# Variation margins, fire sales, and information-constrained optimality

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# Research question

Counterparty risk in derivatives contracts (e.g., Lehman bankruptcy)

Call for higher margin/collateral requirements (Dodd-Frank, EMIR)

But margin calls can trigger inefficient fire sales (BIS, 2010; ESRB 2017; Gromb & Vayanos, 2002)

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**Are privately optimal variation margins also socially optimal?**

# What we do: General equilibrium with optimal contracting

Risk-averse agents with risky endowment (protection buyers)

Interim public signal about future value of endowment

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Risk-neutral protection sellers with limited liability

- Unobservable effort to limit downside risk of own assets
- Extension: Unobservable risk-shifting on own assets

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Risk-averse investors with safe asset

- Can hold protection-seller asset
- But are less efficient

# Results

1. Characterize information-constrained optimum (second best)

    Imperfect risk-sharing (unequal marginal rates of substitution)

    Possible asset transfer from protection sellers to investors

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1. Characterize information-constrained optimum (second best)

    Imperfect risk-sharing (unequal marginal rates of substitution)

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2. Analyze market equilibrium (write & trade optimal contracts)

    Unobservable effort → endogenous market incompleteness

    Derivative contracts with possible variation margin calls

    Protection sellers sell own asset to investors

# Results

**3** Market equilibrium is information-constrained efficient

Despite asset sale reducing cash proceeds for everyone

Protection buyers share fire-sale risk with investors

# Outline

Model

First best

Second best

Market equilibrium

[Implementation]

Pecuniary externality and constrained efficiency

[Regulatory and empirical implications]

# Model

# Agents

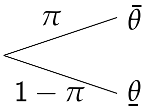
Risk-averse protection **buyers** with utility $u$ and risky $\theta$-asset (e.g., commercial bank with mortgages)

Risk-neutral protection **sellers** with risky $R$-asset (e.g., investment bank)

Risk-averse **investors** with utility $v$ and safe endowment (e.g., sov. wealth fund)

# $\theta$-asset (protection buyers)

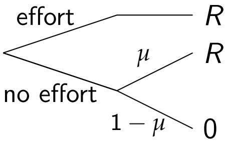
Risky payoff




(aggregate shock to all protection buyers)

# $R$-asset (protection sellers)

Shirking on unobservable costly effort $\rightarrow$ more risk




Constant per-unit cost of effort $\psi$

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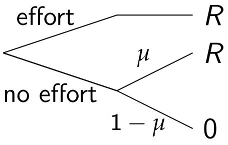



Constant per-unit cost of effort $\psi$

Pledgeable return (Holmström & Tirole, 1997)

$$\mathcal{P} \equiv R - \frac{\psi}{1-\mu} > 0$$

# Time line

**t=0**

Agents receive endowments $(\tilde{\theta}, \tilde{R}, m)$

**t=1**

Informative signal $\tilde{s} \in \{\underline{s}, \bar{s}\}$ about $\tilde{\theta}$

Transfer of fraction $\alpha$ of $R$-asset from protection sellers to investors who are less efficient at running them, $\psi_I(\alpha) > \psi$

Protection sellers decide to exert effort

**t=2**

Asset payoffs occur, $(\bar{\theta}, \underline{\theta})$, $(R, 0)$

Agents consume

# First Best

# Planner's problem

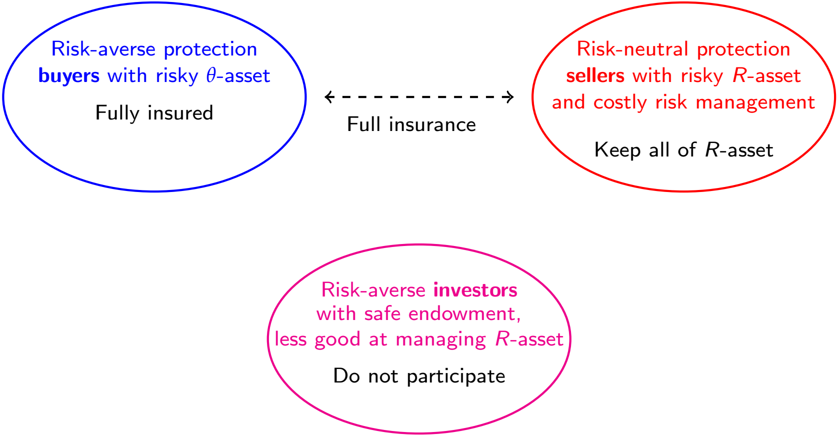
Planner imposes effort and solves

$$\max_{\substack{c_B(\theta,s), c_S(\theta,s) \\ c_I(\theta,s), \alpha(s)}} \quad \omega_B E[u(c_B(\theta,s))] + \omega_I E[v(c_I(\theta,s) - \alpha(s)\psi_I(\alpha))]$$

