Persuading Multiple Audiences:
An Information Design Approach to Banking Regulation

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Motivation

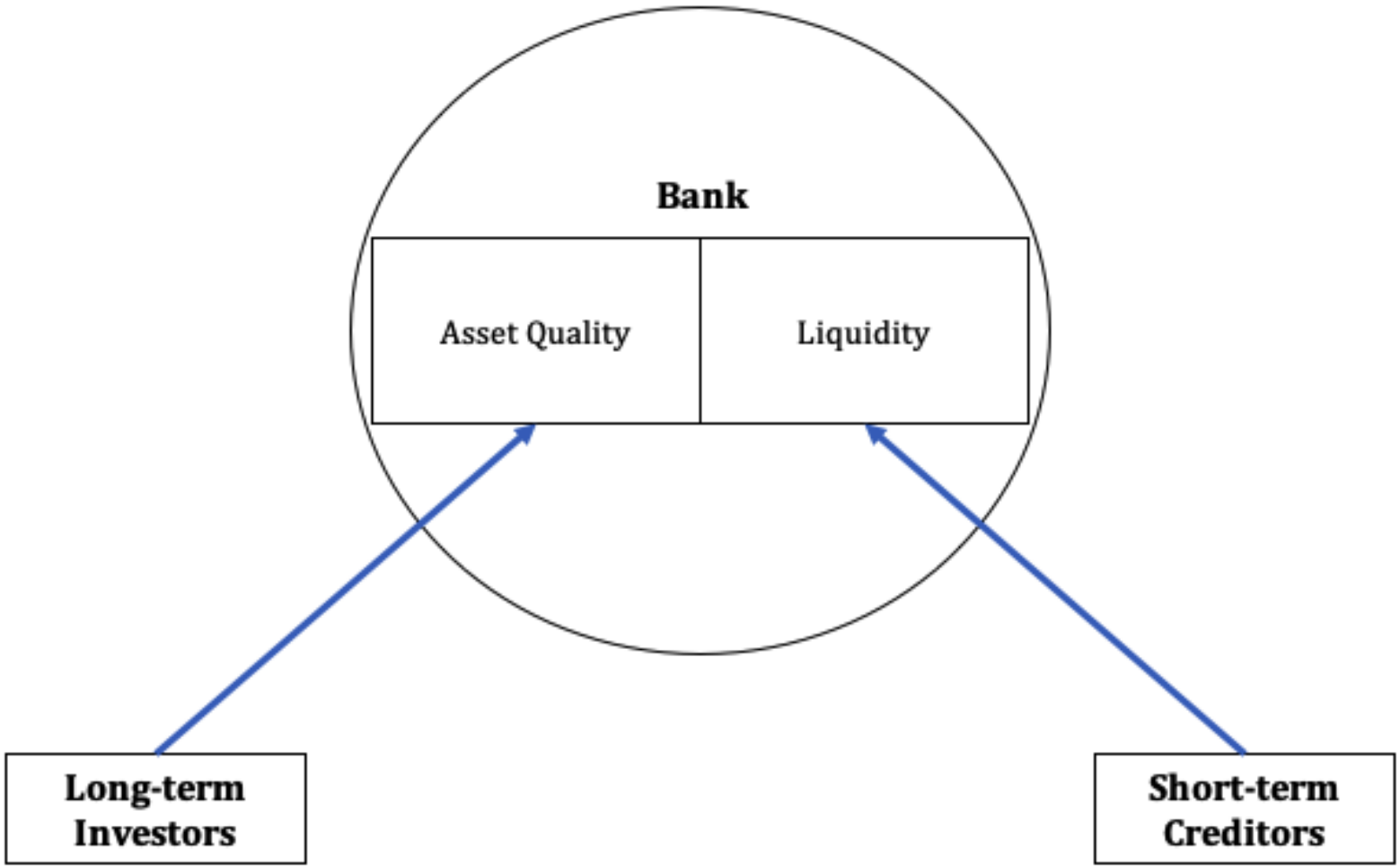
- Stress Tests and Asset Quality Reviews
  - Prominent after 2007-2008 financial crisis
  - Examination Process + Disclosure + Recapitalization
- **Benefits**: Discipline, Provide credible Information about Losses, etc
- **Costs:** Destroy risk sharing, over-reaction public, gaming, etc
- What's the optimal degree of transparency if PM wants to aid a sifi under distress?
- This paper: Information disclosure as *regulatory tool* when public funds limited

