Risk-Taking Dynamics and Financial Stability

Anton Korinek (JHU and NBER)   Martin Nowak (Harvard PED)

First Annual ECB Macroprudential Policy and Research Conference

Frankfurt, Germany

April 2016

Motivation

- Crisis of 2008/09 has catapulted concerns about financial instability and financial policies to the top of the macroeconomic policy agenda
- Important strand of research: study factors behind booms and busts
  - e.g. sector-wide/aggregate distortions like exuberance, agency problems, externalities, ...

Motivation

- Crisis of 2008/09 has catapulted concerns about financial instability and financial policies to the top of the macroeconomic policy agenda
- Important strand of research: study factors behind booms and busts
  - e.g. sector-wide/aggregate distortions like exuberance, agency problems, externalities, ...
  - This paper: focus instead on *composition* of the financial sector
    - booms & busts accompanied by growth & demise of high risk-takers
    - examples in 2000s: Countrywide, WaMu, AIG Fin Services, ...

Key Considerations

- **Heterogeneity:** market participants differ
- **Incomplete markets:** risk-sharing limited by agency problems
- **Distribution of wealth:** drives aggregate risk-taking dynamics

Key Insights

- **Pro-cyclicality** – Minsky's financial instability hypothesis
- **Novel compositional effects** of public policy interventions
- **Leaning against the wind** improves welfare (in both directions)

Related Literature

- **Booms and busts** Minsky (1986), Kiyotaki-Moore (1997), ...
- **Dynamics with heterogeneous agents**, e.g. beliefs (Blume and Easley (1992), Geanakoplos, 2009, Burnside et al., 2015), preferences (Borovicka, 2015), ...
- **Macro externalities** Lorenzoni (2008), Jeanne-Korinek (2010), Farhi-Werning (2016), Korinek-Simsek (2016), ...

Baseline setup

- $i = 1...N$ types of bankers with log preferences

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

with a unit mass of agents each and initial endowment k_{i0}
$\rightarrow$ consume fraction $(1-\beta)$ of wealth k_{it} every period

Baseline setup

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

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

with a unit mass of agents each and initial endowment k_{i0}
$\rightarrow$ consume fraction $(1-\beta)$ of wealth k_{it} every period

- Each type has access to a set of investment strategies $\mathcal{S}^i$
  - each strategy $S^i \in \mathcal{S}^i$ delivers i.i.d. return
  - return depends on aggregate state of nature
  - optimal to maximize geometric mean return – denote by $\tilde{R}_{it}$

Baseline setup

- $i = 1 \dots N$ types of bankers with log preferences

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

with a unit mass of agents each and initial endowment k_{i0}
$\rightarrow$ consume fraction $(1-\beta)$ of wealth k_{it} every period

- Each type has access to a set of investment strategies $\mathcal{S}^i$
  - each strategy $S^i \in \mathcal{S}^i$ delivers i.i.d. return
  - return depends on aggregate state of nature
  - optimal to maximize geometric mean return – denote by $\tilde{R}_{it}$

- law-of-motion for type i capital:

$$k_{it+1} = \beta \tilde{R}_{it} k_{it}$$

Baseline setup

- $i = 1...N$ types of bankers with log preferences

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

  with a unit mass of agents each and initial endowment k_{i0}
  $\rightarrow$ consume fraction $(1-\beta)$ of wealth k_{it} every period

- Each type has access to a set of investment strategies $\mathcal{S}^i$
  - each strategy $S^i \in \mathcal{S}^i$ delivers i.i.d. return
  - return depends on aggregate state of nature
  - optimal to maximize geometric mean return – denote by $\tilde{R}_{it}$

- law-of-motion for type i capital:

$$k_{it+1} = \beta \tilde{R}_{it} k_{it}$$

Financial imperfections

Financial Imperfections:

1. **Equity market:** imperfect risk-sharing
2. **Credit market:** maximum leverage ratio

Financial imperfections

Financial Imperfections:

1. **Equity market:** imperfect risk-sharing
2. **Credit market:** maximum leverage ratio

