COLLECTIVE MORAL HAZARD, MATURITY MISMATCH AND SYSTEMIC BAILOUTS

November 12th, 2009

Emmanuel Farhi (Harvard)

and

Jean Tirole (TSE)

INTRODUCTION

- Two facts:
  1. Overall macroeconomic fragility (sensitivity to macro shocks):
     - wide-scale maturity mismatch
     - economywide exposure to refinancing risk
  2. Unprecedented bailouts (monetary, fiscal)
- This paper:
  - these two facts are related: leverage and the central banker's put
  - amplification mechanism: why crises are bad
  - implications for regulation

(1): Overall macroeconomic fragility

Leverage, refinancing risk

- Suprime borrowers:
  - monthly repayment for ARMs
  - ability to refinance
- Levered mortgage lenders financed on wholesale market
- Commercial banks have pledged substantial liquidity support to conduits (financed in short-term ABCP market)
- Investment banks have gained market share [investment banks rely on Repo and CP funding much more than commercial banks]
- Primary dealers' ratio of overnight to term borrowing has grown
- Others: LBOs, Money-market mutual funds

(2): Unprecedented interventions

- Example: Fed's balance sheet has tripled since 2007
- Interventions (bailouts)
  - monetary policy (interest rate policy)[nominal interest rate close to 0]
  - other
    - direct support to institutions [recapitalizations, purchase of CP, under-priced deposit insurance, debt guarantees]
    - support to asset prices [as planned in TARP I and II, Gheitner plan]

Key insight

- Time-inconsistency of policy
- Policy instruments imperfectly targeted [focus on interest rate policy in talk, see paper for optimal intervention]
- Private leverage / liquidity choices depend on anticipated policy reaction

$\Longrightarrow$ balance-sheet-risk choices are strategic complements.

- When everybody engages in maturity transformation
  - ex-post optimal for authorities to intervene
  - ex-ante optimal to adopt risky balance sheet

"As long as the music is playing, you have to get up and dance"
Charles Prince, CEO Citigroup, summer 2007

Related lit

- Time-inconsistency: Kydland-Prescott (1977), Barro-Gordon (1983)
- Liquidity: Woodford (1990), Holmström-Tirole (1998)
- Moral hazard problems with one bank: Bagehot (1873), Dewatripont-Tirole (1994), Mailath-Mestler (1994) and Freixas (1999)
- Strategic complementarities in macro: Diamond (1982), Cooper-John (1988), Morris-Shin (1998), Schneider-Tornell (2004), Ranciere-Tornell-Westermann (2008), Acharya-Yorulmazer (2007, 2008), Brown, Craig and Serdar Dinc (2009)
- More recent: Kahsyap-Rajan-Stein (2008), Diamond-Rajan (2009), Philippon-Schnabl (2009), Lorenzoni (2008), Korinek (2009)

I. MODEL

- Three periods: $t = 0, 1, 2$
- Two groups of mass 1: banking entrepreneurs and consumers
- *Consumers:*
  - preferences: $V = c_0 + u(c_1) + c_2$ with $c_0, c_1, c_2 \geq 0$
  - large endowments e_t
  - cannot pledge their future income
- *Two storage technologies:*
  - long-term: 1 at date 0 $\longrightarrow$ 1 at date 2
  - short term: 1 at date 1 $\longrightarrow$ 1 at date 2

- *Banking entrepreneurs*:
  - preferences: $U = c_0 + c_1 + c_2$ with $c_0, c_1, c_2 \geq 0$.
  - endowment: A at date 0.
- *Investment and outcomes*:
  - banks invest i at $t = 0$
  - intact (probability α) or distressed (probability $1 - \alpha$) at date 1
  - if distressed, 1-for-1 reinvestment need, can downsize to $j \in [0, i]$
  - perfect correlation [later: choice of correlation]
- *Value and pledgeable income*:

$$\rho_1 > 1 > \rho_0 \quad \text{per unit of investment.}$$

Central Bank / Authorities

- Objective function: $W = V + \beta U$ with $\beta \leq 1$, where β
  - how strategic sector is (credit, payment system)
  - how politically powerful sector is
- Instrument:
  - tax investment in (short term, for the moment) storage technology and rebate proceeds lump-sum to consumers
  - $\Longleftrightarrow$ *sets real interest rate* R between $t = 1$ and $t = 2 (R = 1$ without intervention)
  - rule out other forms of policy intervention (direct bailouts) for now

