# Credit Market Interventions for the Long Run

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# Overview

- Central banks often use lending facilities to "unfreeze" markets.
- How should these lending facilities be deployed?
- With fixed asset quality, the literature says:
  1. Intervene quickly as soon as markets break down.
  2. Provide just enough funding to restore market functioning.
  3. Step out when markets are liquid.
- We model endogenous asset quality (moral hazard) and find the opposite:
  1. Optimal policy may need to be delayed, generous and long-lasting.
  2. Differences most pronounced when shocks to asset quality are more frequent/larger, risk-free rates rise, and there are frictional secondary markets.

# Framework: Laissez-faire

## Environment

- Discrete time, $t = 1, 2, ..., \infty$
- Mass $m > 1$ of risk-neutral, **short-lived lenders**. Required return $r_f = 0$.
- Mass 1 of risk-neutral, **long-lived borrowers**. Discount factor $\beta$.
- Borrowers own long-lived assets with persistent type $\theta \in \{g, b\}$.
- Every period, assets pay cash flow $L_\theta$ and offer investment opportunity.
  - Investment requires one unit of capital, generates an additional return $R_\theta$.
  - Per-period cash flows $= L_\theta + R_\theta \cdot \mathbb{1}(\text{Invest})$.
  - Good assets are better: $L_g \geq 1 > L_b$ and $R_g \geq R_b \geq 1$.

Two main assumptions:

1. Financial friction: $L_\theta$ is pledgeable as collateral, $R_\theta$ is not. No saving.
2. All types are willing to give up collateral to invest, $R_\theta > L_\theta$.

# Hidden Effort and the Evolution of Asset Quality

- Borrowers can exert hidden effort to improve asset quality within a period.
- Effort $e \in [0, 1]$ at cost $c \cdot e$ generates transition probability

$$p(\theta' = g|\theta, e) = \rho \mathbb{1}(\theta = g) + \pi \cdot e \qquad \text{where } \rho + \pi \leq 1.$$

- The share of good assets is $\lambda$. Letting $E = \int_i e_i$, the law of motion is

$$\lambda' = m(\lambda, E) = \rho\lambda + \pi E.$$

- Maximum asset quality is $\lambda^{\max} = \lim_{\tau \to \infty} m^{\tau}(\lambda, 1) = \frac{\pi}{1-\rho}$.

- Take initial condition $\lambda_0$ as given. Later: anticipated shocks to $\lambda$.

# Block 1: The static lending game

# The Lending Market Game

- Every period, borrowers offer repayment terms for one unit of capital.
- $\theta$ is privately known. Share of good assets $\lambda$ is public information.

- Equilibrium: pooling debt contract with face value $B(\lambda) \leq L_g$, and

$$\lambda B(\lambda) + (1-\lambda)L_b = 1.$$

- Hence lending occurs only if $\lambda \geq \bar{\lambda} \equiv \frac{1-L_b}{L_g-L_b}$, and $B(\lambda) = \frac{1-(1-\lambda)L_b}{\lambda}$.
- **Breakdowns are inefficient**. Later: subsidies so that lenders get $L_b + s$.

- Decompose: $B(\lambda) = 1 + b(\lambda)$, where $b(\lambda) = (1-L_b)\left(\frac{1}{\lambda} - 1\right)$ is a mark-up.

# Lending Market Payoffs

- Per-period cash flows $u(\theta, \lambda)$ are increasing in asset quality:

$$u(\theta,\lambda) = \begin{cases} R_\theta + L_\theta - \min\{B(\lambda), L_\theta\} & \text{if } \lambda > \bar{\lambda} \\ \phi^* R_\theta + (1-\phi^*)L_\theta & \text{if } \lambda = \bar{\lambda} \\ L_\theta & \text{if } \lambda < \bar{\lambda} \end{cases}$$

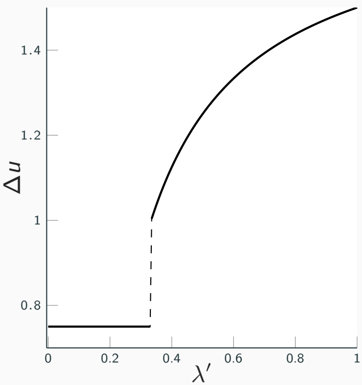
- The per-period payoff *difference* $\Delta u(\lambda) = u(g,\lambda) - u(b,\lambda)$ is

$$\Delta u(\lambda) \equiv) \begin{cases} \Delta R + L_g - \min\{B(\lambda), L_g\} & \text{if } \lambda > \bar{\lambda} \\ \phi^* \Delta R + (1-\phi^*)\Delta L & \text{if } \lambda = \bar{\lambda} \\ \Delta L & \text{if } \lambda < \bar{\lambda} \end{cases}$$