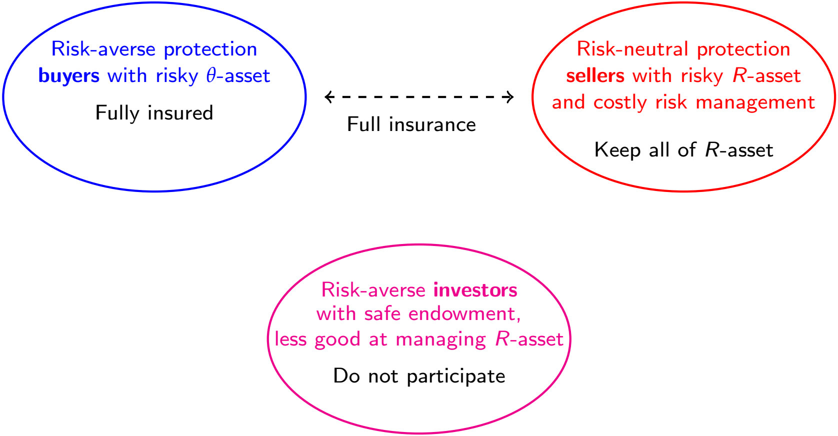
subject to participant and resource constraints

($\omega_S = 0$ corresponds to zero bargaining power in market setup)

# First best


Risk-averse protection **buyers** with risky $\theta$-asset
Fully insured
Full insurance
Risk-neutral protection **sellers** with risky $R$-asset and costly risk management
Keep all of $R$-asset
Risk-averse **investors** with safe endowment, less good at managing $R$-asset
Do not participate

# First best




All marginal rates of substitution equal (=1)

Second best

# Second-best problem

Induce effort via incentive constraints

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Induce effort via incentive constraints

Only the constraint after a bad signal binds

$$E[c_S(\theta, \underline{s})|\underline{s}] \geq (1 - \alpha(\underline{s}))\frac{\psi}{1-\mu}$$

# Second-best


Risk-averse protection
**buyers** with risky $\theta$-asset
Exposed to signal risk (only)
Moral hazard limits
insurance after
bad signal
Risk-neutral protection
**sellers** with risky $R$-asset
and moral hazard
Keep only part of $R$-asset

