Risk-Taking Dynamics and Financial Stability
An Evolutionary Perspective

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Motivation:

- Traditional focus of macroprudential research: factors behind booms and busts for financial sector as a whole
  - e.g. sector-wide/aggregate distortions like exuberance, agency problems, externalities, ...

- This paper: focus instead on composition of the financial sector
  - booms and busts accompanied by growth and demise of high risk-takers
  - examples in 2000s: Countrywide, WaMu, AIG Fin Services, ...
Key Contributions

- **Composition of financial sector** matters for macro phenomena:
  - drives pro-cyclicality: during booms, high risk-takers take over
  - captures important aspect of Minsky’s financial instability hypothesis

- **Novel dynamic selection effects of policy intervention:**
  - stem from evolutionary forces rather than optimizing behavior
  - neglected in traditional (rep. agent) analysis
    → role for non-conventional policy measures, e.g.:
      - growth limits, stress tests, ...
    → novel adverse selection effects of bailouts
    → ...

Related Literature

- **Role of net worth in financial sector**, e.g. Gertler-Kiyotaki (2010), Gertler-Karadi (2011), Brunnermeier-Sannikov (2014), ...
  → we introduce heterogeneity in financial sector

- **Net worth dynamics of heterogeneous agents**, e.g. beliefs (Blume and Easley, 1992; Geanakoplos, 2009; Burnside et al., 2015), preferences (Borovicka, 2015), ...
  → we focus on financial sector and impact of financial policy
    (most closely related: Coimbra and Rey, 2017)

- **Booms and busts**, e.g. Minsky (1986), Kiyotaki-Moore (1997), ...
  → we provide a novel, complementary explanation
Baseline setup

- \( i = 1 \ldots N \) types of bankers with log preferences

\[
U_i = \sum \beta^t \mathbb{E} \left[ \log c_{it} \right]
\]

unit mass of agents each with initial endowment \( k_{i0} \)

- Each type chooses from a set of investment strategies each period
  - a strategy \( S_{it} \) delivers stochastic return \( \tilde{R} (S_{it}) \)
  - return depends on aggregate state of nature \( \omega \in \Omega \), independent over time

- Different interpretations for set of investment strategies:
  - different leverage strategies: \( \tilde{R} (S_{it} = x) = xr + (1 - x) \tilde{R}_t \)
  - differences in diversification: \( \tilde{R} (S_{it} = \{\alpha_j\}) = \sum_j \alpha_{ij} \tilde{Q}_{jt} \)
    
    note: \( \alpha_{ii} \geq \bar{\alpha} \) may capture agency frictions that require minimum investment in its own project \( \tilde{Q}_i \)

- Extensions (later): differences in beliefs \( \mathbb{E}_i \left[ \cdot \right] \), discount factors \( \beta_i \)
Optimization Problem

\[
\max_{c_{it}, k_{it}, S_{it} \in \mathcal{S}_i} \mathbb{E} \left[ \sum_t \beta^t \log c_{it} \right] \quad \text{s.t.} \quad c_{it} + k_{it+1} = \tilde{R}_t(S_{it}) k_{it}
\]

Lemma (Optimal Strategy under Laissez-Faire)

- *investment strategy* \( S_{it} \) *is time-invariant, independent of wealth and maximizes geometric mean return*

\[
S_i = \arg \max_{S_i \in \mathcal{S}_i} \mathbb{E} \left[ \log \tilde{R}(S_i) \right]
\]

- *law-of-motion for type \( i \) capital with growth factor* \( \tilde{G}_{it} = \beta \tilde{R}_t(S_i) \)

\[
k_{it+1} = \tilde{G}_{it} k_{it}
\]

- *unless there is complete risk-sharing, capital shares of different types fluctuate over booms and busts*

in vector notation: \( k_{t+1} = \tilde{G}_t k_t \)
Example of two-state economy $\omega \in \{L, H\}$ with $E \left[ \log \tilde{R} (S_i^*) \right] = \tilde{R}$

Example (Volatility and Procyclicality in Two-State Economy)

**Volatility**: The more risky the wealth distribution of bankers, the greater the $n$-period-ahead volatility of aggregate wealth.

**Pro-cyclicality**: The more positive shocks the economy experiences,
- the greater the $n$-period-ahead volatility of aggregate wealth and
- the greater the loss from a negative shock.

→ Minsky’s financial instability hypothesis
→ Observation: capital shares $\kappa_{it} = k_{it}/\sum_i k_{it}$ fluctuate pro-cyclically
Simulation 1: Volatility and Procyclicality

- Capital positions $k_{it}$
- Aggregate capital $K_t$
- Fraction of the risky type $\kappa_t$

First-Best

Planner allocates capital and consumption and picks strategies $\forall t$ to solve

$$\max_{\kappa_{it}, c_{it}, S_{it}} \sum_{i=1}^{N} \sum_{t=1}^{\infty} \theta_i \beta^t E[\log c_{it}]$$

Proposition (First Best)

1. Planner chooses time-invariant capital shares $\kappa^*_i$ and investment strategies $S^*_i$
2. Optimal capital shares $\kappa^*_i$ equate risk-adjusted returns for all $i$,

$$E \left[ \lambda^* \tilde{R}(S_i) \right] = c \forall i \tag{1}$$

where social marginal utility $\lambda^* \simeq 1/ \sum \kappa^*_i \tilde{R}(S^*_i)$ is time-invariant
3. Economic growth is a.s. faster than in the decentralized economy.