Comments

- Credit channel of monetary policy
- Only instrument = interest rate:
  - key: untargeted
  - amounts to assuming screening infinitely costly
  - ex: large fringe of agents/firms that can pretend to be distressed
- Distortion from monetary policy:
  - wedge between MRS and MRT
  - different from NK (dispersion in relative prices) $\longrightarrow$ monetary model?
- See paper $\longrightarrow$ explicit screening mechanism (untargeted aspects $\Longrightarrow$ insights robust)

II. BANK'S BEHAVIOR

- Representative bank hoards xi at date 0
- Continuation at scale j ($j \leq i$):

$$j = \frac{xi + \rho_0 j}{R} \iff j = \frac{xi}{R - \rho_0}$$

- Borrowing capacity when bank anticipates R :

$$i - A + xi = \alpha(\rho_0 + x)i \iff i = \frac{A}{1 + (1-\alpha)x - \alpha\rho_0}$$

- Tradeoff between scale (i) or leverage (i/A) and ability to withstand shocks (j)
- Alternative sources of illiquidity (debt maturity, regulatory arbitrage, illiquid assets...)

Scale and leverage

- Banks always choose enough liquidity to continue in distress $x = R - \rho_0$
- Scale when bank anticipates R

$$\Longrightarrow \quad i(R) \equiv \frac{A}{1 + (1-\alpha)R - \rho_0} \qquad \text{decreasing in } R, (1-\alpha)$$

- Leverage

$$i/A = m(R) \equiv \frac{1}{1 + R(1-\alpha) - \rho_0}$$

III. COMMITMENT SOLUTION

- Distortion from monetary policy (s = savings):
  - $\widehat{V}(R) \equiv u(e_1 - s) + s$ with $u'(e_1 - s) = R$
  - $\widehat{V}(R)$ concave, maximized at $R = 1$
- If continuation is case of a shock,

$$u(e_1 - s) + Rs + \underbrace{(1 - R)}_{\substack{\text{tax on} \\ \text{storage} \\ \text{rebated to} \\ \text{consumers}}} (s - i) = \underbrace{\widehat{V}(R)}_{\text{DWL}} - \underbrace{(1 - R)}_{\substack{\text{implicit} \\ \text{subsidy}}} i$$

- Ex ante welfare:

$$\alpha \widehat{V}(1) + (1 - \alpha)\left[\widehat{V}(R) - (1 - R)i(R)\right] + \beta(\rho_1 - \rho_0)i(R)$$

The monetary policy tradeoff

- Loose monetary policy:
  - creates DWL
  - involves implicit subsidy (redistribution from consumers to banking entrepreneurs)
  - boosts investment capacity (less liquidity to be hoarded)

Assumption (no ex ante wealth transfer)

$$\beta(\rho_1 - \rho_0) \leq 1 - \rho_0 + 1 - \alpha$$

Assumption is NSC for

Optimal monetary policy under commitment: $R^c = 1$

IV. NO-COMMITMENT SOLUTION

- R^* = equilibrium interest rate in case of a macro-shock.

$$\Longrightarrow \quad x^* = R^* - \rho_0.$$

Continuation scale for $R \geq R^*$

$$j = \frac{\rho_0 j + x^* i(R^*)}{R} \Longrightarrow \quad \boxed{j = \frac{R^* - \rho_0}{R - \rho_0} i(R^*)}$$

- Ex post welfare (in case of a shock) for $R \geq R^*$:

$$W^{\text{ex post}}(R; R^*) = \widehat{V}(R) + \left[\beta(\rho_1 - \rho_0) - (1 - R)\right] \frac{R^* - \rho_0}{R - \rho_0} i(R^*)$$

Characterization of equilibria

- Define set correspondence $\mathcal{R}(R^*)$ by

$$\mathcal{R}(R^*) = \arg\max W^{\text{ex post}}(R; R^*)$$

- $\mathcal{R}(R^*) = 1$ for all $R^* < 1$, if

$$w \equiv \beta(\rho_1 - \rho_0) - (1 - \rho_0) \leq 0$$

- *Result #1*: $w < 0 \implies \{R^{nc}\} = \{1\}$

  more demanding than NSC for $R^c = 1$.

