Optimality of Prompt Corrective Action in a Continuous - Time Model with Recapitalization Possibility

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Prompt Corrective Action (PCA) in US

- Banks classified in 5 categories according to its capital ratio

	Total risk -based capital	Tier 1 risk -based ratio	Tier 1 leverage ratio
Well capitalized	≥ 10	≥ 6	≥ 5
Adequately capitalized	≥ 8	≥ 4	≥ 4
Undercapitalized	< 8	< 4	< 4
Significantly Undercapitalized	< 6	< 3	< 3
Critically Undercapitalized		Tangible equity ≥ 2	

PCA in US

- Restrictions are gradually imposed to each category

Categories	**Restrictions**
Well capitalized	
Adequately capitalized	No brokered deposits
Undercapitalized	Suspend dividends
	Restrict asset growth
Significantly undercapitalized	Same as zone 3
	Order recapitalization
Critically undercapitalized	Same as zone 4
	Conservator within 90 days

PCA in US

- Main ideas behind the PCA system's design
  - More severe restrictions on banks' activities when their situation deteriorates

    ⇒ *The USPCA uses the capital ratios as information to trigger intervention by regulators.*
  - Imposing some mandatory supervisory actions for each bank categories.

    ⇒ *The USPCA aims to limit the prudential supervisors' discretion.*
  - Calling for *timely resolution*, i.e. banks should be forced into resolution even when they still have positive equity capital.

PCA in US

- Main objectives
  - For regulators
    - Encouraging a timely intervention and reducing the supervisors' discretions
  - For Banks
    - Creating an appropriate incentives for bank owners in holding an adequate capital level

Why studying the PCA's design

- Importance of timely intervention
  - Current crisis raises a particular attention to the PCA system
  - Pillar 2 of Basel II
- Adoption of the PCA system in other countries
  - Japan, Korea, Mexico have adopted a similar system of the US PCA
  - The European Shadow Financial Regulatory Committee recommends to implement PCA in each Member Country

Paper's Approach

- Objective
  - Theoretical foundations for this regulation system
- Approach
  - Prudential regulation is seen as mechanism to implement "optimal contract" between bank regulator and bank owners.

    $\Longrightarrow$ A "mechanism design" approach, i.e.
    - First, characterize the optimal contract between the banker and the regulator
    - Then, implement the optimal contract by a menu of "real-world" regulatory instrument

Related Literature
Empirical studies on PCA

- Objective
  - Assessing the function of PCA: Impact of PCA's implementation on banks' capital level and riskiness
- General conclusion: In response to the PCA implementation
  - Banks reduce their leverage
  - Banks also reduce their credit risk

Related Literature
Theoretical studies on PCA

- Freixas et Parigi (2008)
  - Objective: why preventing banks to invest in some types of assets
  - Key property of the model
    - Agency problem may be more severe in certain asset classes than in others
- Shim (2006)
  - Most relevant for our work
    - Objective: Optimal design of the PCA system
    - Approach: Mechanism Design Approach

  HOWEVER

    - Discrete-time model
    - No recapitalization possibility

Related Literature

Dynamic Financial Contracting

- *Security design*: e.g. Biais et al. (2006), DeMarzo and Fishman (2007)
  - Characterizing the optimal contract
  - Implementing this contract via commonly observed securities
- *Financing constraint and investment*: e.g. Albuquerque and Hopenhayn (2004), Clementi and Hopenhayn (2006)
  - Firm's size can be altered from one period to the other by some additional investment or disinvestment
- *Optimal risk sharing*: Wang (2005)
  - Agent is risk averse
  - Direct extension of costly state verification model

Model
Players

- Banker
  - Runing a bank
  - Discount rate: ρ
  - Reservation utility: $\tilde{W}$
- Regulators
  - Deposit Insurance Coporation (DIC)
  - Supervising the banker on behalf of depositors
  - Discount rate $r < \rho$
- All are risk neutral

Model
Bank's Assets

- Loan portfolio
  - Cumulative cashflows

$$dR_t = \mu A_t dt + \sigma dZ_t^A$$

    - Z_t^A is standard Brownian Motion
    - A_t is effort level of the banker at time t: $A_t = \{0, 1\}$
  - Liquidation value $= 0$
- Moral Hazard
  - A_t is unobservable to the regulators
  - Banker's private benefits associated with effort: $v(A_t)$

$$v(0) = B \text{ et } v(1) = 0$$

Model
Activity Restrictions

- Liquidation: Regulators can liquidate the bank at some time τ
- Dividends et Recapitalization
  - Payment flows to the banker before the liquidation

$$C = \{C_t, 0 \leq t < \tau\}$$

    - If $dC_t > 0$: a dividend paid at time t
    - If $dC_t < 0$: a recapitalization of the bank by the banker

$$dC_t \geq -Kdt \text{ où } K > 0$$

    - Recapitalization cost: cost α for each unit of capital injected

Contract

- Contract specifying
  - Liquidation time τ
  - Payment flows to the banker: $C = \{C_t, 0 \leq t < \tau\}$
- In a dynamic environment, the contract $\Pi = (\tau, C)$ can be contingent on the entire history of cashflow realizations

$$\Pi = \{\tau\left(R_s, 0 \leq s < \tau\right);\ C_t\left(R_s, 0 \leq s \leq t\right)\}$$

