 128 |
| JPMorgan Prime Money Market | 67 | 62 | 120 |
| Vanguar Prime Money Market | 33 | 24 | 106 |
| BlackRock Liquidity Temp | 51 | 47 | 68 |
| Reserve Primary | 43 | 37 | 65 |
| Schwab Value Advantage | 54 | 40 | 61 |
| GS FS Prime Obligations | 0 | 0 | 56 |
| Dreyfus Inst Cash Advantage | 62 | 51 | 49 |
| Fidelity Inst Money Market | 61 | 54 | 47 |
| Morgan Stanley Inst Liq Prime | 37 | 37 | 34 |
| Dreyfus Cash Management | 70 | 56 | 33 |
| AIM STIT Liquid Assets | 57 | 45 | 32 |
| Barclays Inst Money Market | 24 | 19 | 31 |
| Merrill Lynch Premier Inst Portfolio | 60 | 51 | 26 |
| Fidelity Inst MM: Prime | 56 | 47 | 21 |
| Total | 50 | 42 | 878 |

Source. Baba et al. (2009) .

# Why Swap Lines now?

Back

## Asymmetry in international banking




[1] Includes Austria, Belgium, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain. [2] Euro, pound sterling and Swiss franc. Pound sterling covers only US banks' UK offices; Swiss franc covers only US banks' Swiss offices.

Sources: BIS consolidated statistics (immediate borrower basis); BIS locational statistics by nationality. Graph 1

# Swap Lines

Back

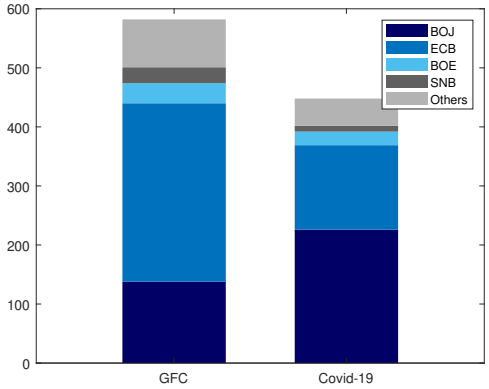
*"The Swap Lines are designed to improve liquidity conditions in dollar funding markets in the US and abroad [...] during times of stress. They have helped to ease strains in financial markets and mitigate their effects on economic conditions."*
(Federal Open Market Committee)

Central banks + Add to myFT

## Central banks announce dollar liquidity measures to ease banking crisis

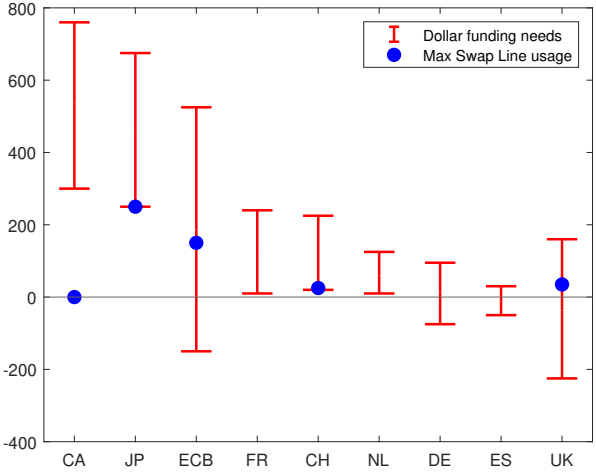
Turmoil prompts authorities to launch daily operations to access dollar funding via standing swap lines

**Colby Smith** in Washington and **Martin Arnold** in Frankfurt MARCH 19 2023 193




Outstanding Swap Lines usage (US$ billions)

# Who used the Swap Lines?

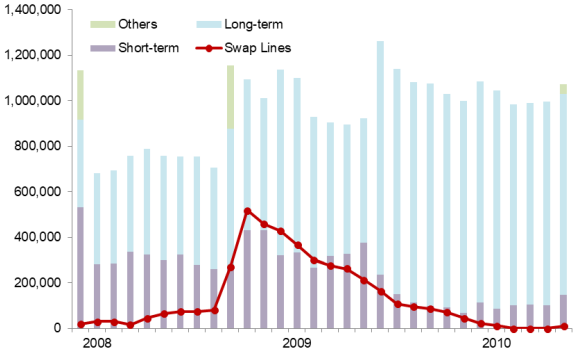



Short-term funding needs and central bank swap lines, by banking system (USD bn)