- *Result #2*: $w > 0$ Equilibria: solutions of fixed point equation

$$R^{nc} \in \mathcal{R}(R^{nc})$$

Assumption (ex post intervention) $w > 0$

Strategic Complementarities

- *Time Inconsistency + Untargeted Intervention* $\Longrightarrow$ *Strategic Complementarities*
  - time consistent equilibrium always an equilibrium: $1 \in \{R^{nc}\}$,
  - multiple equilibria
    - ex ante welfare ranked, better with higher R^{nc}
    - Pareto-ranking of equilibria for banks, better with lower R^{nc}
    - specific Pareto-dominant equilibrium for banks

$$x^* = 0 \iff R^* = \rho_0,$$

exists iff

$$V(1) - V(\rho_0) \leq \frac{wA}{1 - \alpha\rho_0}$$

- Time-inconsistency of monetary policy$\neq$ inflation bias a la Barro-Gordon (1983)
- Efficient for government to provide liquidity in bad times [as in Holmström-Tirole 1998] but supplies too much of it in time-consistent outcome

Other illustration: endogenous correlation

- Suppose in addition:
  - continuum of states of nature
  - banks choose probability of distress in each state, subject ot overall probability of distress being $1 - \alpha$
- Only strict equilibria: maximal correlation

Comparative Statics

- Equilibrium set $\{R^{nc}\}$ expanding in β and A

- Equilibrium set $\{R^{nc}\}$ expanding in γ
  - $\gamma =$ fraction of banks in distress in crisis
  - leverage i/A can increase and liquidity x can decrease with γ: opposite of standard corporate finance results (R constant)

Macroprudential regulation

- **Liquidity requirement**: $x \geq 1 - \rho_0$
- Focus on **overall** exposure to aggregate risk, not only on risk of failure of **individual** institution:
  - Decreasing returns to regulation, $\{R^{nc}\}$ shrinking in fraction n of banks regulated
  - **Pecking order of regulation**:
    - assume cost of regulation ci^{λ} and distribution $dF(\beta, A)$
    - minimize cost of ensuring $\{R^{nc}\} \subseteq [\underline{R}, 1]$
    - regulate first banks with high $[\beta(\rho_1 - \rho_0) - (1 - \rho_0)] A^{1-\lambda}$
- Bad idea: subsidize liquidity hoarding $\Longrightarrow$: i/A increases, x decreases, subsidy turned into bigger investment, less liquidity or capital insurance and a more generous bailout
- Ineffective: breaking down big banks into smaller banks (unless for ex. $\beta(\underset{+}{A})$)

Regulatory arbitrage

- Suppose regulation in place $x \geq 1 - \rho_0$
- For simplicity, banks in distress with proba 1 at date 1
- However, banks might hoard liquidity in form of toxic assets
- cheaper: price $q_0 < 1$ at date 0
  - risky: return 0 with proba $1 - \tilde{\alpha}$ and 1 with proba $\tilde{\alpha}$
- Similar characterization of equilibrium set $\{R^{nc}\}$, strategic complementarities in regulatory arbitrage
- Important to **monitor quality of liquidity**

V. OPTIMAL EX-POST INTERVENTIONS

- See paper
- Intervention not perfectly targeted because of informational rents
- Screening with downsizing for minor cries, monetary transfers for severe ones
- Always use monetary policy
- Region in which equilibrium bailout is purely monetary
- Strategic complementarities and multiple equilibria

CONCLUSION

- Mechanism complements other stories for widescale maturity-mismatch, illiquidity and correlated risk taking (behavioral, informational)
- Sowing the seeds of the next crisis
  - low date 0 interest rates increase leverage i/A and decrease liquidity x
  - loss of reputation for toughness
  - increase in cost of bailouts
- Nominal interest rates

V. MONETARY AND FISCAL BAILOUTS

- Unrestricted instruments: add possibility of fiscal bailouts
- Imperfectly targeted: asymmetric information
- *Modeling*
  - When adverse shock, fraction $\gamma \in [0,1]$ of firms face liquidity need [earlier: $\gamma = 1$]
  - Proportion ν of false positives: A fraction $(1-\gamma)\nu$ are mistaken by the state for banks that need liquidity.These banks know that they belong to the false-positives group

