Financial Literacy and Precautionary Insurance

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Insurance contracts are complex

Insurance contracts are

- long: 20,000 words in typical UK home insurance contracts
  vs. 30,644 words in *Charlie and the Chocolate Factory*
  ⇒ *Which one do you prefer?*
- written in legalese language requiring profound knowledge (Cogan (2010))
  ⇒ Only 22% of consumers know the meaning of "co-insurance" (Policygenius (2016)).

⇒ Insurance is hard to understand.

Consumers are financially illiterate

- Low level of financial literacy, even in developed countries (Lusardi and Mitchell (2011))

  ⇒ Difficulties in understanding insurance products (Policygenius (2016)) and retirement savings plans (The Guardian Life Insurance Company of America (2017))
- Financial illiteracy correlates with shortcomings in retirement planning (Lusardi and Mitchell (2011)), debt problems (Lusardi and Tufano (2015)), and inefficient portfolio choices (Van Rooij et al. (2011))

⇒ Substantial impact of financial illiteracy on consumer's ability to manage risk & welfare

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⇒ Substantial impact of financial illiteracy on consumer's ability to manage risk & welfare

Mapping of illiteracy to decisions?
Implications for insurance demand + supply in particular?

Modeling the consumers' perspective

- Insurance contracts include elements of different complexity:
  $\Rightarrow$ Premium: straightforward to understand
  $\Rightarrow$ Indemnity payment: difficult to assess
- Previous literature models financial illiteracy by either small expected returns (Jappelli and Padula (2013), Lusardi et al. (2017)) , information neglect (Gabaix and Laibson (2006)),or random choice (Carlin (2009))
  $\Rightarrow$ Rationale: more illiteracy $\approx$ less information
- Our focus: Financial illiteracy $\approx$ few information $\Rightarrow$ uncertainty about (insurance) payout

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Example: Consider flood insurance, where different kinds of losses are covered at different levels. Assume you expect 70% of your flood losses being covered and you can purchase co-insurance coverage $q \geq 0$.

If contract perceived as actuarially fair, for paying $P = qp0.7L$ consumers expect to receive uncertain indemnity $q(0.7 + \tilde{\vartheta})L$ with $\mathbb{E}[\tilde{\vartheta}] = 0$.

Our Contribution: (1) Insurance Demand

We study contract complexity in classical insurance models.

Idea: the less consumers understand about insurance, the more uncertain they are about insurance payout $\Rightarrow$ endogenous background risk in loss state

Main finding:
Complexity increases

a) riskiness of insurance $\Rightarrow$ less insurance demand *(risk aversion)*
b) riskiness of wealth $\Rightarrow$ more insurance demand *(prudence)*
= "precautionary insurance" (Eeckhoudt and Kimball (1992))

$\Rightarrow$ Complexity increases optimal coverage for sufficiently prudent consumers.

$\Rightarrow$ Rationale for consumer protection.

Our Contribution: (2) Equilibrium and Financial Illiteracy Premium

Idea: Insurers can exert costly effort to reduce contract complexity.

Main findings:

- Since low complexity is costly, competitive equilibrium may feature complex contracts.
- Measure for the economic cost of financial illiteracy: maximum willingness-to-pay to remove financial illiteracy ($\approx$ perfectly educating consumers)
  $=$ Financial illiteracy premium
- Risk aversion drives the financial illiteracy premium, since more risk averse consumers are more sensitive toward the uncertainty implied by complexity.
  $\Rightarrow$ Effectiveness of consumer education increases with risk aversion.

Related Literature

- Complexity is indemnity risk (Lee (2012))
  ⇒ New insights about insurance demand with indemnity risk
- Nonperformance risk (Doherty and Schlesinger (1990), Doherty and Eckles (2011))
  ⇒ *Difference to contract complexity:* downside risk (wealth + risk effect)
- Prudent consumers respond to future risk via precautionary saving (Rothschild and Stiglitz (1971), Kimball (1990)); and respond to additive background risk via precautionary insurance (Eeckhoudt and Kimball (1992), Gollier (1996), Fei and Schlesinger (2008))
- Firms may exploit biased decision-making of financially illiterate consumers (DellaVigna and Malmendier (2004), Gabaix and Laibson (2006), Carlin (2009))
  ⇒ We highlight *uncertainty* as a channel for financial illiteracy to affect equilibrium supply and demand.