Motivation

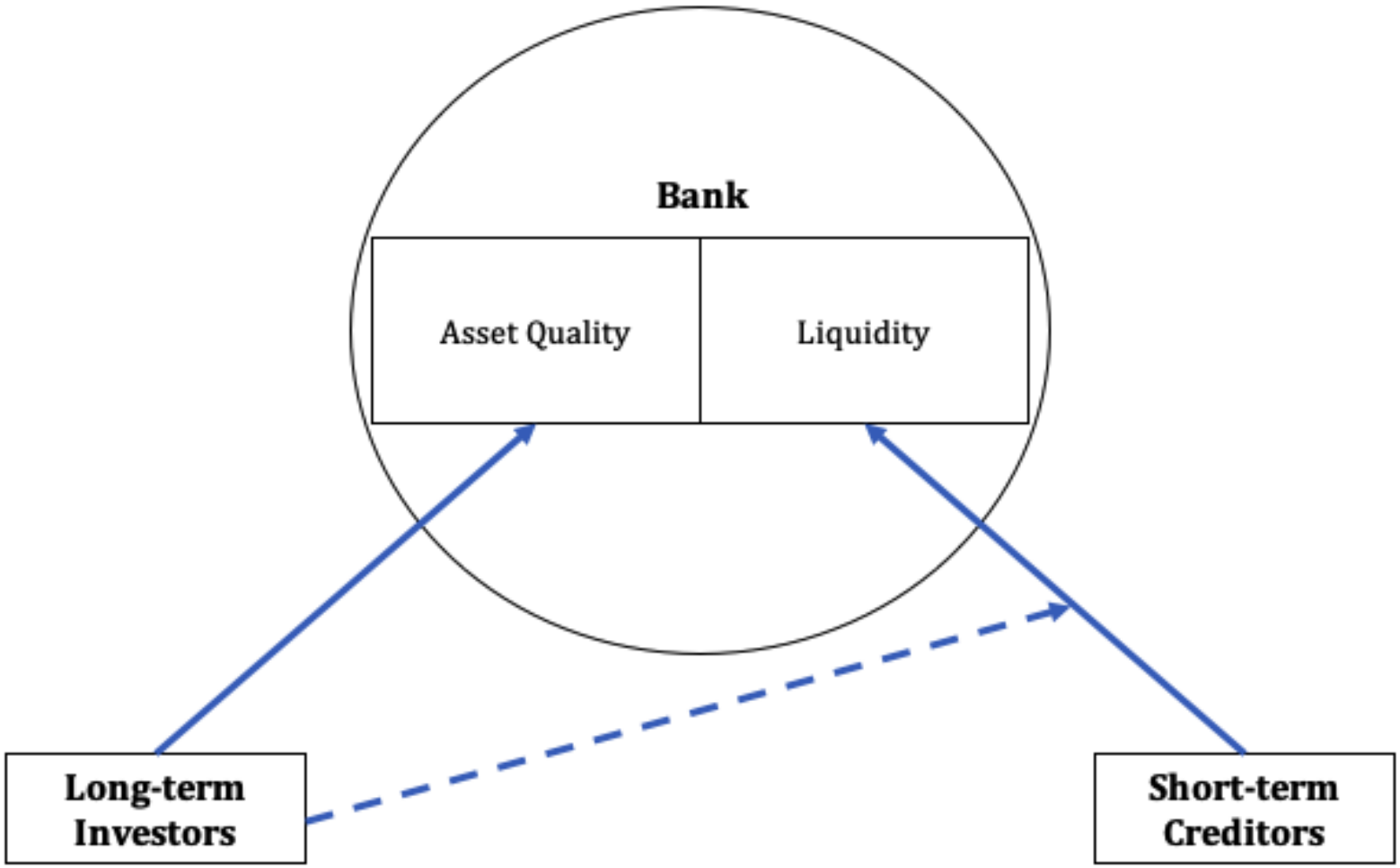
Complexity:

- Many **audiences**
  - Long-term Investors
  - Short-term Creditors
  - Speculators
  - Insurance companies
  - Taxpayers
  - ...
- Many **variables**
  - Asset quality (e.g., NPL)
  - Liquidity
  - Exposure to other sifi
  - ...

Motivation


Bank
Asset Quality
Liquidity
Long-term Investors
Short-term Creditors

Motivation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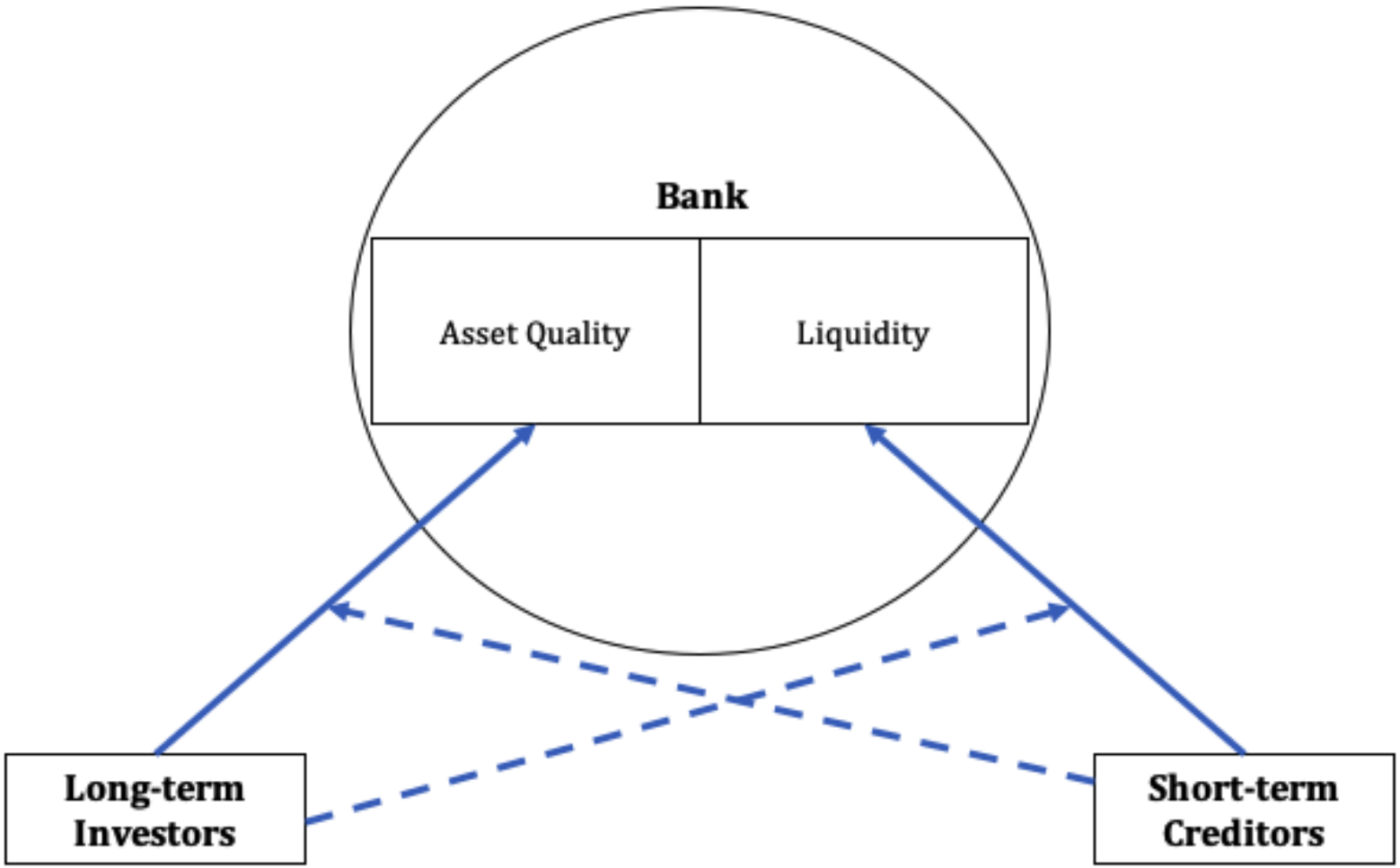
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Asset Quality
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Findings