Aggregate Dynamics 1

- capital allocation in vector notation:
  $k_t = (k_{1t}, ...k_{Nt})', \quad \tilde{R}_t = diag\left[\tilde{R}_{1t}, ...\tilde{R}_{Nt}\right], \quad \iota_N = (1, ...1)$
  w.l.o.g. assume types ordered by increasing return variance $Var(\tilde{R}_i)$

Aggregate Dynamics 1

- capital allocation in vector notation:
  $k_t = (k_{1t}, ...k_{Nt})'$, $\tilde{R}_t = diag\left[\tilde{R}_{1t}, ...\tilde{R}_{Nt}\right]$, $\iota_N = (1, ...1)$
  w.l.o.g. assume types ordered by increasing return variance $Var(\tilde{R}_i)$
- law-of-motion in vector format: $k_{t+1} = \beta \tilde{R}_t k_t$
- aggregate capital: $K_{t+1} = \iota_N \cdot k_{t+1} = \iota_N \cdot (\beta \tilde{R}_t k_t)$
- maximum geometric mean return in economy $\log \bar{R} = \max_i E\left[\log \tilde{R}_i\right]$

Aggregate Dynamics 1

- capital allocation in vector notation:
  $k_t = (k_{1t}, ...k_{Nt})'$, $\tilde{R}_t = diag\left[\tilde{R}_{1t}, ...\tilde{R}_{Nt}\right]$, $\iota_N = (1, ...1)$
  w.l.o.g. assume types ordered by increasing return variance $Var(\tilde{R}_i)$
- law-of-motion in vector format: $k_{t+1} = \beta \tilde{R}_t k_t$
- aggregate capital: $K_{t+1} = \iota_N \cdot k_{t+1} = \iota_N \cdot (\beta \tilde{R}_t k_t)$
- maximum geometric mean return in economy $\log \bar{R} = \max_i E\left[\log \tilde{R}_i\right]$

Lemma (Exclusion of Inferior Strategies)

Bankers who earn geometric mean return $E[\log \tilde{R}_j] < \log \bar{R}$ *will see*

$$\lim_{T\to\infty} k_{jT}/K_T = 0 \quad a.s.$$

Risk & Volatility

- **Definition 1: Increasing Risk:**
  allocation k_t is riskier than k'_t for $K_t = K'_t$ if
  $\sum_{0 \leq i \leq n} k_{it} \leq \sum_{0 \leq i \leq n} k'_{it} \forall n \in \{1, ...N\}$

Risk & Volatility

- **Definition 1: Increasing Risk:**
  allocation k_t is riskier than k'_t for $K_t = K'_t$ if $\sum_{0 \leq i \leq n} k_{it} \leq \sum_{0 \leq i \leq n} k'_{it} \forall n \in \{1, ...N\}$

- **Definition 2: Volatility:**
  n-period-ahead volatility $V_{t+n} = \frac{Std(K_{t+n})}{K_t}$

Volatility and Procyclicality

Proposition (Volatility and Procyclicality)

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

Pro-cylicality: *The more positive shocks the economy experiences,*

- *the greater the period-ahead volatility of aggregate wealth and*
- *the greater the loss from a negative shock.*

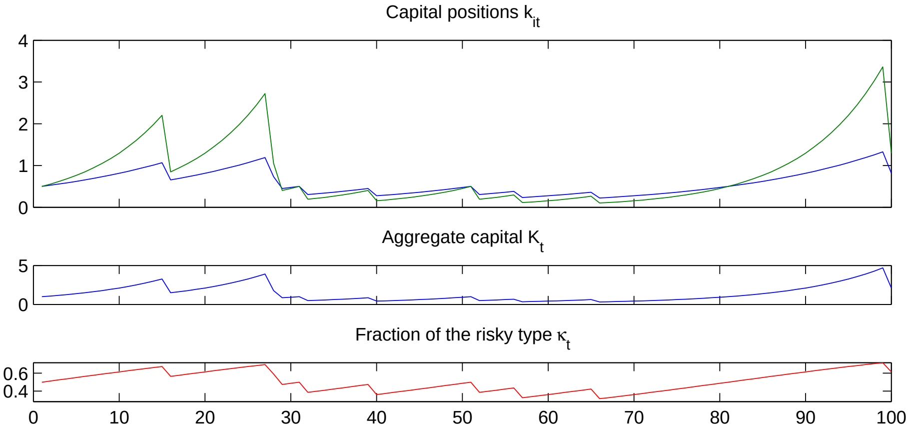
$\rightarrow$ Minsky's financial instability hypothesis