Detailed model comparison

Overview

Model

- Risk averse consumers have initial wealth w_0 and concave utility function $u(\cdot)$
- Loss $L > 0$ occurs with probability $0 < p < 1$
- Insurance contracts are from consumer perspective: while consumers know premium $\$\alpha$, they have subjective belief about payout.
- Average per-unit payout: I (subjective and conditional on loss)
  $\Rightarrow$ Pay $\$\alpha$; belief to receive $\$\alpha I$ on average upon loss, and 0 otherwise.
  $\Rightarrow$ Insurance is perceived as actuarially fair if $pI = 1$.
  $\Rightarrow$ Full insurance if $\alpha I = L$.

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  $\Rightarrow$ Insurance is perceived as actuarially fair if $pI = 1$.
  $\Rightarrow$ Full insurance if $\alpha I = L$.
- Contract complexity = zero-mean risk to per-unit payout $I + \tilde{\vartheta} = \begin{cases} I + \varepsilon, & 1/2, \\ I - \varepsilon, & 1/2. \end{cases}$
  $\Rightarrow$ ε = standard error = level of complexity

Model: Illustration

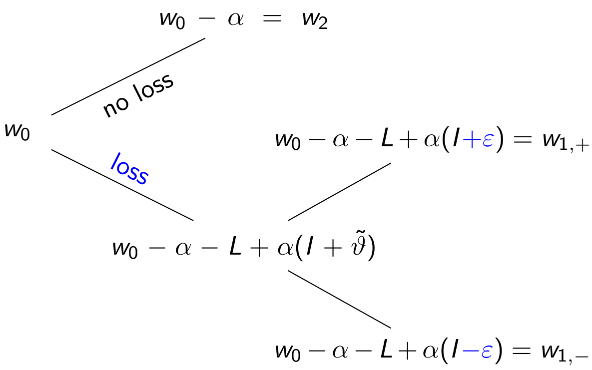

Figure: Consumer wealth.

E.g., total flood loss is L. Upon paying \$$\alpha$, consumers belief insurer to cover either $\alpha(I - \varepsilon) = 60\%$ or $\alpha(I + \varepsilon) = 80\%$ of L.

Overview

Insurance Demand

Partial equilibrium perspective: Given expected payout I and complexity ε, consumers maximize expected utility w.r.t. co-insurance coverage $\alpha \geq 0$

$$EU(\alpha) = \frac{p}{2} \underbrace{\left(u(w_{1,+}) + u(w_{1,-})\right)}_{\text{loss}} + (1-p) \underbrace{u(w_2)}_{\text{no loss}} .$$

Our focus: How does optimal insurance coverage react to changes in ε?

Optimal insurance coverage

$$\text{FOC:} \qquad \underbrace{(I-1)\mathbb{E}[u_1']}_{\text{(II)}} - \underbrace{\varepsilon \frac{u_{1,-}' - u_{1,+}'}{2}}_{\text{(I)}} = \frac{1-p}{p} u_2'.$$

(I) Smooth marginal utility <u>within loss</u> state.
Penalize insurance coverage if complexity large.
$\Rightarrow$ Risk aversion effect.

(II) Smooth marginal utility <u>across loss and no-loss</u> state.
Increases with complexity ε if $u''' > 0$ (= prudence).
$\Rightarrow$ Insurance becomes more valuable with higher ε since it transfers background risk to higher wealth states. $\Rightarrow$ Precautionary insurance

Optimal insurance coverage

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(I) Smooth marginal utility within loss state.
Penalize insurance coverage if complexity large.
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(II) Smooth marginal utility across loss and no-loss state.
Increases with complexity ε if $u''' > 0$ (= prudence).
⇒ Insurance becomes more valuable with higher ε since it transfers background risk to higher wealth states. ⇒ Precautionary insurance

⇒ **Trade-off between (I) less and (II) more insurance** upon increase in ε.
⇒ Ultimate effect depends on the level of **prudence**, i.e., convexity of u'.