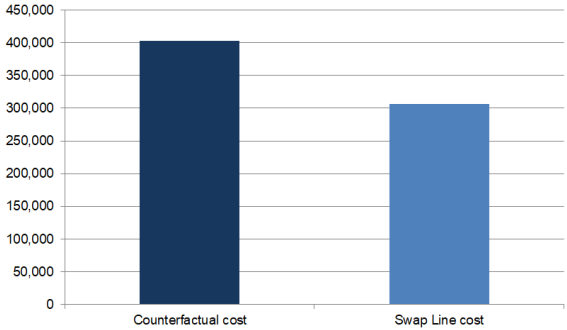
# Is this relevant in magnitude?

Back

**(a)** Liquidity injections by the ECB outstanding, USD millions




**(b)** Interest payments of the ECB on Dollar loans in 2008-2009, USD millions




- Swap Lines equivalent to 40% of the ECB euro liquidity injection at the peak of the GFC.
- Over 2008-2009, the ECB/EU-Banks would have had to spend an additional $100 billion.

# Related work

Back

- **Self-fulfilling crises.** Calvo (1988), Schmitt-Grohé & Uribe (2016), Obstfeld (1996), Cole & Kehoe (2000), Céspedes et al. (2017), Aguiar et al. (2017), Farhi & Maggiori (2018), Bocola & Lorenzoni (2020).
- **Role of the US and the dollar** in the international monetary system. Farhi & Maggiori (2018), Maggiori (2017), Gourinchas, Rey, & Govillot (2018), Kekre and Lenel (2021), Cesa-Bianchi & Eguren-Martin (2021), Obstfeld & Zhou (2022).
- **Empirical work on Swap Lines:** effective in easing strains in dollar funding markets. Baba & Packer (2009), Aizenman & Pasricha (2010), Moessner & Allen (2013), Aizenman et al. (2021), Bahaj & Reis (2020), Goldberg & Ravazzolo (2022), Ferrara et al. (2022).
- **Theoretical work on Swap Lines.** Bahaj & Reis (2022), Eguren-Martin (2020), Marin (2022), Cesa-Bianchi et al. (forth.)

# Optimality conditions

- EU FOCs:

Euler: $p_{t+1}C_{t+1}^{T} = \beta R_t p_t C_t^{T}$

NT demand: $C_t^{N} = \frac{\theta}{1-\theta} p_t C_t^{T}$

- US FOCs:

Euler: $p_{t+1}^{*} C_{t+1}^{*T} = \beta^{*} R_t^{*} p_t^{*} C_t^{*T}$

NT demand: $C_t^{*N} = \frac{\theta^{*}}{1-\theta^{*}} p_t^{*} C_t^{*T}$

# Equilibrium depends on fundamentals

Back

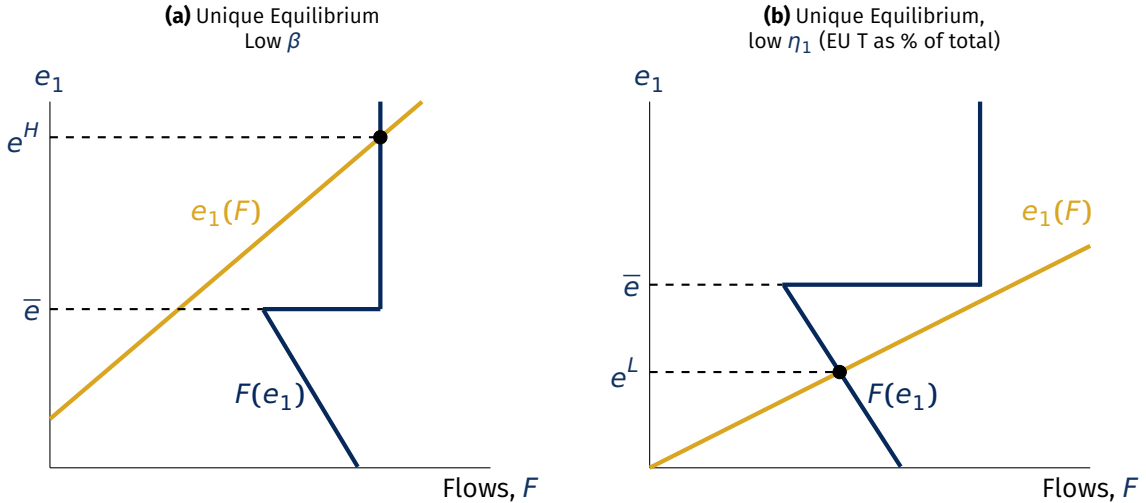



**Figure** Exchange rate and Capital Flows

# Multiple equilibria

Back

**When can they arise?**

- Bad eq:

$$e_1^H = \frac{1-\eta}{\eta}$$

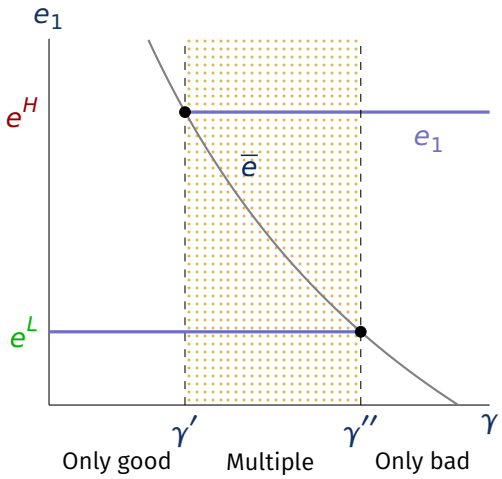
- Good eq:

$$e_1^L = \frac{1-\eta}{\eta + \frac{\theta}{1-\theta}\frac{1}{1+\beta}\left(\frac{1}{R^*}A^* - L^*\right)}$$

- Threshold:

$$\overline{e} \equiv \frac{A/R}{(1+\gamma)L^* - A^*/R^*}$$

**Figure** Equilibrium exchange rate and financial constraint $\gamma$



# Multiple equilibria

Back

- Exchange rates in equilibrium

$$\text{Good eq.}: \quad e_1^L = \frac{1-\eta}{\eta + \frac{\theta}{1-\theta}\frac{1}{1+\beta}\left(\frac{1}{R^*}A^* - L^*\right)}$$

$$\text{Bad eq.}: \quad e_1^H = \frac{1-\eta}{\eta}$$

$$\text{Threshold}: \quad \overline{e} \equiv \frac{A/R}{(1+\gamma)L^* - A^*/R^*}$$

- Different scenarios arise,

$$\overline{e} < e^L < e^H \quad \text{: only bad eq. possible}$$

$$e^L < \overline{e} < e^H \quad \textbf{: multiple equilibria}$$

$$e^L < e^H < \overline{e} \quad \text{: only good eq. possible}$$

# Comparative Statics

**Drop in $A^*$ (USD assets) or increase in $L^*$ (USD liabilities)**

**Figure** State of the economy

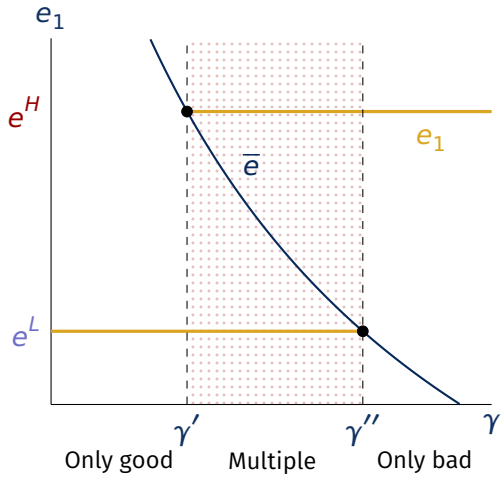
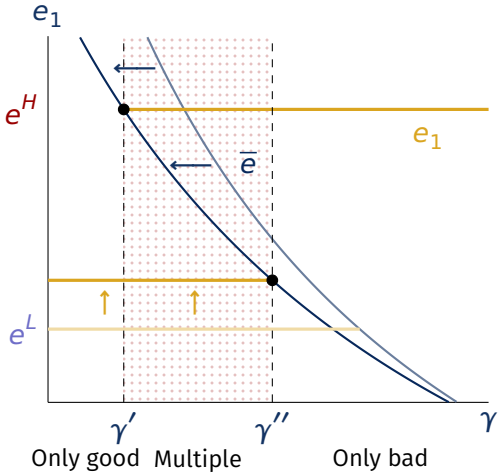
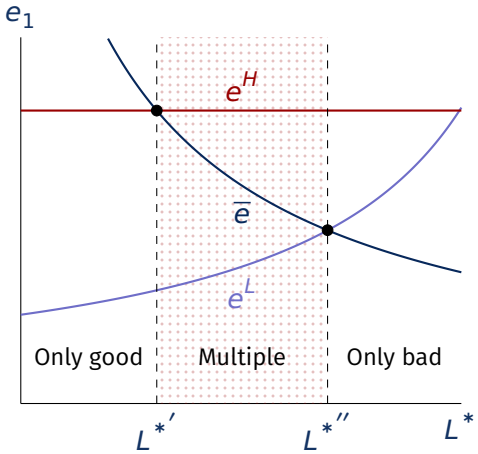



