# Crises in the Modern Financial Ecosystem

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# Motivation

- Banking/financial regulation and financial stability.
- Conceptual framework for market-based financial intermediation.
- Financial crises, manifestation of real economy developments.

# This paper/outline of the talk

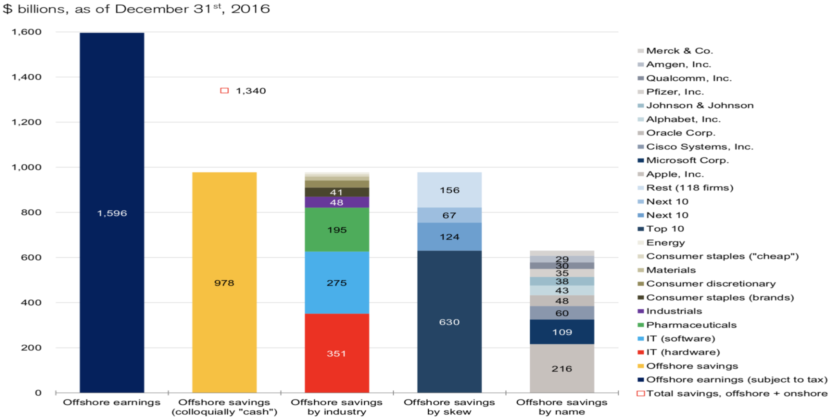
1. Market-based intermediation evolves to accommodate *transformations* of the financial ecosystem.
    - **Institutional savers**, in need for "parking space".
    - **Institutional investors**, in need for returns.
2. Incorporate these concepts into a theoretical model:
    - How these transformations affect *systemic risk*-taking.
    - Post-crisis *reforms* and new sources of systemic risk.

# Institutional savers: Who they are

Examples:

- Treasurers of multinational corporations.
- FX reserve mangers.
- Central liquidity desk of large asset managers.

# Example: Multinational corporations




Offshore earnings and savings by the largest 150 US non-financial firms, breakdown by industry and name.

# Institutional savers

*Real economy roots*:

- Arbitrage of global tax regimes.
- Capital vs labor share: technological progress.
- Global imbalances: large savers inhabit economies with less sophisticated financial markets.

*What do they do*:

- A decade ago: mainly institutional cash pools.
- After the crisis: Size (*you can't run trillions the way you run billions*) and global QEs (ultra-low yields) force them to morph into bond portfolios.

# Institutional investors: Who they are

Examples:

- Life-insurance companies offering products with guaranteed returns.
- Defined-benefits pensions.

# Institutional investors

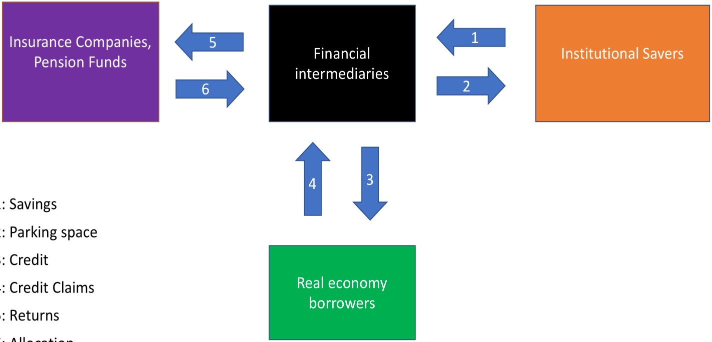
*Why are they reaching for yield*:

- Long-term liabilities expressed in fixed nominal amounts.
- Disappointing market returns on traditional portfolios.
- Real economy drivers include population ageing, savings glut and large appetite for US dollar-denominated assets.

*What do they do*:

- A decade ago: mainly "alternative" investments (e.g. allocation to hedge funds,...).
- After the crisis: more synthetic leverage, more direct credit exposures.

# Simplified conceptual framework




1: Savings

2: Parking space

3: Credit

4: Credit Claims

5: Returns

6: Allocation

# Relationship with the literature

- General approach to demand and supply of liquidity of Holmström-Tirole (2011).
- Shadow banking as intermediation mechanism (Farhi and Tirole 2017).
- Shadow banking and risk-taking (e.g. Gennaioli et al. 2013).
- Financial innovations as a liquification technology (Gorton and Metrick 2012).
- Discussions on the modern financial ecosystem (e.g. Pozsar 2014, 2015) and on real economy roots of financial developments (e.g. Bernanke's savings glut and Summers' secular stagnation).