- Transparency
  - High-quality assets$\rightarrow$ Unique passing grade (Opaque)
  - Poor-quality assets$\rightarrow$ Multiple failing grades (More Transparent)
- Recapitalizations
  - Key to effectiveness of information disclosure. Without: Disclosures may **backfire**
  - Undermine effectiveness of PM's Emergency Lending Mechanisms

Related literature

- **Financial Regulation and Stress Test Design**: Bouvard et al. (2015), Faria-e-Castro et al (2016), Cong et al (2016); Goldstein and Leitner (2018), Orlov et al (2018), Goldstein and Yang (2018), Quigley & Walther (2019), Leitner & Williams (2019), Basak & Zhou (2019), Inostroza and Pavan (2019),...
  Multiple audiences and multi-dimensional fundamentals. Interaction: disclosure and regulatory policies.
- **Security Design:** Myers & Majluf (1984), Nachman & Noe (1994), ... , Daley et al (2018), Yang (2018), Szydlowski (2018), Malenko & Tsoy (2019), Azarmsa & Cong (2019)...
  Interplay information design & security design (endogenous probability of default).
- **Optimal Interventions w Endogenous Participation Constraints.** Philippon & Skreta (2012), Tirole (2012), Fuchs & Skrzypacz (2015).
  Add Information Design (Ex-ante and Interim)
- **Persuasion and Information design:** Myerson (1986), ..., Calzolari and Pavan (2006, Kamenica and Gentzkow (2011), Gentzkow & Kamenica (2015), Ely (2016), Bergemann and Morris (2017), Dworczak & Martini (2018), Li et al (2020), Doval & Ely (2019), Dworczac & Kolotilin (2019), Morris et al (2020) .
  Multiple audiences with different objectives and multi-dimensional state space.

Plan

- Model
- Stress Testing and Recapitalizations
- Emergency Lending Mechanisms
- Conclusions

Model

Market Participants:

- Bank
- Long-term Investors
- Short-term Creditors
- Policy maker

Model

Gradual Resolution of Uncertainty

- $t \in \{1, 2, 3\}$
- **Period 1**
  - Asset profitability $y \in \mathbb{R}_+$
    - ⋆ drawn from F^y
    - ⋆ pays at $t = 3$
  - Bank observes signal $\theta \in \{L, H\}$ about y
    - ⋆ F_θ is posterior given θ

$$F_H \succeq_{MLRP} F_L$$

  - **Bank** can sell claims on its asset to long-term investors

$$s(y) \in [0, y], \ \forall y$$

  - Long-term investors pay P to bank

Model

- **Period 2**
  - Short-term creditors: $i \in [0,1]$, each owns claim of 1

$$a_i = \begin{cases} 1 & \text{withdraw early at t=2} \\ 0 & \text{rollover until t=3} \end{cases}$$

  - $A \in [0,1]$: fraction of early withdrawals.
  - Liquid funds $\omega \sim F^{\omega}$ on $[0,1]$
  - Liquidity Position: $\omega + P$
  - **Bank defaults if**

$$A > \omega + P$$

  - Adversarial Selection

$$\mathbb{E}\left(u_{\text{Run}}\left(\omega, P, A=1\right)\right) \geq 0 \Rightarrow A^{\star}(P) = 1.$$

Model - Actions

Policy-maker

- At $t = 1$
  - Asset quality review $\Gamma^y = \{M^y, \pi^y\}$

$$\pi^y : \quad Y \quad \rightarrow \quad \Delta(M^y)$$

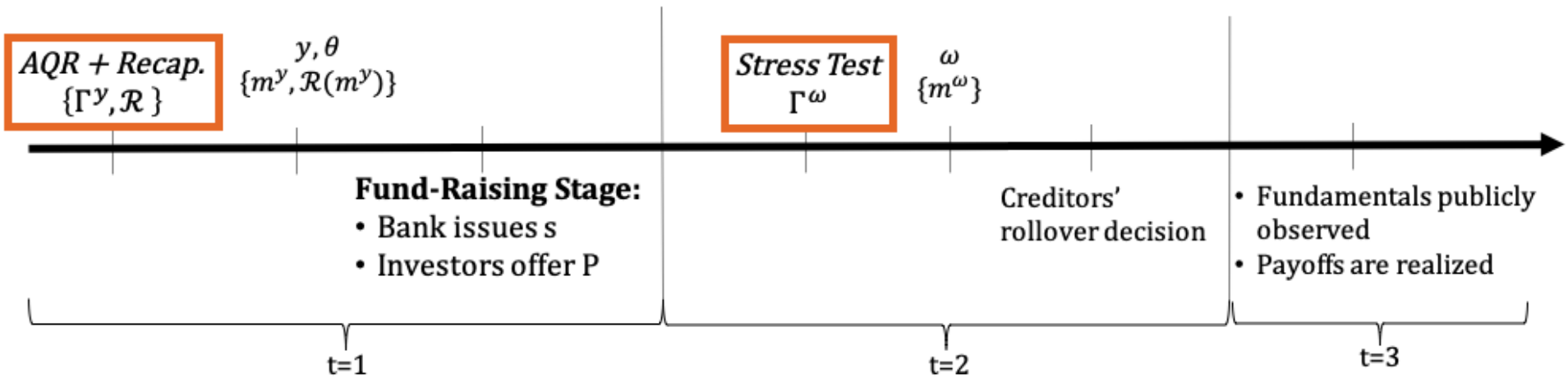
  - Recapitalization $\mathcal{R}(m^y)$

$$\mathcal{R} : M^y \rightarrow \mathbb{R}_+$$

- At $t = 2$,
  - Stress Test $\Gamma^\omega = \{M^\omega, \pi^\omega\}$:

$$\pi^\omega : \quad \Omega \quad \rightarrow \quad \Delta(M^\omega)$$

Timing

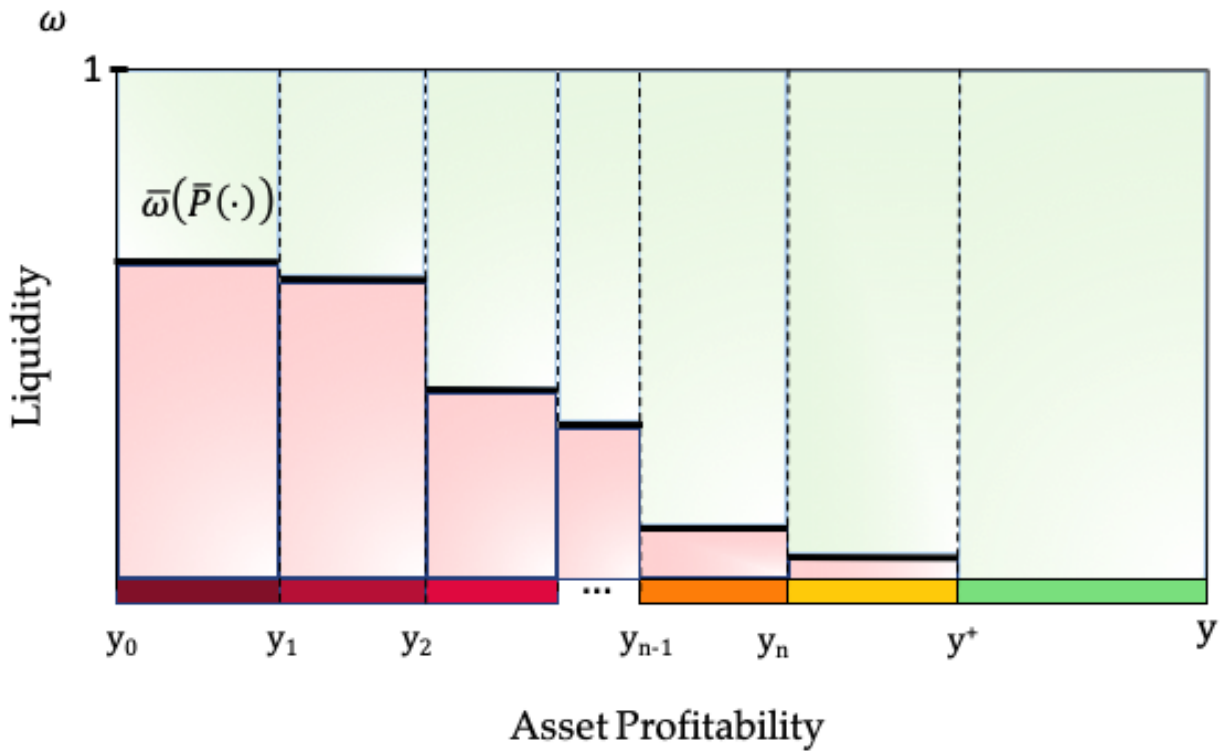

AQR + Recap.
$\{\Gamma^y, \mathcal{R}\}$
y, θ
$\{m^y, \mathcal{R}(m^y)\}$
Stress Test
Γ^ω
ω
$\{m^\omega\}$
Fund-Raising Stage:
• Bank issues s
• Investors offer P
Creditors' rollover decision
• Fundamentals publicly observed
• Payoffs are realized
t=1
t=2
t=3

Plan

- Model
- **Stress Testing and Recapitalizations**
- Emergency Lending Mechanisms
- Conclusions

Comprehensive Assessment

Theorem 1. The Optimal Comprehensive Assessment $\Psi = (\Gamma^y, \mathcal{R}, \Gamma^\omega)$ has monotone partitional structure:



Asset quality revirew Γ^y

- Each score m^y induces $\mathbb{E}(y|m^y)$
- $\Gamma^y = \{M^y, \pi^y\}$ induces distribution, G, of $\mathbb{E}(y|m^y)$
- Blackwell Thm implies PM's problem:

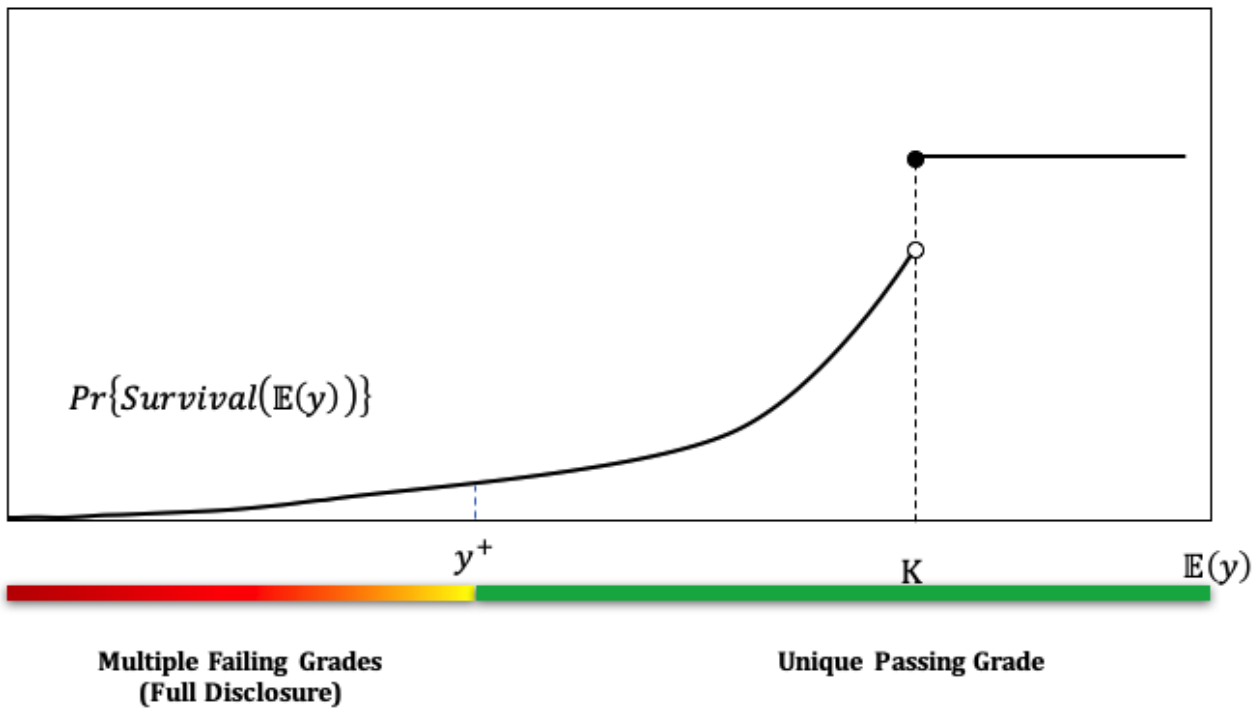
$$\max_{G} \int_0^\infty \mathbb{P}\left\{\text{Survival}\left(\tau\right)\right\} G\left(d\tau\right)$$
$$\text{s.t:} \quad F^y \succeq_{MPS} G$$

- Solution: Monotone Partitional Structure
- Duality arguments

(Proof Thm 1)

Driving Forces

- Amplification mechanism with low quality assets
  - $\uparrow$ quality$\Rightarrow\uparrow P\Rightarrow\uparrow\mathbb{P}\{\text{survive}\}\Rightarrow\uparrow P\Rightarrow\ldots$



- Flannery, Hirtle and Kovner (2017) and Ahnert et al. (2019) find US STs more informative for banks with poorer balance sheets.

Need of Recapitalizations

- Banks (residual) private information θ induces separation incentives during fund-raising stage (**Lemons Problem**)
- Absence of disclosures: threat of runs imposes discipline during fund-raising stage $\Rightarrow$ banks raise precautionary funds
- With Stress Tests: $\mathbb{P}\{\text{survival}\}$ goes up $\Rightarrow$ exarcebates incentives to signal by exposing to rollover risk.
- Recapitalizations bring discipline back. PM threats with forbidding dividends if precautionary funds are not raised.

Plan

- Model
- Stress Testing and Recapitalizations
- Recapitalizations
- **Emergency Lending Mechanism**
- Conclusions

Conclusions

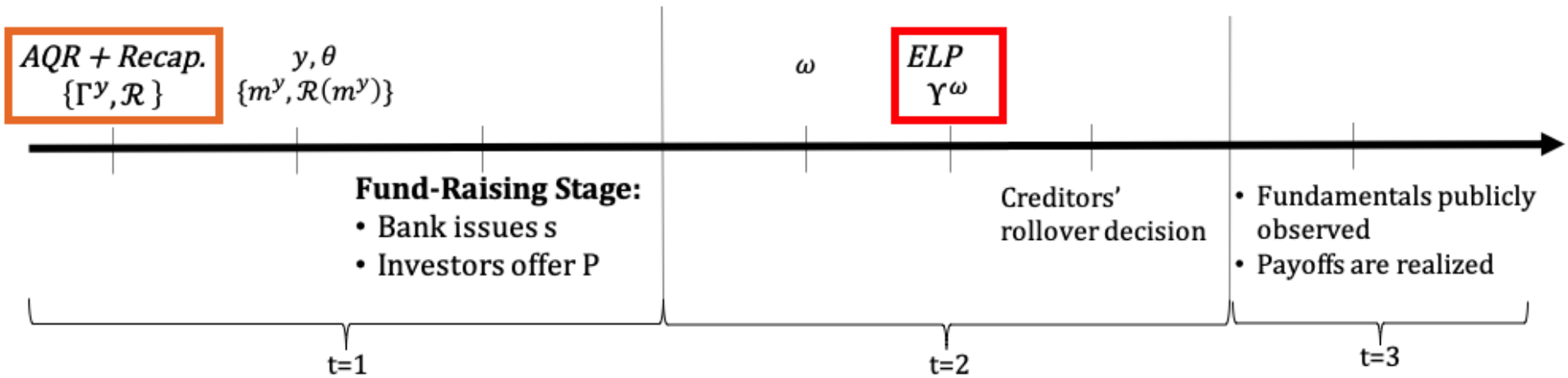
- Information Disclosure with Multiple Audiences and Multi-Dimensional Fundamentals
- Endogenous Interaction of Multiple Audiences
  - High-quality assets: (Opaque) Single passing grade
  - Low-quality assets: (More transparent) Multiple failing grades
- Recapitalizations:
  - Key to effectiveness of Disclosure Policies
  - Undermine effectiveness of PM's Emergency Lending Programs
- Public + Private Sector Interventions: Substitutes