**Figure** State of the economy after drop in $A^*$ or increase in $L^*$

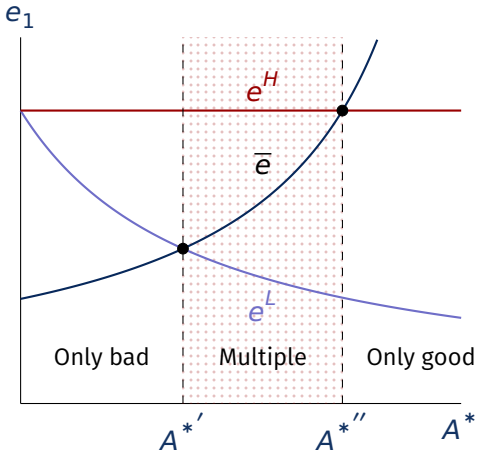


# Comparative Statics

**(a)** State of the economy and dollar liabilities $L^*$




**(b)** State of the economy and US assets $A^*$



# Lending of Last Resort - ECB

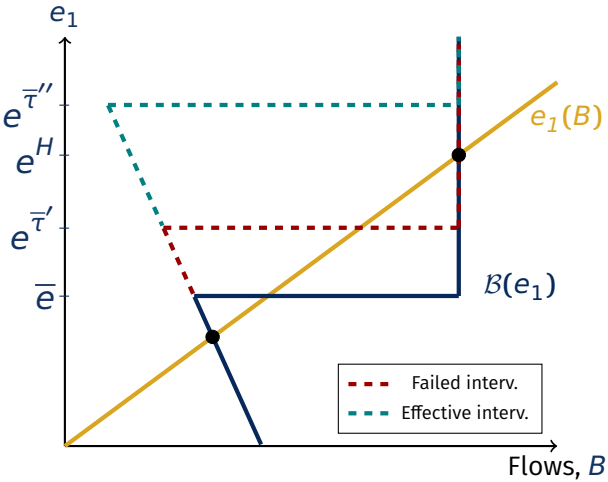
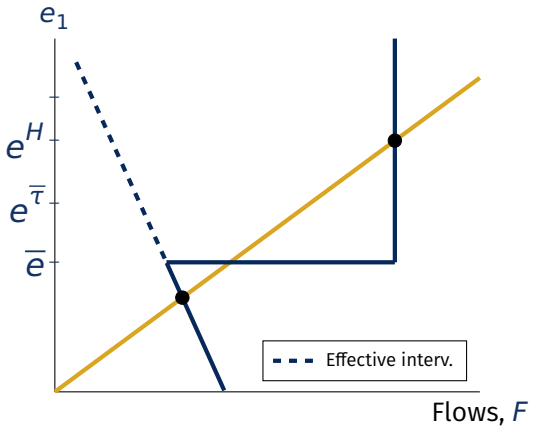