Demand for insurance and prudence

Lemma (Precautionary insurance)

(1) *Optimal insurance coverage decreases with complexity ε for imprudent consumers ($u''' \leq 0$).*

Demand for insurance and prudence

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(1) *Optimal insurance coverage decreases with complexity ε for imprudent consumers ($u''' \leq 0$).*

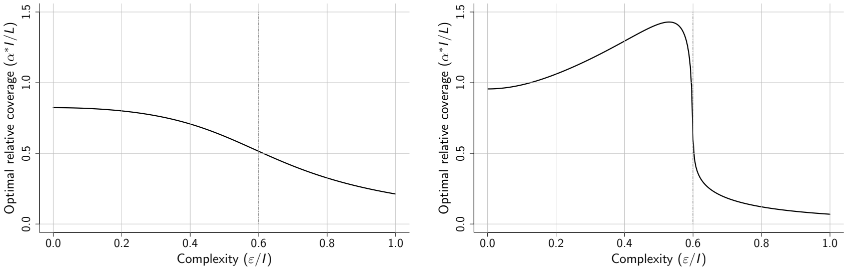
(2) *If $\varepsilon < I - 1$ and (in equilibrium)*

$$\underbrace{-\frac{\bar{u}_1'''}{u_{1,-}''}}_{\approx \text{Absolute prudence}} > \frac{2}{\alpha(I-1)},$$

optimal insurance coverage increases with the level of complexity ε, where $\bar{u}_1''' = \frac{u_{1,-}'' - u_{1,+}''}{w_{1,-} - w_{1,+}}$ is the average slope of u'' in the loss state. If $\varepsilon \geq I - 1$, optimal insurance coverage decreases with ε.

*A similar condition as in (2) holds for general indemnity risk distributions.

Example: Optimal coverage



(a) Less prudent ($ARA = 0.05$). (b) More prudent ($ARA = 0.2$).

Figure: Consumer with initial wealth $w_0 = 100$ maximizes CARA utility for $L = 50$ with $p = 0.3$ and $I = 2.5$, implying a relative price loading $\frac{1-pI}{pI} = 1/3$.

$\Rightarrow$ If $\varepsilon/I > (I-1)/I = 0.6$, $w_{1,-}$ is decreasing with coverage.

$\Rightarrow$ Sufficiently prudent consumers might want to *overinsure* ($\alpha^* I > L$) for $\varepsilon < I - 1$.

Overinsurance

Define expected payout above loss as overinsurance, $\alpha I > L$.

Proposition

Let $\varepsilon < I - 1$. If prudence is sufficiently large (at optimal insurance coverage) such that

$$-\frac{\bar{u}'''}{\bar{u}''} > \frac{1}{2\alpha(I-1)}\left(1 + \frac{1-pI}{\alpha\varepsilon^2 p}\left(-\frac{u'(\mathbb{E}[w_1])}{\bar{u}''}\right)\right),$$

then consumers demand overinsurance ($\alpha^* I > L$), where $\bar{u}_1''' = \frac{u''_{1,-} - u''_{1,+}}{w_{1,-} - w_{1,+}}$ and $\bar{u}_1'' = \frac{u'_{1,-} - u'_{1,+}}{w_{1,-} - w_{1,+}}$.

$\Rightarrow$ Sufficiently prudent (large $-u'''/u''$) consumers demand overinsurance.

$\Rightarrow$ If insurance is actuarially fair ($pI = 1$), $-\frac{\bar{u}'''}{\bar{u}''} > \frac{1}{2\alpha(I-1)}$ is sufficient for overinsurance.

Overview

Firms

Experienced complexity (= uncertainty faced by consumers) depends on (a) actual contract complexity (e.g., # words) and (b) consumer illiteracy:

$$\varepsilon = \underbrace{\nu}_{\substack{\text{actual complexity} \\ \text{(firms)}}} \times \underbrace{\beta}_{\substack{\text{illiteracy} \\ \text{(consumers)}}}$$

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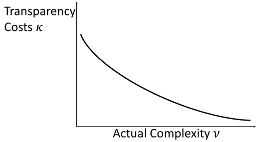
Offering contracts with lower complexity ν generates larger transparency costs for firms, $\kappa = \kappa(\nu)$, $\kappa' < 0$, $\kappa'' > 0$.



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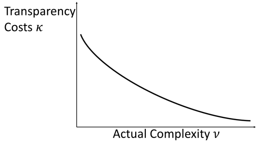


Firms are risk neutral, compete over payout I and actual complexity ν, and are willing to sell any contract at non-negative expected profit

$$\Gamma(\alpha, \nu, I) = \alpha(1 - pI) - \kappa(\nu) \geq 0.$$

Consumers

$$\boxed{\varepsilon = \underbrace{\nu}_{\substack{\text{actual complexity}\\ \text{(firms)}}} \times \underbrace{\beta}_{\substack{\text{illiteracy}\\ \text{(consumers)}}}}$$

Consumers are homogeneous, have (exogenous) financial illiteracy $\beta \geq 0$, and maximize expected utility among contracts offered

$$\max_{(\alpha,\varepsilon,I)\in Q} EU(\alpha, \varepsilon, I).$$

**Assumption: Consumers and firms expect the same per-unit payout $I (upon loss) since our focus is the impact of uncertainty. Straightforward to include bias, raising consumers' price elasticity.*

Competitive Equilibrium...