Contract

- Given a contract $\Pi = (\tau, C)$ and an effort strategy A
  - Banker's total expected utility

$$\mathbb{E}^A \left[\int_0^\tau e^{-\rho t} \left[(1 + \alpha \mathbf{1}_{\{dC_t < 0\}}) dC_t + v(A_t) dt \right] + e^{-\rho \tau} \tilde{W} \right]$$

  - Expected utility of DIC

$$\mathbb{E}^A \left[\int_0^\tau e^{-rt} \left(\mu A_t dt - dC_t \right) \right]$$

Contract

- A strategy A is optimal for the banker if it maximizes her total expected utility, given a contract (τ, C)
- A contract (τ, C) is said optimal if
  - $A^* = \{A_t = 1 \ \forall 0 \leq t < \tau\}$ is incentive compatible with respect to it
  - The banker never chooses to quit
  - It provides the DIC with the highest payoff

Optimization Problem

$$Max\ \mathbb{E}\left[\int_0^\tau e^{-rt}\left(\mu dt - dC_t\right)\right]$$

subject to

$$A^* = \{A_t = 1\ \forall 0 \leq t < \tau\} \text{ is incentive compatible w.r.t } (\tau, C) \tag{1}$$

$$W_0 = \mathbb{E}\left[\int_0^\tau e^{-\rho t}(1 + \alpha \mathbf{1}_{\{dC_t<0\}})dC_t + e^{-\rho\tau}\tilde{W}\right] \tag{2}$$

$$\mathbb{E}\left[\left(\int_t^\tau e^{-\rho(s-t)}(1 + \alpha \mathbf{1}_{\{dC_s<0\}})dC_s + e^{-\rho(\tau-t)}\tilde{W}\right)\middle|\mathcal{F}_t\right] \geq \tilde{W} \tag{3}$$

Dynamic Programming

- State variable: the banker's continuation utility at time t (i.e. total expected utility of the banker from time t on)

$$W_t = \mathbb{E}_t \left(\int_t^{\tau} e^{-\rho(s-t)} (1 + \alpha \mathbf{1}_{\{dC_s < 0\}}) dC_s + e^{-\rho(\tau - t)} \tilde{W} \right)$$

- The optimal contract will be written as a function of this state variable

Incentive Compatibility Condition

- Dynamic evolution of the banker's continuation utility

$$dW_t = \rho W_t dt - (1 + \alpha \mathbf{1}_{\{dC_t < 0\}}) dC_t + G_t dZ_t$$

Proposition

The banquer will choose the high effort level at any time if and only if the volatility of her continuation utility is at least equal to $\frac{B}{\mu}\sigma$

DIC's Payoff Function

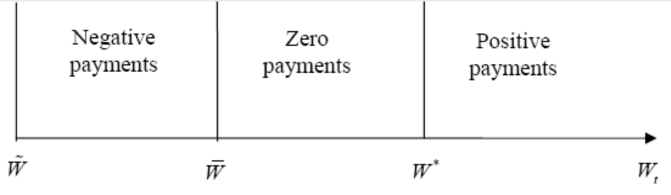
- Denoted by $F(W_t)$
- It is the maximal continuation payoff the DIC can earn when a continuation utility W is promised to the banquer
- The function F satisfies the following HJB equation

$$\underbrace{rF(W_t)dt}_{\substack{\text{expected change}\\ \text{of total payoff}}} = Max \left[\underbrace{\mu dt - dC_t}_{\substack{\text{current}\\ \text{payment}}} + \underbrace{\mathbb{E}\left[dF(W_t)\right]}_{\substack{\text{expected change of}\\ \text{continuation payoff}}} \right]$$

Optimal Mechanism

Proposition

- *Optimal compensation for the banker: three regions*



- *Liquidation Policy*

$$\tau = \inf\left\{t : W_t = \tilde{W}\right\}$$

Regulatory Menu

- Regulatory Instruments
  - *Bank chartering*: define the initial amount of capital the banker must contribute to open the bank
  - *Deposit insurance premium*: characterized by a sequence of payments to the DIC
  - *Capital regulation*: determine the restrictions regarding the policies of dividend, recapitalization and liquidation
- The regulatory menu is made contingent on the amount of bank's capital E_t

Regulatory Menu

Proposition

- *Initial amount of capital* $E_0 = W_0^* - \tilde{W}$
- *Deposit insurance premium*
  - *Periodic payment to the DIC is decreasing with the amount of bank's capital*
    $\Longrightarrow$ *Risk – based insurance premium where risk measure is bank's capital level*
- *Capital regulation: Two thresholds* E^* *and* $\bar{E}$
  - *No dividends if the amount of capital is not greater than* E^*
  - *Recapitalization if the bank's capital level falls below* $\bar{E}$
  - *Bank is placed in liquidation as soon as its capital is zero*

Discussion

- Regulators' Discretion
  - According to our regulatory menu, all actions of the regulator are specified ex-ante $\Longrightarrow$ the regulators' discretion is limited
  - Our liquidation policy claims to liquidate the banks as soon as their capital is wiped out $\Longrightarrow$ Insolvent banks with negative capital should not be allowed to continue in operation

Discussion

- Book – value vs. Market value
  - According to our regulation, the regulatory restrictions are contingent on the book-value of capital

HOWEVER

  - In our model, interest rate and loan default probability of loans are fixed

$\Longrightarrow$ In our model, there is no distinction between book – value and market – value

Conclusion

- Approach
  - We design the prudential regulation as a mechanism to implement the socially optimal contract between the DIC and the banker
  - Capturing the recapitalization possibility
- Main Conclusion
  - The PCA version applied in US closely mimics properties of an optimal regulation