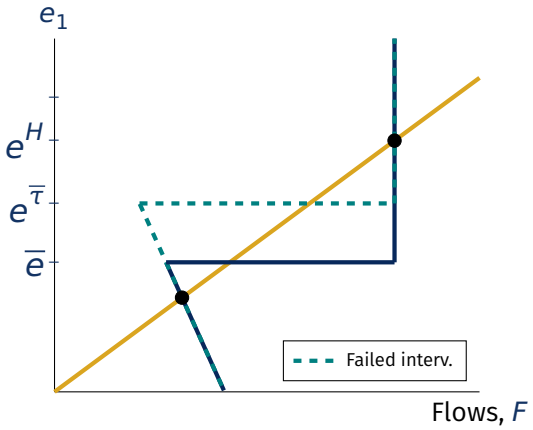

**Figure** Interventions with $\overline{\tau}' < \overline{\tau}''$

# Fed Swap Lines if $\tau > \overline{\tau} > \tau^*$

**(a)** Intervention by the Fed when $\overline{\tau} > \tau^*$




**(b)** Intervention by the ECB when $\tau > \overline{\tau}$



# Winners and Losers

Back

- US Welfare losses from the crisis

$$U_L^* - U_H^* = \theta\beta^* \ln\left(\frac{A^* + Y_2^{*N}}{Y_2^{*N}}\right) - (1-\theta)\left[\ln\left(\frac{C_{H,1}^{*T}}{C_{L,1}^{*T}}\right) + \beta^* \ln\left(\frac{C_{H,2}^{*T}}{C_{L,2}^{*T}}\right)\right]$$

- In the collapse scenario: $C_{H,t}^{*T} = Y_t^{*T}$ for $t = 1, 2$. So the focus is on $C_{L,t}^{*T}$,

$$C_{L,1}^{*T} = (Y_1^T + Y_1^{*T})\frac{e_1^L}{1 + e_1^L} \qquad C_{L,2}^{*T} = (Y_2^T + Y_2^{*T})\frac{e_1^L}{\beta/\beta^* + e_1^L}$$

- **Analysis of $A^*$:** if $\uparrow A^*$, then $\downarrow e_1^L$ and thus $\downarrow C_{L,t}^{*T}$. Opposite forces on welfare losses
  - Increases the first term ($\uparrow NT$ consumption), but also the second one ($\downarrow T$ consumption)

# Extensions

# Nominal version (w/ monetary policy)

- EU consumption basket now includes **real money balances**, $M_t/P_t$

$$C_t \equiv \left[ (C_t^N)^{\theta} (C_t^T)^{\phi} (M_t/P_t)^{\omega} \right]$$

$M_t$ is the amount of money held by the HH, and $P_t$ is the nominal price level.

- Budget constraint

$$\sum_{t=1}^{2} R^{-t} (p_t^N Y_t^N + p_t^T Y_t^T + M_t^S) = \sum_{t=1}^{2} R^{-t} (p_t^N C_t^N + p_t^T C_t^T + M_t)$$

$M_t^S$ is the seigniorage rebated lump sum by the government. Equal to $M_t$ in equilibrium.

# Nominal version (w/ monetary policy)

- Static optimization (US)

$$\frac{M_t^*}{\omega} \equiv m_t^* = p_t^{*N} C_t^{*N} \frac{1}{\theta} = p_t^{*T} C_t^{*T} \frac{1}{\phi}$$

- **Euler equation**: interest rate $R_t^*$ now depends on **current and future money supply**

$$\mathbb{E}(m_{t+1}^*) = m_t^* \beta R_t^*$$

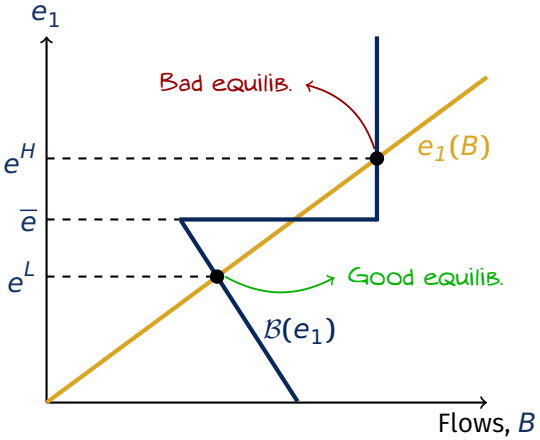
- **US MP tightening** in $t$ pushes the global economy closer to the **bad equilibrium**: $\downarrow m_t^* \Rightarrow \uparrow R^* \Rightarrow \downarrow \overline{e}$

$$\downarrow \overline{e} = \frac{A/R}{(1+\gamma)L^* - A^*/\uparrow R^*}$$

# Access to Dollar Bonds

- **Two problems** with standard framework:
  1. Multiple eq. require the US running a **positive** *CA* **balance** in "normal" times.
  2. When global banks collapse, economy converges to **autarky**.
- **How to fix it?** EU households can trade dollar bonds with US HH, **but at a cost.**
  - By correcting 2), possible to correct 1).