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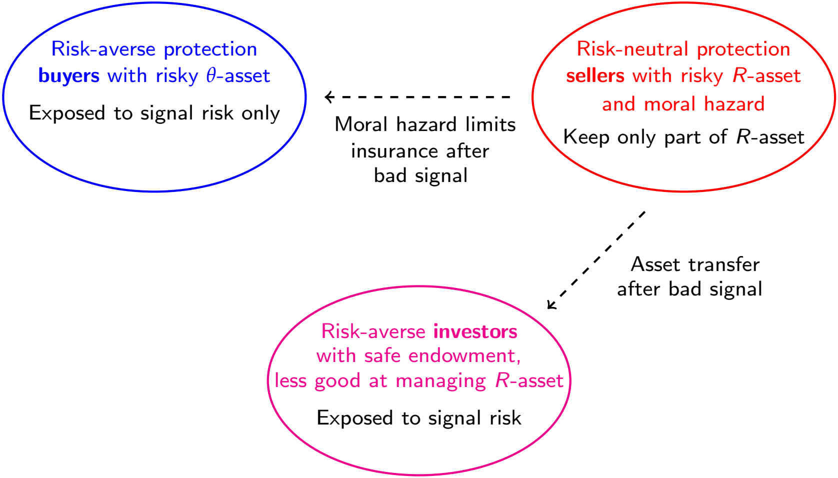
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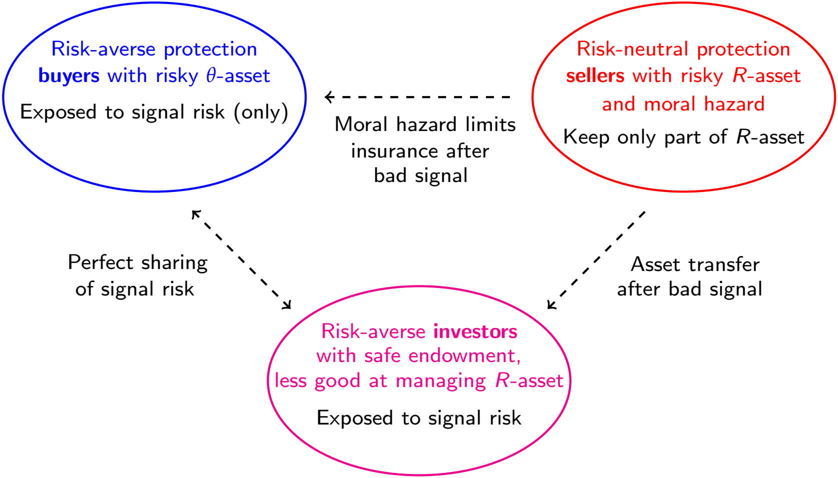
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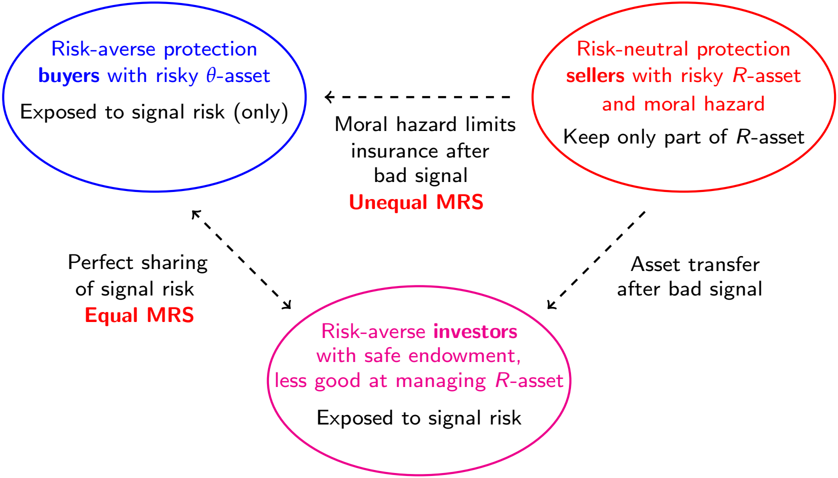
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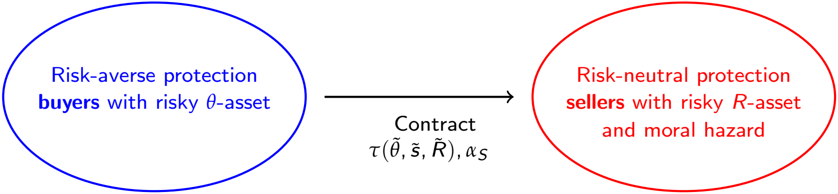
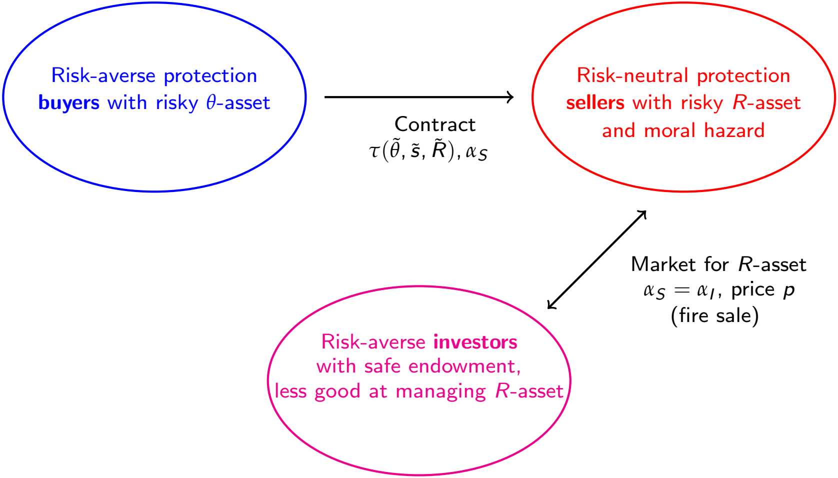
# Market equilbrium

