The effects of clawback provisions on bank risk-taking

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Debate about intervening in CEO compensation structure

- **Mark Carney** (Governor BOE) 2014: “Compensation schemes encouraged imprudent *risk taking*. To align better incentives with the *long-term interests of society*, we have introduced a remuneration code prescribing that payment of bonuses must be exposed to clawback for up to seven years. Bonuses can clawed back if *evidence emerges* of employee misconduct or failures of risk management.”

- **Christine Lagarde** (IWF) 2015: “Remuneration could become subject to claw-back provisions in cases where the institution requires the direct support of taxpayers.”

- Logic of heuristic argument by regulator
  1) Banks take on more risks than socially optimal
  2) Time provides more information about risk-taking
  3) Requiring clawbacks induces less risk-taking

- **Research question:** (When) is this logic correct?
Introduction

Contribution

1. We develop a principal-agent framework in which
   1. time provides “more information” about agent effort
   2. payment deferral is costly because agent is impatient
   3. regulation interferes with privately optimal compensation design
      (trade-off between information and impatience) ⇒ affects risk-taking

2. Predictions on effects of regulatory interference in timing of pay
   1. Low agent outside option: Regulation may backfire
      1. If effort lowers growth of information ⇒ higher risk-taking!
      2. Standard arrival time distributions imply opposite conclusions
   2. High agent outside option: Heuristic regulator rationale works!
      1. Deferral ↑ ⇒ level of information ↑ ⇒ lower risk-taking
      2. Intuition: Principal cannot adjust size of compensation package due to
         outside option: forced to provide more incentives
Literature

- **Moral hazard with risk-neutral agent and limited liability:**
  - Our model: One-shot effort with persistent effects + timing of pay

- **Comparing information systems in agency problems:**
  - (Sufficient) conditions for information to have value for principal: Holmström 1979, Gjesdal 1982, Grossman and Hart 1983, Kim 1995
  - Our model: Explicitly solve trade-off between costs and benefits of “more information” (cf. also Chaigneau et al. 2015)

- **Regulation of (executive) compensation:**
  - Regulation of size (Acharya and Volpin 2010, Thanassoulis 2012, Benabou and Tirole 2015)
  - Our model: Regulation of the timing dimension
Static moral hazard problem with timing dimension

- Agent takes an unobservable action \( a \in A \subseteq \mathbb{R}^+ \) at cost \( c(a) \)
- Action \( a \) controls arrival time distribution \( F(t|a) \) of disaster event, such as “Bank failure” or “Nuclear Meltdown”, affecting
  - principal’s (discounted expected) gross payoff \( \pi(a) \)
  - negative externality \( X(a) \): wedge between society payoff and \( \pi(a) \)

Preferences:
- Principal \( P \) and agent \( A \) are risk-neutral
- Impatient agent discounts payments at \( r_A = r_P + \Delta r \) with \( \Delta r > 0 \)

Restrictions on compensation design
- Agent is subject to limited liability (LL)
- Regulator imposes that payments to agent may only be made after \( \tau \) years of survival (absence of disaster)
Assumptions

1. The hazard rate $h(t|a) = f(t|a)/[1 - F(t|a)]$ is decreasing in $a$

$$\frac{\partial}{\partial a} h(t|a) < 0 \quad \forall t \in (0, \infty)$$

   - implies first-order stochastic dominance (similar to MLRP)
   - higher effort lowers risk-taking

2. Agent’s effort cost is sufficiently convex

$$\frac{c''(a)}{c'(a)} > \frac{F_{aa}(t|a)}{F_a(t|a)} \quad \forall t$$

   - ensured by convexity of distribution function (CDFC)
   - implies validity of first-order approach

3. Both $\pi(a)$ and $-X(a)$ are strictly increasing and concave

$\Rightarrow$ Principal only partially accounts for disaster event
Agency constraints

**Lemma**

*Without regulation the principal never pays the agent upon failure.*

Without regulation, present value of agent pay derived from date-$t$ compensation is

$$dB(t) = e^{-rAt} \cdot S(t|a) \cdot db(t)$$

- **Survival probability**
- **Bonus conditional on survival**

Agent net pay $V$ is subject to **participation constraint (PC)** $v$

$$V(a|\tau) = \arg \max_a \int_{\tau}^{\infty} dB(t) - c(a) \geq v$$

Agent **incentive constraint (IC)** using first-order approach

$$\int_{\tau}^{\infty} \frac{S_a(t|a)}{S(t|a)} dB(t) = c'(a)$$
Principal’s Compensation Design Problem

\[ W(a|\tau) = \min \int_{\tau}^{\infty} e^{\Delta r t} dB(t) \quad s.t. \]