THANK YOU

Emergency Lending: Screening and Persuasion

- Goal: Interplay between **Info Disclosure** & PM's role as **LOLR**
- Emphasis on Urgency of Events
  - PM can't conduct Liquidity ST in period 2
- PM may use **public funds** but to purchase securities under a *budget balance* constraint (Bagehot principle)
- Room for information transmision $\rightarrow$ **Emergency Lending Mechanism**:
  - Asks bank to self-report private information ω
  - Provides liquidity by **purcahasing assets** and a **public diclosure**

Timing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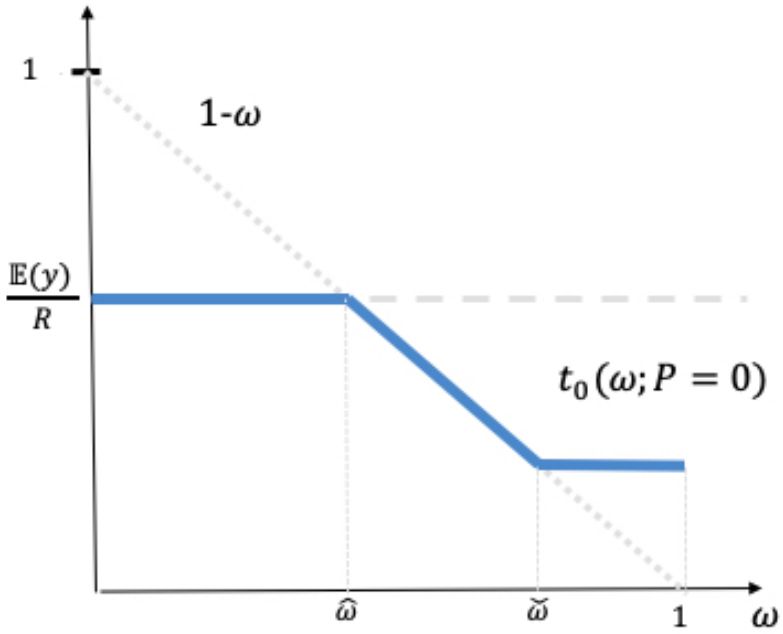
Comprehensive Intervention

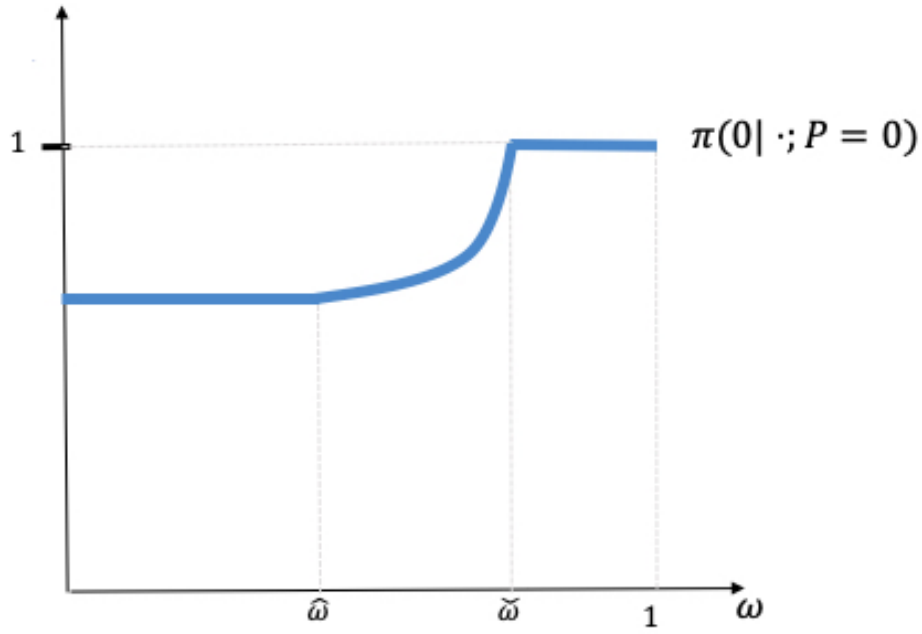
Designing Emergency Lending Mechanism

- Conflict: Credibility and Incentive Compatibility.
- Optimal mechanism assigns stochastic pass/fail grades. Conditional on passing, liquidity is provided
- Liquidity types passed with **lower probability** (illiquid), are compensated with **better prices** for assets (smaller discounts).