# Baseline framework

- 2-period model à la Holmström-Tirole (1998, 2011).
- Three dates: 0,1,2.
- Single good used for consumption and investment.
- All contracts must be backed by pledgeable claims on real assets.
- Limited pledgeability (informational frictions).

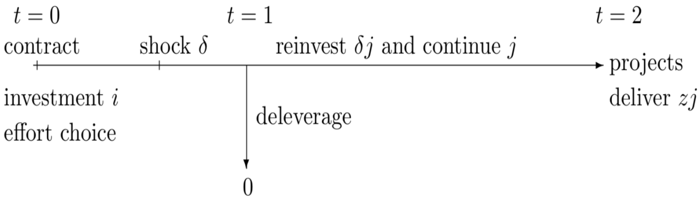
# Agents

- (Financial intermediaries, shortly) **Bankers**:
  - Initial equity $A$.
  - Protected by limited liability.
  - Borrow and invest in projects at $t = 0$.
- **Households**:
  - Large endowment at each date.
  - Access to a storage technology.
- (Institutional savers, shortly) **Firms**:
  - Endowment $Y_f$ at $t = 0$
  - Dislike consumption at $t = 0$ and no storage technology.
  - Can invest in a finite amount $T$ of productive projects.
  - When $Y^f > T$, they lend $Y_f - T$.
  - (Assumption: do not borrow).

# Investment technology

- **Projects**: invest 1 at $t = 0$, get $Z$ if success, 0 if failure at $t = 2$.
- **Moral hazard**: prob of success depends on the effort of the agent (banker):
  - High effort: prob of success is $q$.
  - Low effort: prob of success is 0, private benefits $b$.
- (define: $z \equiv qZ$) **Pledgeability**: $\rho_0 \equiv z - b$.

# Aggregate liquidity shock at $t = 1$




- Prob $1 - \alpha$: aggregate liquidity shock (**crisis**); $\delta$ must be reinvested for each unit to be brought to completion.
- Claims on projects' future returns can be pledged to meet the reinvestment need ($j \leq i$: continuation scale).
- Continuation requires $\ell \geq \delta$, where $\ell$ is the pledgeability of the claims in a crisis, aka **liquidity**.

# Two types of projects

- **Low risk projects**:
  - Expected return: $z$
  - Moral hazard: $b$
  - Pledgeability: $\rho_0 \equiv z - b$
  - Liquidity: $\ell \geq \delta$ in a crisis.
- **High risk projects**:
  - Expected return: $z^r$
  - Moral hazard: $b^r$
  - Pledgeability: $\rho_0^r \equiv z^r - b^r$
  - Liquidity: $\ell^r$ in a crisis.

Assumptions:

1. $z^r > z$
2. $\rho_0^r > \rho_0$
3. $\ell^r < \delta$

# The banker's problem

Maxime **utility**

$$\max_{i^r, i} \; \alpha[z^r i^r + zi] + (1-\alpha)[(z^r - \delta)j^r + (z - \delta)j] - R(i^r + i)$$

subject to

a **borrowing constraint**:

$$R(i^r + i - A) \leq \alpha[\rho_0^r i^r + \rho_0 i] + (1-\alpha)[(\rho_0^r - \delta)j^r + (\rho_0 - \delta)j].$$

and **liquidity constraints**:

$$j^r = 0; \; j = i$$

Lagrangian is linear, the banker either invests in low-risk projects or in high-risk ones.

# The banker's choice

- Utility from investing in high-risk projects:

$$u_b^r = (\alpha z^r - R) i^r$$

with

$$i^r = \frac{A}{1 - \alpha \rho_0^r / R}$$

- Utility from investing in low-risk projects:

$$u_b = [z - (1 - \alpha)\delta - R]\, i$$

with

$$i = \frac{A}{1 - \alpha \rho_0 / R}$$

# Optimal choice

- High-risk projects: Higher leverage and per-unit return, but return zero in a crisis (full deleverage).
- Low-risk projects: Lower leverage and per-unit return, but brought to completion in all states of nature.