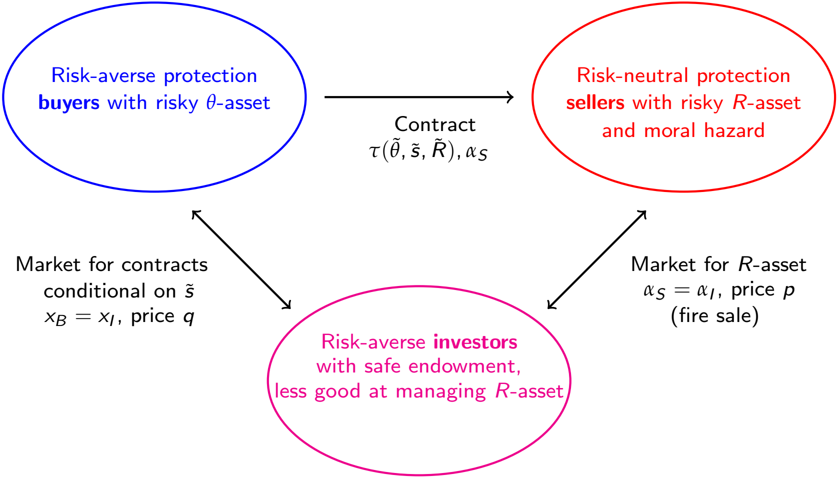
# Optimal contracting



# Asset market



# Insurance market



# Variation margin (McDonald & Paulson, 2015, “'AIG in Hindsight')

Many **derivatives contracts** have zero market value at inception... As time passes and prices move... [derivatives'] fair value **[becomes] positive for one counterparty and negative ... for the other**. In such cases it is common for the negative value party to make a compensating payment to the positive value counterparty. Such a payment is referred to as **variation margin**

# Variation margin (McDonald & Paulson, 2015, "'AIG in Hindsight')

... this transfer of funds based on a market value change is classified as a change in **collateral** and not as a payment... collateral is held by one party against the prospect of a loss at the future date when the contract matures or makes payment on a loss.

If the contract ultimately does not generate the loss implied by the market value change, **the collateral is returned**.

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Derivative contract: $\tau(\tilde{\theta}, \tilde{\mathbf{s}}, \tilde{R})$

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Asset sale + using proceeds as collateral

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Protection seller incentive constraint

$$\underbrace{\alpha_S p}_{\text{cash from asset sale}} + \underbrace{(1-\alpha_S)\mathcal{P}}_{\text{assets under seller control}} \geq \underbrace{E[\tau(\theta, s)|\underline{s}]}_{\text{liability (derivative position)}}$$

# Pecuniary externality and constrained efficiency

# Pecuniary externality, but planner cannot do better

Pecuniary externality

- Larger asset sale $\alpha$
- Lower asset price $p = R - \frac{d(\alpha\psi_I(\alpha))}{d\alpha}$
- Lower collateral value of sellers' asset $\alpha p$
- Less incentive-compatible insurance for all buyers

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Usual argument for intervention

- Limit margins $\rightarrow$ fewer asset sales

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But higher price $p \rightarrow$ less profit for investors

# Internalization: Insuring fire-sale risk

Fire sale (bad signal, $\underline{s}$)

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$\Rightarrow$ Room for ex-ante trade of contracts contingent on signal $s$

# Concluding remarks

Bad new about insured risk $\rightarrow$ deposit cash on margin account

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- Still, market is (endogenously) incomplete

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Insuring fire-sale risk internalizes the externality

- Still, market is (endogenously) incomplete

Instead of regulating margins, policy should promote insurance against fire-sale risk

# Additional slides

# Literature

Equilibrium inefficiency when markets are exogenously incomplete

Stiglitz (1982), Geanakoplos & Polemarchakis (1986), Greenwald & Stiglitz (1986), Gromb & Vayanos (2002), Lorenzoni (2008), Davila & Korinek (2017)

Equilibrium efficiency and optimal contracting, but no interim trades (no fire sales)

Prescott & Townsend (1984), Kehoe & Levine (1993), Kocherlakota (1998), Alvarez & Jermann (2000), Kilenthong & Townsend (2014)

# Literature

Collateralized lending and fire sales, but no normative analysis

Brunnermeier & Pedersen (2009), Acharya & Viswanathan (2011), Fostel & Geanakoplos (2014), Kuong (2016), Kurlat (2018)

Inefficient fire sales in other contexts

Caballero and Krishnamurthy (2003), Stein (2012), Kondor & He (2016)

# Empirical implications

Endogenous correlation of asset value (contagion)

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Endogenous correlation of asset value (contagion)

- After bad signal $\rightarrow$ drop in expected value of $\theta$-asset
- Margin call $\rightarrow$ asset sale $\rightarrow$ lower price for $R$-asset
- No such co-movement in first best

Only after bad news

Stronger if agent subject to margin call has worse governance

Stronger if markets incomplete

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Promote participation of those who lose and gain in fire sale