Example with Two States of Nature

- two types $i = 1, 2$ and two states $\omega \in \{L, H\}$
- identical geometric mean return $\bar{R}$ but different dispersion $s_1 < s_2$

$$\tilde{R}_i = \begin{cases} \bar{R}(1+s_i)^{-\frac{1}{p}} & \text{in low state } L \text{ (with prob. } p\text{)} \\ \bar{R}(1+s_i)^{\frac{1}{1-p}} & \text{in high state } H \text{ (with prob. } 1-p\text{)} \end{cases}$$

Simulation 1: Volatility and Procyclicality



Optimal Capital Allocation

- under laissez faire, capital shares $\kappa_{it} = k_{it}/K_t$ fluctuate pro-cyclically
  $\rightarrow$ is this optimal?

Optimal Capital Allocation

- under laissez faire, capital shares $\kappa_{it} = k_{it}/K_t$ fluctuate pro-cyclically $\rightarrow$ is this optimal?
- compare to capital allocation chosen by a social planner who
  - allocates capital among all technologies
  - allocates consumption to the agents of the economy

$$\max \sum_{i=1}^{N} \sum_{t=1}^{\infty} \lambda_i \beta^t E[\log c_{it}]$$

Optimal Capital Allocation

Proposition (Optimal Capital Allocation)

1. *The planner allocates constant shares κ_i^* to each strategy to solve*

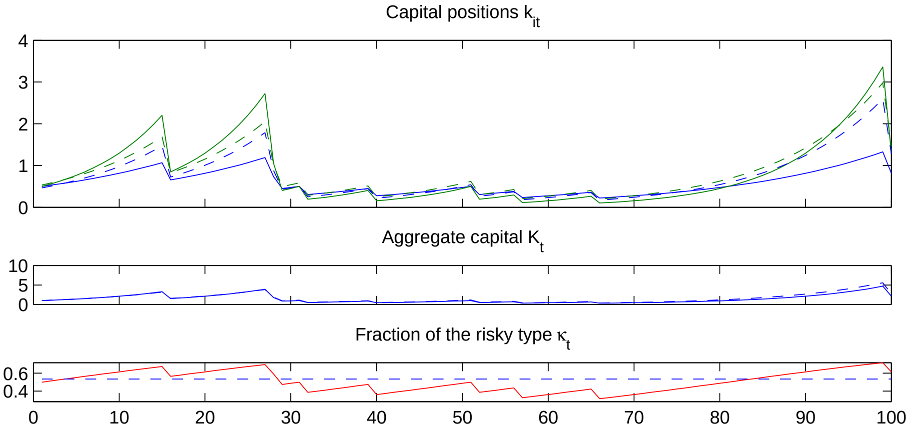
$$\max_{\kappa_i \in [0,1]} E\left[\log \sum_i \kappa_i \tilde{R}_i\right]$$

2. *Economic growth is a.s. faster than in the decentralized economy.*

Note:

- planner solves [static] portfolio allocation problem
- she overcomes the imperfections in risk markets

Simulation 1': Dynamics With Optimal Capital Allocation



Novel Effects of Financial Regulation

How do we implement a more stable capital allocation?

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 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*

$\rightarrow$ the dynamic effect of regulation is inherently counter-cyclical

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

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

Spillovers and bailouts

- $\exists \hat{K}$ such that workers benefit from providing one-way transfers to bankers
- assume transfers distributed in lump-sum fashion

Proposition (Bailouts and Natural Selection)

The introduction of 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)*

Idiosyncratic Shocks

Big theme in literature on firm heterogeneity: technological churning

Three interpretations in our setup:

1. change in set of investment opportunities for given bankers, e.g.:
   - random change in technology
   - change in management/personnel
   - merger, take-over, firm entry and exit
2. reallocation of capital between bankers by outside investors
3. reallocation via public policy

$\rightarrow$ for all three, implications captured by transition matrix $M = (m_{ij})$, where m_{ij} is fraction of capital of type i that is reallocated to type j