Instruments

- Banks and their investors form perfect coalitions, banks have full bargaining power
- Banks can borrow from investors at same interest rate R
- Participation in bailout is voluntary
- *Instruments* when facing distribution $dF(i,x)$ of banks
  - R
  - ($w$log) gives $j(i,x) \leq i$ in exchange of shares, valued $\rho_0 j(i,x)$, to banks in distress
  - ($w$log) lets intact banks continue at scale i, and gives them $T(i,x) \geq 0$

Timing within period 1

1. government announces rescue scheme $\{R, j(i,x), T(i,x)\}$
2. each banking entrepreneur offers his investors an individually rational plan
   - participation, report, transfers between parties (constrained by limited liability)
   - investors at least as well off as without participation
3. banking entrepreneur-investors coalition implements their stage-(2) agreement

Incentive and participation constraints

- *Either* intact bank cannot compensate its investors

$$j\left(i,x\right) < \frac{\left(\rho_0 + x\right) i}{R} \qquad (IC_1)$$

or coalition does not gain:

$$(\rho_1 - \rho_0) i + T\left(i,x\right) \geq (\rho_1 - \rho_0) j\left(i,x\right) + \left[j - \tfrac{(\rho_0+x)i}{R}\right] \qquad (IC_2)$$

- Participation:

$$T\left(i,x\right) \geq 0 \qquad (PC1)$$

$$j\left(i,x\right) \geq \tfrac{xi}{R-\rho_0} \qquad (PC2)$$

- Note that only (IC_2) and (PC_1) are relevant: optimum under (IC_1) has $j\left(i,x\right) = \left(\rho_0 + x\right) i / R \implies (IC_2)$ satisfied (even with $T = 0$)
- Later analysis: (PC_2) also irrelevant

Planning problem

$$\text{Max} \left\{ \widehat{V}(R) + \int \left[\gamma w j(i,x) - (1-\gamma)\nu(1-\beta)\, T(i,x) \right] dF(i,x) \right\}$$

s.t.

$$(\rho_1 - \rho_0) i + T(i,x) = (\rho_1 - \rho_0) j(i,x) + \left[j(i,x) - \frac{(\rho_0 + x) i}{R} \right]$$

$$j(i,x) \leq i$$

$$T(i,x) \geq 0$$

Either $T(i,x) = 0$ or $j(i,x) = i$ (or both)

Optimal ex post bailout

Let $\overline{\gamma}$ solution of

$$\gamma w / \left(1 + \rho_1 - \rho_0\right) = \nu \left(1 - \gamma\right) \left(1 - \beta\right)$$