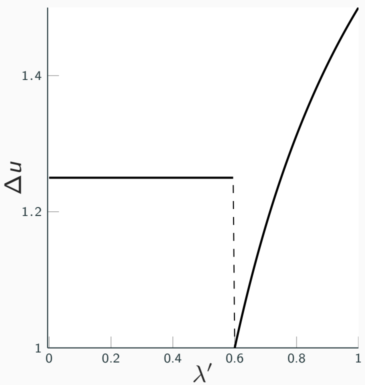
where $\Delta L = L_g - L_b$ and $\Delta R = R_g - R_b$. This may *not* be monotone.

# The Per-Period Payoff Difference

Case 1: $\Delta R > \Delta L$




Case 2: $\Delta L > \Delta R$




Important: Low payoff difference at $\bar{\lambda}$ because adverse selection is severe.

# Block 2: The dynamic quality game

# The Dynamic Quality Game

Timing:

1. Enter period $t$ with average asset quality $\lambda$.
2. Aggregate effort $E$ jointly determines new average asset quality $\lambda'$.
3. Lending market takes place given $\lambda'$. Payoffs summarized by $u(\cdot)$.

Equilibrium:

Look for a law of motion for asset quality such that:

1. Agents choose effort $e_i$ given beliefs $\hat{E}$ over aggregate effort.
2. Beliefs are consistent with actual effort decisions, i.e. $\hat{E} = \int e_i$.

The value function for a borrower in state $(\theta, \lambda)$ given belief $\hat{E}$ is

$$V(\theta, \lambda|\hat{E}) = \max_e \quad \sum_\theta p(\theta'|\theta, e)\Big(u(\theta', \lambda') + \beta V(\theta', \lambda'|\hat{E})\Big) - ce \tag{1}$$

$$\text{s.t.} \quad \lambda' = m(\lambda, \hat{E}).$$

Define the good asset's **premium** as $\Delta(\lambda, \hat{E}) \equiv V(g, \lambda|\hat{E}) - V(b, \lambda|\hat{E})$. Then

$$V(\theta, \lambda|\hat{E}) = \max_e \quad \underbrace{u(b, \lambda') + \beta V(b, \lambda'|\hat{E})}_{\text{Value of a bad asset}} + p(g|\theta, e)\Delta(\lambda', \hat{E}) - ce$$

**Proposition.** Effort is optimal if $\pi\Delta(\lambda', \hat{E}) \geq c$. This is independent of type $\theta$.

# Understanding the Premium

Write the premium recursively, adjusting the discount factor for persistence:

$$\Delta(\lambda, \hat{E}) = \Delta u(\lambda') + \beta\rho\Delta(\lambda', \hat{E}) \qquad \text{s.t. } \lambda' = m(\hat{E}, \lambda).$$

1. If markets are expected to be liquid forever, the premium is

$$\Delta^{\text{liquid}}(\lambda, \hat{E}) = \frac{\Delta R + L_g - 1}{1 - \rho\beta} - \sum_{k=0}^{\infty} (\beta\rho)^k \underbrace{b(m^{k+1}(\lambda, \hat{E})).}_{\text{adverse selection markups}}$$

2. If markets are expected to remain illiquid forever, then

$$\Delta^{\text{illiquid}}(\lambda, \hat{E}) = \frac{\Delta L}{1 - \beta\rho}.$$

Self-fulfilling beliefs allow for multiple self-fulfilling paths, including cycles.

# Pareto-Dominant Competitive Equilibrium

- We select the "best" equilibrium; loosely, the one with highest effort.
- So, guess and verify $E = 1$. Key step: the **effort threshold** $\lambda^E$ at which

$$\pi\Delta(m(\lambda^E, 1), 1) = c.$$

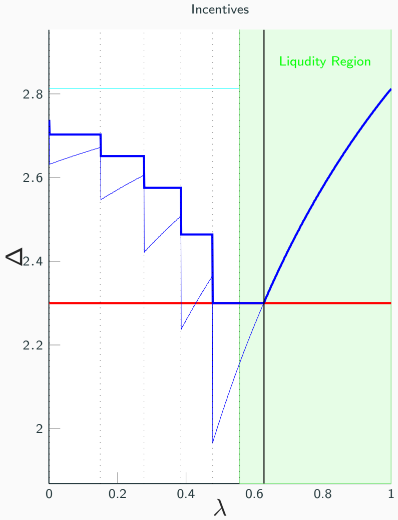
If $\lambda^E$ is reachable from illiquidity, quality recovers to $\lambda^{\max}$ (possibly slowly).