Law of motion under reallocation:

$$k_{t+1} = \beta M \tilde{R}_t k_t$$

Idiosyncratic Shocks

- Optimal reallocation captured by matrix $M^* = \begin{pmatrix} \kappa_1^* & \cdots & \kappa_1^* \\ \cdots & \cdots & \cdots \\ \kappa_N^* & \cdots & \kappa_N^* \end{pmatrix}$

  $\rightarrow$ implements planner's constant capital shares

- Symmetric churning (two types): $M^{sym} = \begin{pmatrix} 1-\mu & \mu \\ \mu & 1-\mu \end{pmatrix}$

Proposition (Symmetric Churning, Two Risk Types)

(i) Introducing a small churning rate $\mu > 0$ is desirable iif $\kappa_t < \min\{\kappa^*, 1/2\}$ or $\kappa_t > \max\{\kappa^*, 1/2\}$

(ii) The optimal churning rate is

$$\mu^*(\kappa_t) = \min\{\max\{0, \mu(\kappa_t)\}, 1\} \quad \textit{where} \quad \mu(\kappa_t) = \frac{\kappa_t - \kappa^*}{1 - 2\kappa_t}$$

Desirability of Random Churning

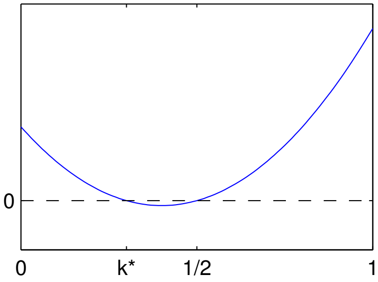
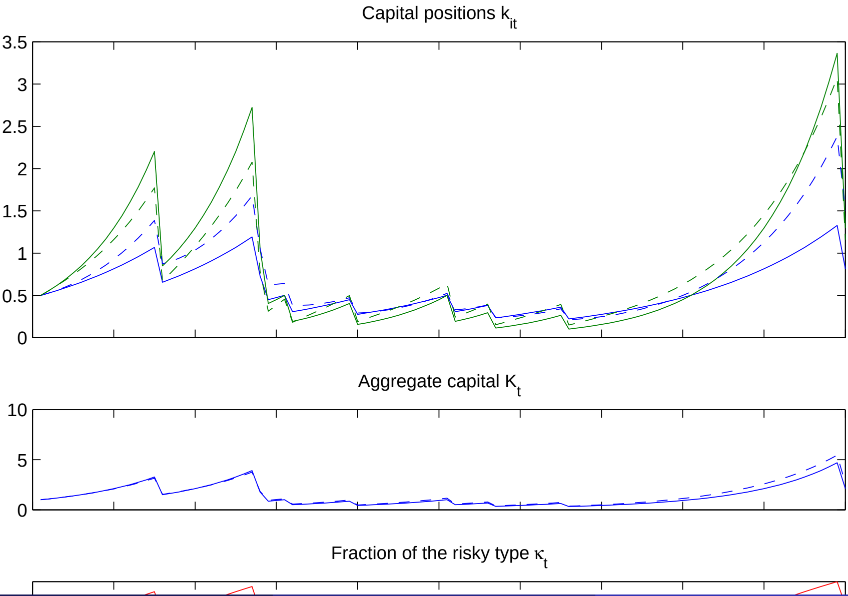


Figure: Desirability of introducing churning $\left.\frac{dE[\log K_{t+1}]}{d\mu}\right|_{\mu=0}$

Simulation 2: Random Churning



State-Dependent Idiosyncratic Shocks

- state-depent reallocation matrix $\tilde{M}_t$
- law-of-motion $k_{t+1} = \tilde{M}_t \tilde{R}_t k_t$

Definition (Momentum and Contrarian Reallocations)

Momentum: M^L is upper-triangular and M^H is lower-triangular
Contrarian: vice versa

Proposition (Contrarian Reallocation and Volatility)

For $\kappa_t \in \left[\kappa^L, \kappa^H\right]$, contrarian reallocation reduces period-ahead volatility V_{t+1} whereas momentum-based reallocation increases period-ahead volatility.

Conclusions

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