**Result**

*Bankers invest in high-risk projects when the cost of leverage R is low enough:*

$$R < \bar{R} \equiv \frac{\alpha}{1-\alpha}(\rho_0^r - \alpha\rho_0)$$

**Intuition**. Banker's utility is a combination of leverage (investment scale) and insurance against the liquidity shock (continuation scale).

## Competitive equilibrium

Two cases:

1. Firms do not save: Bankers borrow only from households.
2. Firms need to save: Bankers borrow (also) from firms.

Bankers' cost of leverage $R$ is decreasing in the firms' savings $Y^f - T$:

$$R = 1 - (1 - \beta)\frac{\max[Y_f - T, 0]}{i^r + i - A}$$

**Result**

*The higher the firms' savings, the lower $R$, the higher the bankers' incentives to invest in high-risk projects.*

# Take home messages, part I

- Equilibrium (output and output volatility) is affected by:
  - Availability of investment opportunities to firms (rise of institutional savers).
  - Initial distribution of wealth among households, firms and bankers.
  - Bankers' technology to liquefy credit claims ($\sim$ financial innovation).

# ICPFs and the need for returns

- Insurance companies and pensions funds (ICPFs) with endowment $A_p$ at $t = 0$
- Must repay at least $\bar{C}_p$ to their clients at $t = 2$ (let $C_p$ be their assets at $t = 2$).
- ICPFs maximize utility:

$$u_p = \begin{cases} C_p - \bar{C}_p & \text{if} \quad C_p \geq \bar{C}_p \\ -M & \text{if} \quad C_p < \bar{C}_p \end{cases} \tag{1}$$

- Let $\bar{c}_p \equiv \bar{C}_p / A_p \sim$ required return.
- ICPFs allocate $A_p$ to bankers with the mandate to invest in high or low risk projects, paying a fee $w$.

# ICPFs and the need for returns

**Result**

*ICPFs allocate to high-risk projects if the (leverage-enhanced) return of low risk projects in a crisis is low enough:*

$$\bar{c}_p > \frac{z - \delta - R}{1 - \alpha\rho_0/R} - w$$

**Intuition.** When low-risk projects fail to deliver the required return in a crisis, ICPFs seek to maximize the return in the no crisis state, and allocate to high-risk projects.

# Take home messages, part II

- ICPFs naturally dislike high-risk projects (return zero in a crisis, $u_p = -M$).
- But, when required return is high (as compared to projects' productivity), ICPFs allocate to low-risk projects only if leverage is cheap.
- When allocation is aimed at meeting a fixed return target, leverage and liquidity risk become substitute.
- Either ICFPs access cheap leverage and lever low-risk assets up, or they seek to invest in high-risk assets.

# Authority with a financial stability mandate

- No externality in the model.
- Assume there is a public authority with a financial stability mandate: no deleveraging at the equilibrium.
- First evaluate policy measures in the context with bankers, households and firms, then in the extended version with ICPFs.

# Leverage Ratio

- $LR \equiv i_{LR}/A$, with $i_{LR} = \frac{\rho_0^r - \alpha\rho}{\rho_0^r - \rho} A$
- Banker's utility is a combination of investment scale (leverage) and continuation scale (insurance).
- When investment scale is capped, the banker exhausts borrowing capacity by boosting continuation scale, i.e. invest in low-risk projects.

# Sovereign bonds

- Introduce sovereign bonds to investigate the effects of liquidity regulation and public parking space.
- The authority issues sovereign bonds $X$ at $t = 0$ backed by the promise to tax households at future dates.
- Sovereign bonds cost 1 at $t = 0$ and repay $R_X \in [\beta, 1]$ at $t = 1$.