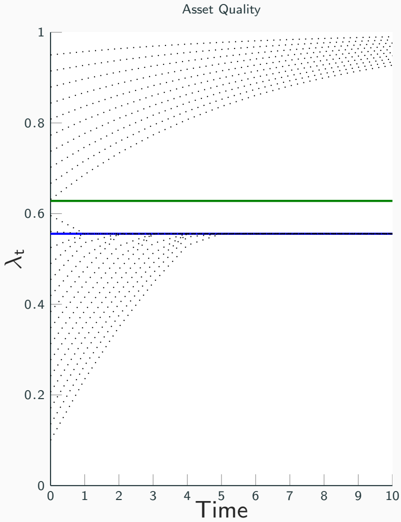
**Proposition**

For each $\lambda_0$, there is a unique PCE with cut-off asset quality dynamics:

(i) Asset quality grows above a threshold, shrinks below a (different) threshold.
(ii) Long-run limit is one of three steady states: $\lim_{t\to\infty} \lambda_t \in \{0, \bar{\lambda}, \lambda^{\max}\}$.
(iii) Even if $\lambda \to \lambda^{\max}$, growth is too slow due to a dynamic coordination failure.

# An Illustration with $\Delta L > \Delta R$



# Welfare and policy

# Reasons for Interventions

- Two sources of inefficiency: lending breakdowns and slow/no growth.
- Policy exercise as in Tirole (2012): maximize welfare by injecting subsidy.

- Instrument: pay $s(\lambda)$ to lenders whose borrowers default.
- Lender's participation constraint binds conditional on the subsidy

$$B(\lambda, s) = \frac{1 - (1 - \lambda)(L_b + s(\lambda))}{\lambda}.$$

  For any $\lambda$, can find the "minimal" subsidy that permits borrowing.

- Deadweight cost of subsidies $\delta > 0$. Focus mostly on $\delta \to 0$.

# Welfare Function

Policy seeks to maximize utilitarian welfare

$$W(\lambda, E) = w(\lambda) + \beta W(\lambda') - cE(\lambda).$$

where the per-period payoff function $w(\lambda) = \lambda u_g(\lambda) + (1-\lambda)u_b(\lambda)$ is

$$w(\lambda) = \begin{cases} L_b + R_b + \lambda(\Delta L + \Delta R) - 1 & \text{if } \lambda > \bar{\lambda} \\ L_b + \lambda \Delta L + \phi\Big(R_b + \lambda \Delta R - 1\Big) & \text{if } \lambda = \bar{\lambda} \text{ for some } \phi \in [0,1] \\ L_b + \lambda \Delta L & \text{if } \lambda < \bar{\lambda}. \end{cases}$$

This is *independent of interest rates*. Only cash flows and liquidity matter.

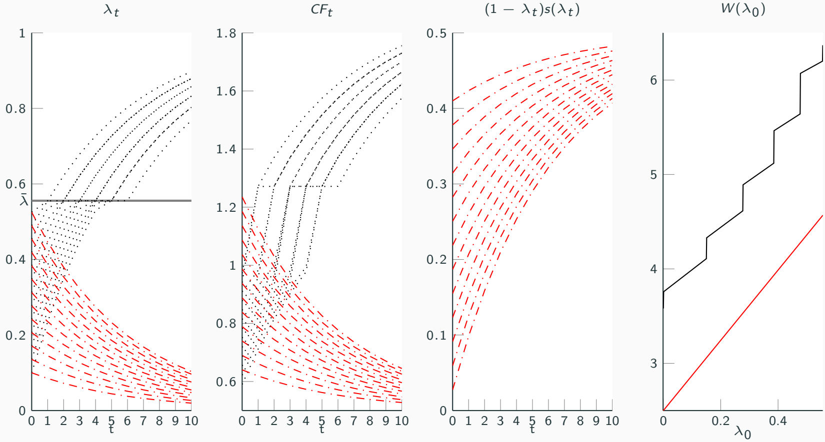
# No Commitment

- Without commitment, subsidy must be optimal *conditional* on $\lambda$.

- This leads to the minimal subsidy that restores borrowowing.

- Such interventions may be harmful because the premium is *as if* $\lambda = \bar{\lambda}$.

## Intervention Traps: Laissez-Faire (black) vs. Subsidy (red)



# Policy with Full Commitment

- Now assume the government can commit to a subsidy function $s(\lambda)$.
- The gov't uses this policy to influence the path of of *liquidity* and *quality*.