Optimal Emergency Lending Mechanism



Transfers

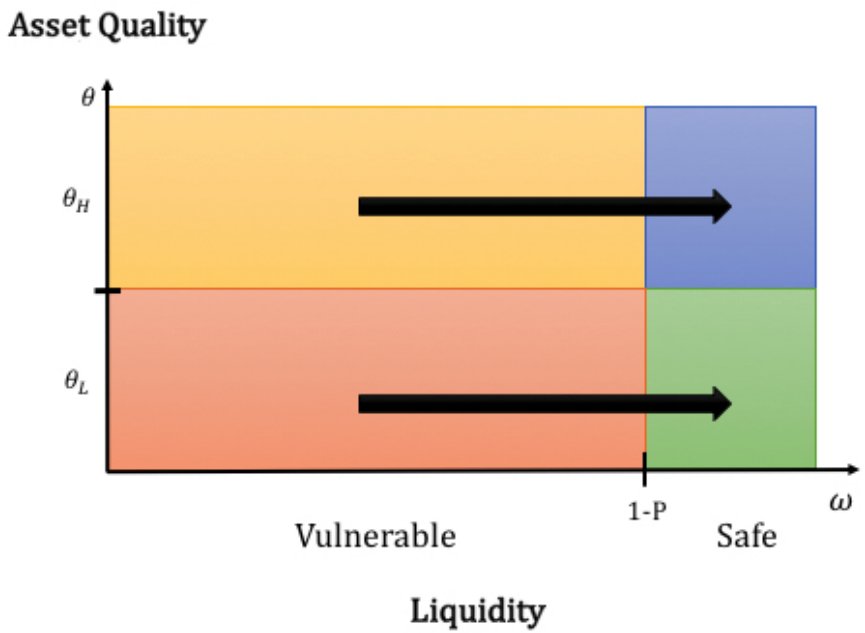


Probability of Passing

Figure : Optimal Emergency Lending Program

Emergency Lending Mechanism: Screening and Persuasion

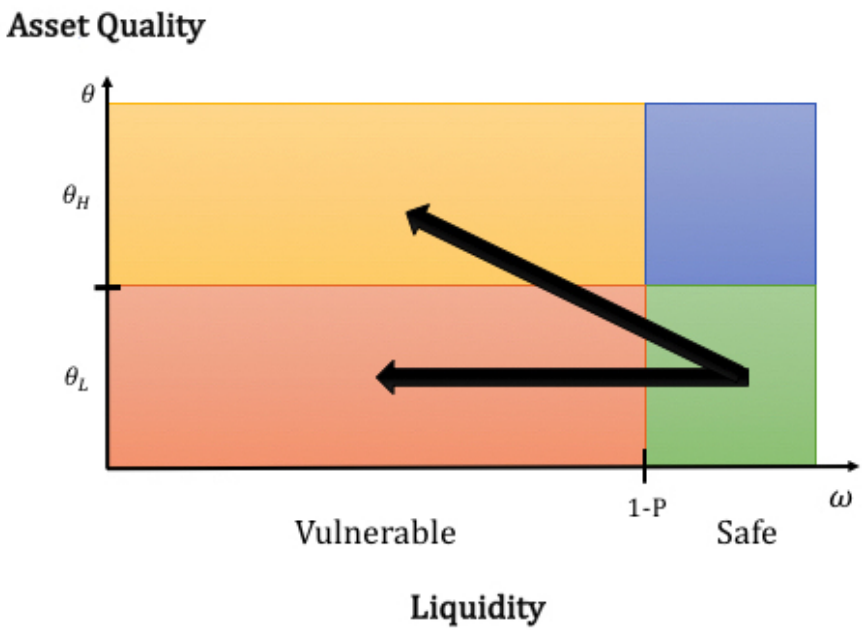
- To avoid $\{\omega < 1 - P\}$ mimic: PM fails safe banks with large probability
- Average liquidity passing banks deteriorates
- *Most illiquid banks passed with low probability.*



Emergency Lending Mechanism: Screening and Persuasion

Moreover,

- To avoid $\{(\theta_L, \omega > 1 - P)\}$ mimic $\{\omega < 1 - P\}$: *PM cannot pledge more than* $\frac{1}{R}\mathbb{E}_L(y - s)$.
- Best Resolution Program sets $P = 0$.