# Liquidity regulation

- Bankers are required to purchase $x \equiv \delta / R_X$ sovereign bonds for each unit invested in high-risk projects.
- Sovereign bonds are liquid in all states of nature and can be used in a crisis to raise funds, accommodate the reinvestment need and bring high-risk projects to completion.
- But, LCR particularly costly to bankers when firms are in need for parking space, as they bid aggressively for sovereign bonds $R_X = \beta$.
- $i_{LCR} = \frac{A}{1+\delta\left(\frac{1}{\beta}-\frac{\alpha}{R}\right)-\frac{\alpha\rho_0^r}{R}}$

# Public parking space

- Sovereign bonds represent parking space to institutional savers and compete with the parking space supplied by bankers.
- $X$ is usually set according to exogenous fiscal policy considerations.
- Central banks with large sovereign bonds holdings can repo out sov bonds ($\sim$ Fed RRP accessible to nonbank counterparts), thereby expanding sovereign bonds availability to institutional savers.
- The higher $X$ the higher the cost of leverage for bankers.
- $X_{pps} = Y_f - T - (i_{pps} - A)\bar{R}$.

# Addendum: US tax reform

- Before the reform: 35% tax was due on offshore earnings in the case of repatriation (offshore savings $\sim$ $1 trillion invested in corporate bonds, Treasuries and agency securities).
- The reform, Jan 1, 2018: (8% or 15.5%) taxes have to be paid whether earnings are repatriated or not. No more incentives to retain earnings offshore.
- Effects:
  - *Dismantling bond portfolios* (firms' asset side). Over the next 8 years, the pace will be dictated by the type of trade to be funded (M&As, paying dividends, stock and debt buybacks).
  - *Roll-back of funding strategies*. US firms have been issuing bonds onshore and using the proceeds to pay dividends and share buybacks (firms' liabilities side).
- In the model: lower demand for parking space.

# Policies and ICPFs

- Let $R^*$ be the cost of leverage and $R_X$ the return of sovereign bonds.
- ICPFs can allocate to high- and low-risk projects and also purchase sovereign bonds.
- Bankers' leverage (equity multiplier) is capped by regulation and must be lower than $1/\lambda$ (higher $\lambda$ stands for tighter regulatory constraints)
- Continuum of ICPFs, heterogeneous wrt $\bar{c}_p$

# Equilibrium allocations

**Result**

*Optimal portfolio:*

- *Low-risk projects for* $\bar{c}_p \leq \frac{z-\delta-R^*}{\lambda} - w$
- *Sovereign bonds for* $\bar{c}_p \in (\frac{z-\delta-R^*}{\lambda} - w, R_X]$
- *High-risk projects for* $\bar{c}_p > \max[R_X, \frac{z-\delta-R^*}{\lambda} - w]$

# Side-effects of banks' regulation

- Fraction of ICPFs investing in high-risk projects is decreasing in $R_X$ and increasing in $\lambda$.
- Tight liquidity ($\sim$ low $R_X$) and leverage ($\sim$ high $\lambda$) regulations have "ambiguous" financial stability implications.

# Pre-crisis

- The environment:
  - High demand for parking space, relatively low supply of public parking space: low $R^*$ and $R_X$
  - Low $\lambda$: "softer" regulation and buoyant market valuation of $\rho_0^r$.
- The equilibrium
  - ICPFs with smaller $\bar{c}_p$ allocate to low-risk projects and sov bonds
  - Bankers (prop trading) and ICPFs with larger $\bar{c}_p$ allocate to high-risk projects.

# Post-crisis

- The environment:
  - Larger public parking space (more T-bills, RRP), ultra low $R_X$ (global QEs and liq reg).
  - High $\lambda$: tight regulation, low $\rho_0^r$.
  - Looking forward: lower demand for parking space from US global corporations (US tax reform).
- The equilibrium
  - Low-risk projects less attractive.
  - Synthetic leverage (consume less dealers' balance sheet).
  - Global banks/dealers less popular (low $\lambda$, high $w$).
  - Asset managers operating at lower $w$ (e.g. ETFs) more popular.
  - More direct (unlevered) exposures to more and more illiquid and credit risky assets (loans, infrastructures, EMs).

# Conclusions

- Intermediation mechanism evolves to accommodate needs that originate from outside the financial sphere.
- In recent decades, these demands and needs have caused deep **transformations** in the financial ecosystem.
- These transformations mirror real economy **developments** on a global scale.
- Embracing this view sheds a different light on **policies** aimed at safeguarding financial stability.
- Financial stability implications from different kinds of **imbalances**.