\[ \int_{\tau}^{\infty} dB(t) \geq c(a) + \nu \quad \text{PC} \]

\[ \int_{\tau}^{\infty} L(t|a) dB(t) = c'(a) \quad \text{IC} \]

\[ dB(t) \geq 0 \quad \text{LL} \]

where \( L(t|a) = \frac{S_a}{S} \) summarizes information arrival over time

- For fixed \( t \), \( L \) can be interpreted as the (textbook) likelihood ratio
- \( L \) is a increasing in \( t \) with \( L(0) = 0 \) and \( L_t = -\frac{\partial}{\partial a} h(t|a) > 0 \), larger sensitivity of hazard rate to action \( \Rightarrow \) faster learning
Examples: hazard rate and information

- **Mixed Exponential**: Hazard rate and likelihood ratio for low, medium, and high effort.
- **Exponential**: Similar to mixed exponential, showing hazard rate and likelihood ratio for different effort levels.
- **Lognormal**: Hazard rate and likelihood ratio for low, medium, and high effort, with a focus on the impact of information and effort levels.
Equilibrium action choice

- Principal induces action $a^*$ that maximizes:

$$a^*(\tau) = \arg \max_a \pi(a) - W(a|\tau)$$

or FOC:

$$\pi'(a^*) = W_a(a^*|\tau)$$

- Trivial: Level of wage cost, $W(a|\tau)$, is increasing in $\tau$
  - Intuition: restriction on contracting space cannot yield lower cost!
  - But, irrelevant for effect on equilibrium action $a^*$

- Nontrivial: How does deferral affect marginal cost?
  - Difficult to get ex-ante intuition for cross-partial $W_{a\tau}$
  - Sign determines effect on equilibrium action $a^*$
Analysis Roadmap

1. Relaxed problem without PC constraint
   1. Optimal compensation design
   2. Effect of regulation

2. Full problem with PC constraint
   1. Optimal compensation design with binding PC
   2. Optimal compensation design problem
   3. Equilibrium effect of regulation

3. Welfare implications
Compensation design relaxed problem

Consider the principal’s problem when the participation constraint is slack

\[ W(a|\tau) = \min_{B(t)} \int_{\tau}^{\infty} e^{\Delta r t} dB(t) \quad \text{s.t.} \]
\[ \int_{\tau}^{\infty} L(t|a) dB(t) = c'(a) \]

Lemma

Fix \( a \), a cost-minimizing contract requires a single payment date \( T \)

\[ T(a, \tau) = \arg \min_{t \geq \tau} \frac{e^{\Delta r t}}{L(t|a)} \]

- \( T \) minimizes cost of delay, \( e^{\Delta r t} \), per unit of information, \( L(t|a) \)
- If there is no cost of delay, \( \Delta r = 0 \), \( T = \arg \max_t L(t|a) \to \infty \)
Effect of regulatory deferral in relaxed problem

- Without regulation, \( (\tau = 0) \), payment date \( T(a,0) \) solves FOC:

\[
\left. \frac{d \log L}{dt} \right|_{t=T(a,0)} = \Delta r
\]

Growth rate of information

Growth rate of cost of delay

- What matters is the effect of regulatory deferral \( \tau \) on growth rate of information, \( \frac{d \log L}{dt} \), not the effect on the level of information \( L \)

Lemma (Effect of binding regulatory deferral on equilibrium action)

\[
\text{sgn} \left( a^{*f} (T(a,0)) \right) = \text{sgn} \left( \left. \frac{\partial}{\partial a} \frac{d \log L}{dt} \right|_{t=T(a,0)} \right)
\]
Examples and implications

- Mandatory deferral may increase or decrease equilibrium effort
  1) Mixed distribution: \( F(t|a) = aF_L(t) + (1-a)F_H(t) \) where \( F_L(t) \) dominates \( F_H(t) \) in the hazard rate order
     \( \Rightarrow \) Deferral causes lower equilibrium effort
  2) Weibull distribution, i.e., \( S(t|a) = e^{-\left(\frac{t}{a}\right)^k} \)
     \( \Rightarrow \) (Marginal) deferral does not affect equilibrium effort
  3) Lognormal distribution with mean \( a \)
     \( \Rightarrow \) Deferral increases equilibrium effort

- Regulating deferral has non-trivial effects:
  - Short-term (long-term) pay may indicate good (poor) incentives!
  - Mandating earlier payouts may reduce risk-taking!

- Key: If PC is slack, principal may adjust net total comp to agent, \( \int_{\tau}^{\infty} dB(t) - c(a) \), in response to regulation (vs. binding PC)
Compensation design with binding PC

Lemma

In any optimal compensation contract that implements action $a$ with binding PC, the maximum required number of payments is 2.