**Lemma.** The social value of effort exceeds the private value. Moreover, the social value of effort is constant in the liquidity region, and equal to $\pi \frac{\Delta L + \Delta R}{1 - \rho\beta}$.

# Generous and long-lived interventions

## Optimal Policy under Commitment

**Proposition.** Suppose that $c \leq \pi \frac{\Delta L + \Delta R}{1 - \rho\beta}$ and $\lambda^E > \bar{\lambda}$. Then it is optimal to intervene even if the market would be liquid on its own, and if the market is not liqud on its own, it is optimal to intervene generously.

- Genereous means "bigger $s$ than required to unfreeze markets."
  - But: it may be **cheaper** in total than the minimal subsidy.
- Long-lived subsidies are optimal because we care about long-run stability.

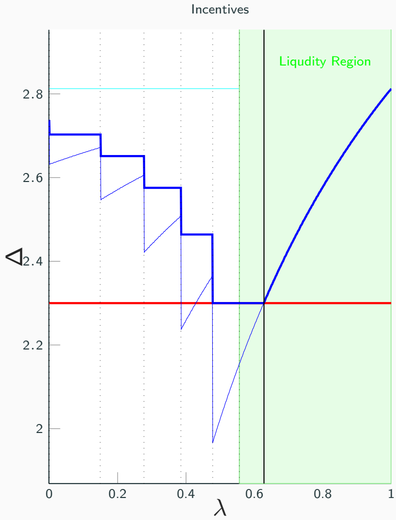
- Formally: optimal policy is recursively determined via IC constraint.
- No backloading: this is expensive because $\rho\beta < \beta$.

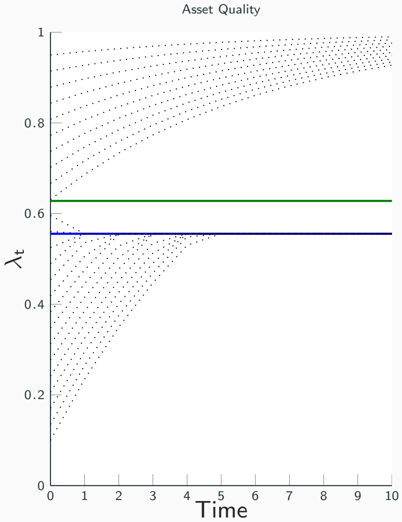
# Waiting is optimal

# Waiting under Budget Constraints

**"Proposition."** If the gov't faces a budget constraint $\sum_t (1 - \lambda_t)\beta^t s(\lambda) \leq \bar{S}$ (or high deadweight cost) it may wait for quality to reach $\bar{\lambda}$ before intervening.

# Our Illustration Again



# Comparative statics: shocks and markets

# Aggregate Asset Quality Shocks

- Mean-zero shocks to $\lambda$ weaken private (but not social) value of effort.
- This is because the *private* (but not the social) premium is concave in $\lambda$.
- Hence, policy must be "countercyclical."

# Interactions with Conventional Monetary Policy

- Imagine lenders charge $1 + r_f$, and $r_f$ has to increase to fight inflation.

- Direct effect: investment potentially less desirable.
- Indirect effect: worse adverse selection problem.

- If some lending remains efficient, subisidies may need to be more generous.

- Imagine borrower have to exit the market with probability $1 - \chi$.
- Upon exit, sell their asset to a new borrower.
- Say the price is $\omega V(\theta, \lambda)$, where $\omega$ is bargaining power.

- Such a sale is neutral for welfare, but it matters for private horizons.
- This maps into an additional discount factor $\xi = \chi + (1 - \chi)\omega$, whereby

$$V(\theta, \lambda | \hat{E}) = \max_{e} \quad \sum_{\theta} p(\theta' | \theta, e)\Big(u(\theta', \lambda') + \beta \xi V(\theta', \lambda' | \hat{E})\Big) - ce$$

$$\text{s.t.} \quad \lambda' = m(\lambda, \hat{E}).$$

- *Any* secondary market friction weakens incentives, but leaves the social value of effort unchanged. Again favors long-term (indefinite?) policy.

# Conclusion

Dynamic model of collateralized lending markets.

- Long-run quality depends on expected market conditions.
- Failure to reach stable and high quality can be managed by policy.

Optimal policy may need to address two goals:

- Restoring market liquidity.
- Fostering stable asset quality.

Doing so simultaneously might require “generous” long-term policies.

Rich interactions with market structure and shocks.