**Figure** Multiple Equilibria



# Access to Dollar Bonds

- EU households face a more complex problem,

$$\max_{C_t} U = \ln(C_1) + \beta \mathbb{E} \ln(C_2) - \zeta(\widetilde{B})$$

- Budget constraint

$$p_1 Y_1^T + Y_1^N = p_1 C_1^T + C_1^N + B + e_1 \widetilde{B}$$
$$\Pi + RB + e_2 R^* \widetilde{B} + p_2 Y_2^T + Y_2^N = p_2 C_2^T + C_2^N$$

- Access to euro deposits with banks $B$ paying $R$, and to dollar bonds with US HH, $\widetilde{B}$ paying $R^*$. Holding balances in foreign currency entails a small non-pecuniary cost:

$$\zeta(\widetilde{B}) = \begin{cases} \chi & \text{if } \widetilde{B} \neq 0 \\ 0 & \text{otherwise} \end{cases}, \qquad \chi > 0$$

# Access to Dollar Bonds

- In normal times, $\tilde{B}$ are not used. EU households prefer to save in euro bonds given UIP and the extra cost of saving in dollars.
  - Only when **banks collapse**, EU households rely on the **costly dollar bonds**.
- What I need is that **EU runs a trade balance surplus in "normal" times**

$$P_1(Y_1^T - C_1^T) = B > 0$$

- This is achieved by a **weak euro in** $t = 1$

$$e_1^L > \frac{1-\eta_1}{\eta_1} = \frac{Y_1^{*T}}{Y_1^T}$$

- If that holds, then also $e_1^H > e_1^L$: EU TB is larger when collapse.

# Access to Dollar Bonds

- In equilibrium, the exchange rate is

$$e_1^L = \frac{1-\eta_1+\beta(1-\eta_2)}{\eta_1+\beta^*\eta_2+\frac{\theta}{1-\theta}\left(A^*/R^*-L^*\right)}$$

- So that in terms of the parameters, the condition is

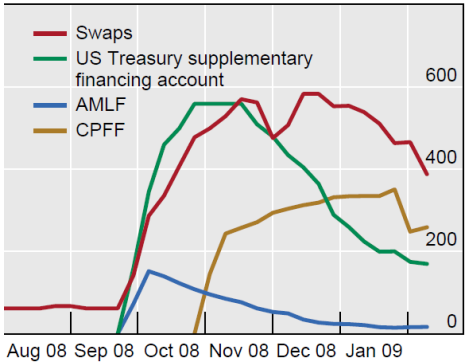
$$\frac{\eta_1}{1-\eta_1}\beta(1-\eta_2)-\eta_2\beta^* > \frac{\theta}{1-\theta}\left(\frac{A^*}{A^*+Y_2^{*N}}\beta^* Y_1^{*N}-L^*\right)$$

- **Many possibilities** to achieve this:
  - Low $\beta^*$: US is impatient.
  - High $\eta_1$: EU has lots of $T$ in $t=1$.
  - Low $\eta_2$: but small share of $T$ in $t=2$.
  - High $L^*$: US has a lot saved, so want to consume today.
  - Low $A^*$: US require less savings because output in $t=2$ is low.

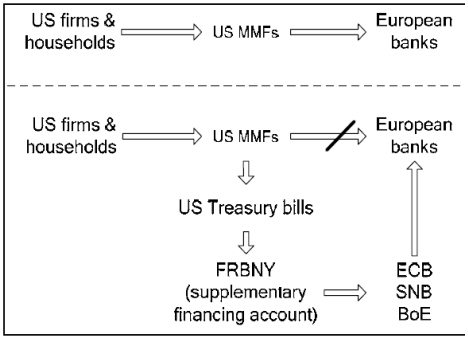
# Fed liquidity and official reintermediation

Back

Federal Reserve liquidity operations[1]




Official reintermediation of US dollar credit to non-US banks




[1] Outstanding amounts, in billions of US dollars; Wednesday observations.

Source. Baba, McCauley and Ramaswamy (2009)