Optimal ELM- Observable Asset Quality Type

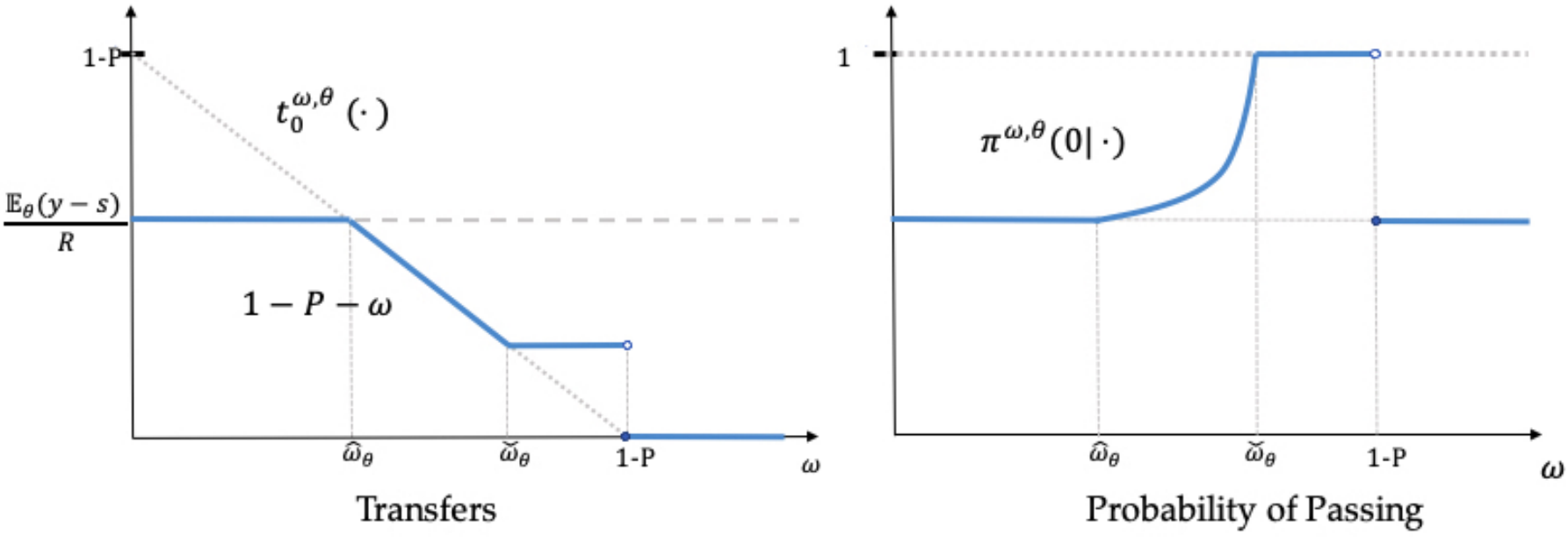


Figure : Emergency Lending Program with Observable Quality

Government & Private Sector - Substitutes

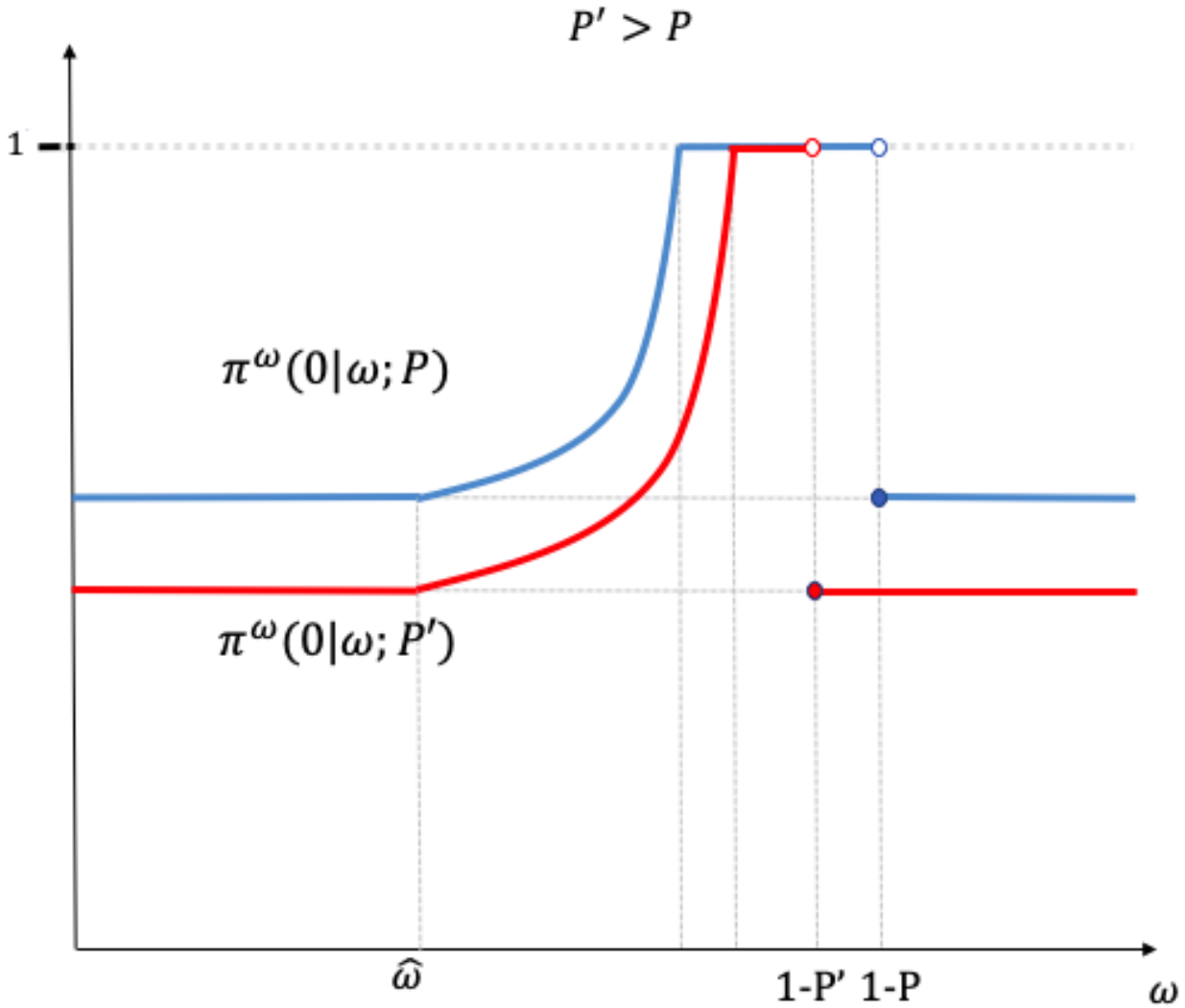


Figure : Probability of passing $\pi^{\omega,\theta}(\mathit{pass}|\cdot)$

Model-Payoffs

- Bank:

$$u^B(\omega, \mathcal{R}, s, P, A, y) = \left(P + \frac{y - s(y)}{R}\right) 1\{P + \omega \geq A\} 1\{P \geq \mathcal{R}\}$$

- Investors

$$u^I(s, P, A, y; \mu) = \frac{s(y)}{R} 1\{\omega + P \geq A\} - P$$

- Short-term creditors:
  - Withdraw early: 0
  - Rollover:

$$u_{\text{Rollover}}(\omega, P, A) = \begin{cases} g > 0, & \omega + P \geq A \\ b < 0, & \omega + P < A \end{cases}$$

- Policy-maker

$$u^P(\omega, P, A) = \underbrace{W_0(A)}_{\downarrow A} \times 1\{\omega + P > A\}.$$

Emergency Lending: Screening and Persuasion

- Constraints:
  - PM cannot force bank to accept deal (Individual Rationality).
  - PM cannot pay more than faire-price of securities (Budget Balance)
  - Bank willingly discloses its private information (Incentive Compatibility)

Optimal Interventions

Theorem 1

Optimal Comprehensive Policy $\Psi = (\Gamma^y, R, \Upsilon^\omega)$ *follows partitional structure and features non-monotone pecking order:*

(1) If $y \geq y^+$*: single pass grade,* m^y_{pass}*, with* $\mathbb{E}(y|m^y_{pass}) \geq K$*, and* $R\left(m^y_{pass}\right) = K$ *[Private Sector Funding].*

(2) If $y^- < y < y^+$*, multiple failing grades + liquidity provision,* $P = 0$ *[Liquidity Provision Program].*

(3) If $y \leq y^-$*: Multiple failing grades, and bank sells whole asset*

Motivation

- Fed's Approach
  - Disclosures: Stress Tests (DFAST + CCAR) $\rightarrow$ Report + 3 grades
  - Recapitalizations: Public Recommendations
- ECB's Approach:
  - Disclosures: Asset Quality Review (ECB+ESRB)+ Stress Tests (EBA)$\rightarrow$ Report + No grades
  - Recapitalizations: Private Recommendations (SREP)