... is the solution to

$$\max_{\alpha,\varepsilon,I} EU(\alpha,\varepsilon,I),$$
$$\text{s.t. } \Gamma(\alpha,\varepsilon/\beta,I) \geq 0,$$

is unique, and features zero profits $\Gamma = 0$.

Complexity in Competitive Equilibrium

Examine contract (ε, I)-space conditional on optimal coverage α^*.

- Upward-sloping concave zero-profit curve
  $\Rightarrow$ Marginal cost in reducing complexity ε offset by reduction in payout I.
- Upward-sloping convex indifference curves
  $\Rightarrow$ Utility-gain from higher expected payout I offsets disutility from higher complexity ε.

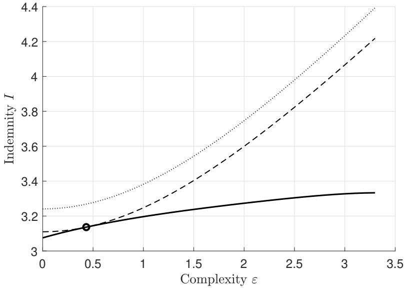


Figure: Zero-profit curve (straight), indifference curves (dotted and dashed), and equilibrium contract (dot).

Welfare effect of financial illiteracy

More financial literacy (smaller β) raises welfare:

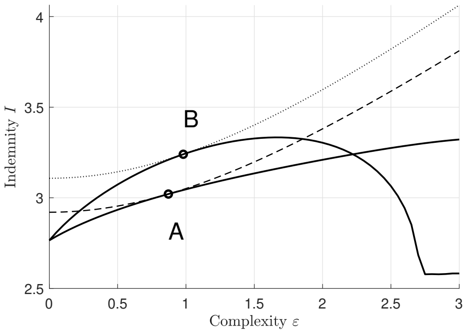


Figure: A: $\beta = 1$; B: $\beta = 0.5$.

Break even lines (straight), indifference curves (dotted and dashed), and optimal contracts (dots).

*Note that $\nu = \varepsilon/\beta \Rightarrow$ small β allows high ν and thus small $\kappa(\nu)$ for given ε

Financial Illiteracy Premium

What is the welfare cost of financial illiteracy?

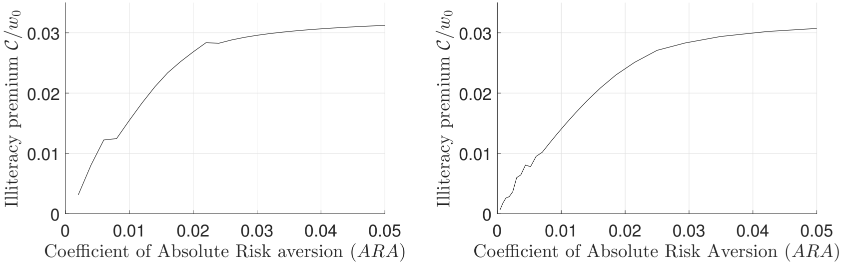
If $\beta = 0$ (consumers fully understand all contracts), equilibrium features min $\kappa(\nu) = 0$ (by assumption) and full insurance.

Financial illiteracy premium $\mathcal{C}$ = maximum WTP to move from high $\beta = 1$ to $\beta = 0$:

$$\underbrace{u(w_0 - pL - \mathcal{C})}_{\text{EQ with } \beta=0} = \underbrace{EU^*|_{\beta=1}}_{\text{EQ with } \beta=1} .$$

Due to risk aversion, $\mathcal{C} > 0$ if $pl \leq 1$ and $\alpha^*|_{\beta=1} > 0$.

Financial Illiteracy Premium and Risk Aversion



(a) Absolute risk aversion ARA and prudence with CARA utility.

(b) Absolute risk aversion with quadratic utility (no prudence).