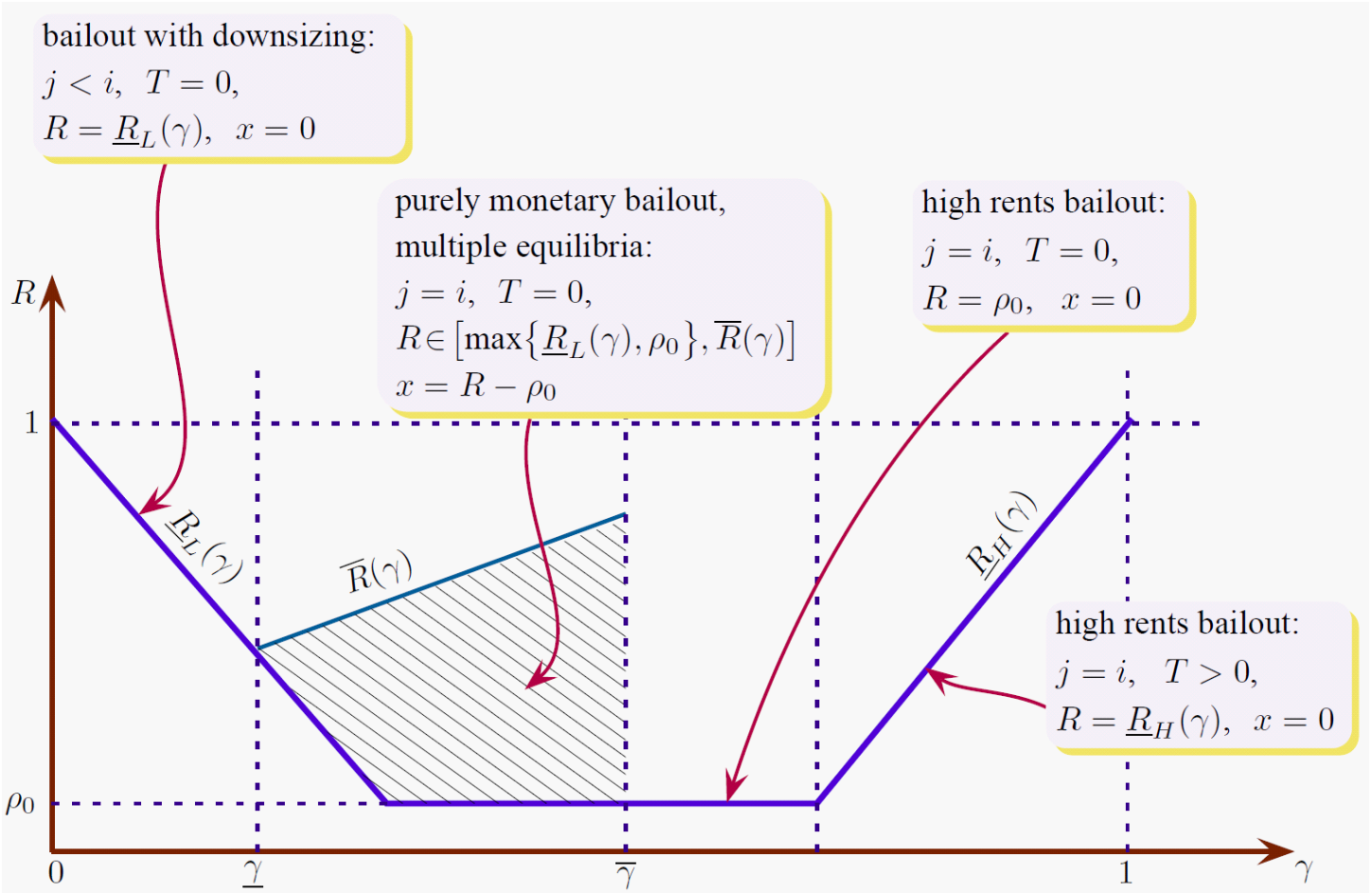
1. (sufficient liquidity) if $R \leq \rho_0 + x$, then $T\left(i, x\right) = 0$ and $j\left(i, x\right) = i$
2. (downsizing) if $R > \rho_0 + x$ and $\gamma < \overline{\gamma}$, then $T\left(i, x\right) = 0$ and $j\left(i, x\right) = \frac{(\rho_0 + x)/R + \rho_1 - \rho_0}{(1 + \rho_1 - \rho_0)} i$
3. (high rents) if $R > \rho_0 + x$ and $\gamma > \overline{\gamma}$, then $T\left(i, x\right) = \left[1 - \frac{\rho_0 + x}{R}\right] i$ and $j\left(i, x\right) = i$

Liquidity choice

Define

$$\bar{R}(\gamma) \equiv \frac{1-\rho_0}{\hat{\alpha}+(1-\hat{\alpha})(1-\gamma)+\rho_1-\rho_0}$$

1. (mild crisis, expensive refinancing) if $\gamma < \overline{\gamma}$ and $R > \bar{R}(\gamma)$, then $i/A = m(\rho_0)$ and $x = 0$
2. (mild crisis, cheap refinancing) if $\gamma < \overline{\gamma}$ and $R < \bar{R}(\gamma)$, then $i/A = m(R)$ and $x = R - \rho_0$
3. (severe crisis) if $\gamma > \overline{\gamma}$, then $i/A = m(\rho_0)$ and $x = 0$


bailout with downsizing:
$j < i,\ \ T = 0,$
$R = \underline{R}_L(\gamma),\ \ x = 0$
purely monetary bailout,
multiple equilibria:
$j = i,\ \ T = 0,$
$R \in \left[\max\left\{\underline{R}_L(\gamma), \rho_0\right\}, \overline{R}(\gamma)\right]$
$x = R - \rho_0$
high rents bailout:
$j = i,\ \ T = 0,$
$R = \rho_0,\ \ x = 0$
high rents bailout:
$j = i,\ \ T > 0,$
$R = \underline{R}_H(\gamma),\ \ x = 0$
R
1
ρ_0
0
$\underline{\gamma}$
$\overline{\gamma}$
1
γ
$\underline{R}_L(\gamma)$
$\overline{R}(\gamma)$
$\underline{R}_H(\gamma)$