- Intuition for proof
  
  - Suppose a contract required $k > 2$ payment dates $\{T_i\}_{i=1}^k$
  - Then there is a perturbed contract that implements $a$ at lower cost

  1) Select short-term payment time $T_S = \min \{T_i\}$
  2) Select long-term date $T_L > T_S$ with lowest incremental cost-to-information ratio $T_L = \arg \min_{T_j \in \{T_i\}} \lambda_{IC} (T_S, T_j)$ where

     \[
     \lambda_{IC} (T_S, T_j) = \frac{e^{\Delta r T_j} - e^{\Delta r T_S}}{L(T_j) - L(T_S)}
     \]

  3) Lower bonus at any other payment date $\tilde{T} \notin \{T_S, T_L\}$
  4) Adjust size of bonus at $T_S$ and $T_L$ to satisfy IC and PC
  5) Perturbed contract has lower cost
  6) Iterate until 2 payment dates are left
Compensation design with binding PC: One vs. two dates

1. **Single-date contract:** Date, $T_1(a)$, and pay, $dB(T_1)$, determined by binding IC and PC

   $$dB(T_1) = v + c(a)$$
   $$L(T_1|a) = \frac{c'(a)}{v + c(a)}$$

2. **Two-date contract:** Dates $T_S < T_L$ must ensure identical weighted average information

   $$L(T_S)w + L(T_L)(1-w) = L(T_1)$$

   1. weight $w = \frac{dB(T_S)}{dB(T_S) + dB(T_L)}$ determined by PV of cash flows

   2. Limited liability implies $w > 0$ so that $\tau \leq T_S < T_1 < T_L$
Optimal compensation design with binding PC

Lemma (Compensation design with binding PC)

The single-date contract is optimal if for all feasible $T_S$ the date $T_1$ offers the lowest incremental cost-to-information ratio, i.e.,

$$\lambda_{IC}(T_S, T_1) = \min_{t \geq T_1} \lambda_{IC}(T_S, t)$$

Otherwise, there are 2 payment dates with $T_L^* = \arg \min_{T_L} \lambda_{IC}(T_S^*, T_L)$.

Intuition:

- Recall $T_1$ just determined by binding PC and IC (no optimization)
- Suppose one learns “a lot” shortly after $T_1$, then optimal to
  - tap this information with long-term pay $T_L > T_1$ to solve IC
  - use short-term pay $T_S < T_1$ to ensure that PC is satisfied
Full problem: Putting the pieces together

A solution for $T_1$ exists if and only if $a < \bar{a}$:

$$
\lim_{t \to \infty} L(t|\bar{a}) = \frac{c'(\bar{a})}{v + c(\bar{a})}
$$

Lemma

Regulation prohibits implementation of $a$ if $\tau > T_1(a)$ for $a < \bar{a}$.

Intuition: If $\tau > T_1(a)$, then the minimum expected gross pay $v + c(a)$ (contingent on date-$\tau$ survival) provides excess incentives for $a$.

Theorem

For any implementable action $a$, the optimal contract is

1) characterized by Lemma 2 (PC binding) if $a < \bar{a}$ and $T(a, \tau) > T_1(a)$

2) characterized by Lemma 1 (PC slack) otherwise.
Effect of regulation in equilibrium

**Lemma**

*PC binds in equilibrium if* \( v \geq \bar{v} \).

**Proposition (Equilibrium effect of regulation)**

*Suppose PC slack in the absence of regulation, the (marginal) effect of regulation depends on the information process (see relaxed problem). Suppose PC binds, so that* \( a^*(0) < \bar{a} \), *then mandating a deferral time of* \( \tau > T_1(a^*(0)) \) *will strictly increase equilibrium effort.*

**Key:** If PC binds, net total compensation package \( \int_{\tau}^{\infty} dB(t) - c(a) \) fixed by outside option \( v \) \( \Rightarrow \) Principal cannot adjust that margin.

Heuristic intuition works for binding PC: Same level of pay must be made contingent on more information \( \Rightarrow \) better incentives / lower risk-taking.
Conclusion

1. Our principal-agent model provides a general and intuitive characterization of contract design when time provides more information about agent risk-taking.

2. Effect of regulatory intervention in timing of pay via clawback provisions non-trivial. Regulation only has an unambiguously positive effect if the participation constraint of the agent binds.

3. Key economic forces that imply binding participation constraints:
   1. More competition for agents: size of pay fixed by outside option!
   2. High leverage of principal $\Rightarrow$ higher risk-taking incentives
      - Regulation of compensation design interacts with capital regulation!