Note: first best solves [static] portfolio allocation problem
- overcomes the imperfections in risk markets
- social marginal utility $\lambda$ more stable than private $\lambda_i$ captures benefits of diversification
Simulation 1’: Dynamics of First-Best Capital Allocation

Capital positions $k_{it}$

Aggregate capital $K_t$

Fraction of the risky type $\kappa_t$


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Constrained Planning Problem

Planner who respects internal capital accumulation $k_{it+1} = G_{it}k_{it}$

Proposition (Constrained optimum in private ownership economy)

1. Planner chooses time-varying investment strategies $S_{it} \in \mathcal{S}_i$ that are counter-cyclical and satisfy

$$E \left[ \lambda_t \tilde{R}'(S_{it}) \right] = 0 \forall i \tag{2}$$

since social marginal utility $\lambda_t \simeq 1/\sum \kappa_{it} \tilde{R}(S_{it})$ is time-varying

2. Economic growth is a.s. in between decentralized economy and first-best.

Note:

- social pricing kernel $\lambda_t$ more risk-averse (risk-loving) if more capital held by risky (safe) types
- may justify both taxes and subsidies on strategies such as leverage, diversification etc.
Proposition (Effects of Financial Regulation)

Restricting risk-taking in a given period $t$ leads to:

- a **static effect** on period $t$ volatility from restricting the choice set and
- a **dynamic selection effect** from changing the wealth composition in all future periods, which
  - reduces volatility if the period $t$ shock is positive
  - increases volatility if the period $t$ shock is negative

→ the dynamic effect of regulation is inherently counter-cyclical

Role for unconventional policy instruments:

- limits on growth
- stress tests
- ...

Korinek and Nowak (2018)
Proposition (Effects of Government Policies)

Any government policy that differentially affects different risk types has dynamic selection effects.

Examples:

- support for home ownership among low-income individuals:
  → selects for institutions specializing in subprime

- bailouts: usually occur after high risk-takers make large losses
  → select for high-risk strategies

- monetary policy: low interest rates select for high-leverage strategies
  → “risk-taking channel” of monetary policy
Capital Reallocations

Reallocations of capital among different types:

- allows for richer dynamics than purely internal net worth accumulation
- captured by transition matrix $M = (m_{ij})$, where $m_{ij}$ is fraction of type $i$ capital reallocated to type $j$ each period
- (Vector) law of motion $k_{t+1} = MG_t k_t$

Interpretations:

1. changes in type of a given financial institution
   - via change in management, personnel, internal decision-makers, information, ...
2. changes in set of financial institutions who are operating
   - via mergers, take-overs, firm entry and exit
3. reallocations due to public policy actions
4. (more broadly) reallocations of internal funds by external investors
Capital Reallocation

Examples:
- symmetric reallocation: $M$ non-stochastic and symmetric
- momentum: reallocates towards recent winners
- reversal: reallocates towards recent losers

Proposition (Effects of Capital Reallocation)

A small amount of reallocation that is

(i) symmetric: increases the growth rate of the economy a.s.

(ii) momentum-based: reduces the growth rate of the economy a.s.

(iii) reversal-based: increases the growth rate of the economy a.s.
Simulation 2: Symmetric Reallocation


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Extension to capture spillovers to the real economy

- Unit mass of workers:
  - same (log) utility as bankers
  - supply one unit of labor
  - live hand-to-mouth so \( c_t = w_t \),

- after shock realization, capital \( k'_{it} \) lent to real economy for production

\[
y_{it} = A k'_{it}^{\alpha} \ell_{it}^{1-\alpha}
\]

- Equilibrium wage satisfies \( w_t = (1 - \alpha)AK'_t \)
Spillovers to the Real Economy

Observe: Workers care about stable supply of risk capital

Proposition (Spillovers)

1. Aggregate bank capital creates spillovers to the real economy.
2. The results on (a) procyclicality and (b) optimal capital allocation continue to hold.

Role of Financial Regulation:

→ ensure stable supply of capital to the real economy
→ desirable to stabilize capital shares of different investment technologies
→ output and wages less volatile
→ output and wages on average higher
Bailouts

- workers benefit from providing bailout transfers to bankers when capital falls below a threshold $\hat{K}$

Proposition (Bailouts and Natural Selection)

The introduction of lump-sum bailouts

- increases the fraction of capital controlled by high risk-types
- allows for long-run survival of inferior risk types (that would otherwise go extinct)
Conclusions

- Heterogeneity in risk exposure creates novel channel that drives the riskiness of the aggregate economy
- Pro-cyclicality
- Policy interventions have dynamic selection effects
  - Question: which financial institutions will benefit?
- Role for smoothing cycles – in both directions