Figure: Illiteracy premium $\mathcal{C}$ scaled by initial wealth $w_0 = 100$ for loss $L = 50$ and loss probability $p = 0.3$. Transparency cost are given by $\kappa(\nu) = k(\nu - \nu_0)^2$ with $\nu_0 = 1/p$ and $k = 0.3$ such that k/p^2 are the cost to entirely remove contract complexity. $ARA = 0.02$ corresponds to $RRA = 1.7$ at wealth $w_0 - pL = 85$.

$\Rightarrow$ Risk aversion drives welfare cost of financial illiteracy.

Policy Implications

Two primary regulatory responses to financial illiteracy:

(A) Transparency requirements for firms, and

(B) Financial education of consumers.

In our model

(A) binding requirements lead to welfare-reducing over-investment in transparency

(B) $\mathcal{C}$ is an upper bound for education cost to eliminate illiteracy

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(A) binding requirements lead to welfare-reducing over-investment in transparency

(B) $\mathcal{C}$ is an upper bound for education cost to eliminate illiteracy

Recent regulation focuses on (A).
$\Rightarrow$ Only works under the presumption of additional frictions/biases and/or non-competitive market (indeed, e.g., 4 largest US+Canadian insurers have $> 50\%$ market share in car insurance).
$\Rightarrow$ Financial illiteracy on its own not necessarily sufficient reason for transparency regulation.

Conclusion

- Novel rationale for decision-making under financial illiteracy
  $\Rightarrow$ Focus on uncertainty
- Insurance demand driven by trade off between 2nd and 3rd order risk preferences: Sufficiently prudent consumers raise insurance demand when faced with more complex products
- Complexity is persistent in competitive equilibrium when firms face transparency costs
- Financial illiteracy (á la uncertainty) alone is not sufficient rationale for transparency regulation.

Thank you!

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Complexity and Indemnity Risk

Lee (2012) shows that partial coverage is optimal for insurance contracts with (arbitrarily distributed) indemnity risk if consumers are not too prudent.

We extend his result:

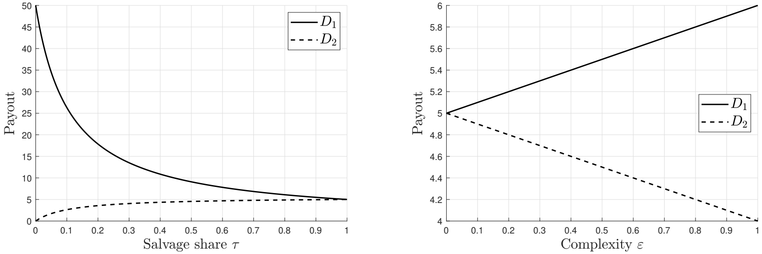
- *Comparative Statics:* If consumers are sufficiently prudent and indemnity risk small, optimal coverage is increasing with indemnity risk, otherwise it is decreasing.
- *Equilibrium indemnity risk:* Indemnity risk arises endogenously in equilibrium if it is costly for firms to reduce it (e.g., complexity, costly underwriting/auditing).

Complexity vs. Contract Nonperformance

Payout per $1 premium for contracts with (a) nonperformance vs (b) complexity risk:

$$(a)\ \mathcal{D}^{\text{nonperformance}} = \left\{ \frac{1}{p(q+(1-q)\tau)m}(1,\tau) : m \geq 0;\ \tau, q \in [0,1] \right\},$$

$$(b)\ \mathcal{D}^{\text{complexity}} = \left\{ (I+\varepsilon, I-\varepsilon) : I \geq 1, \varepsilon \geq 0 \right\}.$$



(a) Nonperformance risk. (b) Complexity risk.

Figure: Comparison of contract payouts upon changes in nonperformance and complexity risk.

Complexity vs. Contract Nonperformance

Proposition

Let $\varepsilon > 0$. Then, no contract with nonperformance risk $\tau \geq 0$ and non-negative premium ($m \geq 0$) provides the same payout distribution per unit-premium as a complex contract with ε.

Forms of Background Risk

The literature knows several forms of background risk, resulting in the following indemnity payments:

- Additive (Fei and Schlesinger (2008)): $\alpha I + \tilde{\vartheta}$
- Multiplicative (Franke et al. (2006)): $\alpha I \tilde{\vartheta}$
- Hybrid (Doherty and Eckles (2011)): $(\alpha I, 0, \alpha I + D)$ (nonperformance + additive background risk)
- Our approach: Hybrid (Lee (2012)): $\alpha(I + \tilde{\vartheta})$

Back to Literature Review