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# Competitive Insurance Markets Under Asymmetric Information When Agents Make Mistakes

Deutscher Verein für Versicherungswissenschaft
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## Motivation

- **Mistakes** appear to be prevalent in human decision making, especially when risk is involved.


## Insights

- We provide the first analysis of mistakes in the context of competitive insurance markets. Mistakes can appear in the sense that people misjudge their risk type.

- Under symmetric information, consumer mistakes have (virtually) no effects.

- Under asymmetric information, there are several effects:
  - Per definition, mistakes are not good for the agents who make them (**direct effect**).
  - However, competitive pressure induces mistakes to be reflected in the pricing of insurance contracts. As a result **indirect effects** arise.
  - When only high risks make mistakes, the direct effect is nil and the indirect one on low risks is negative.
  - When only low risks make mistakes, the direct effect is negative whereas the indirect one on low and high risks is positive.
  - Aggregate **welfare effects** are non-trivial; the **nature of equilibrium** might also change.

## Literature

- Mistakes in decision making under risk have mostly been discussed in the **experimental** literature (Harless and Camerer, 1994; Hey and Orme, 1994; Loomes and Sugden, 1995).
  - → The empirical analysis of experimental data should account for the fact that errors occur.

- Mistakes have rarely been studied in **microeconomic theory**. Notable exceptions are Diamond (1974), Demougin and Fluet (2001), and Thistle (2010).

- The literature on **adverse selection** on **insurance markets** is large.
  - It originated from the theoretical works by Rothschild and Stiglitz (1976), Wilson (1977), Miyazaki (1977), Spence (1978), …
  - There is an abundance of empirical tests (see Cohen and Siegelman, 2010, for a survey); the overall evidence is mixed and depends on the type of product considered.

## Literature

- Some authors have added a nuance to the assumption that individuals perfectly know their risk type in the Rothschild and Stiglitz (1976) model.
  - There are studies of **endogenous information** (Doherty and Thistle, 1996; Barigozzi and Henriet, 2009; Peter et al., 2013).
  - Huang et al. (2013) introduce **ambiguity**.
  - Overconfidence and its implications on **risk perception** have been discussed (Opp, 2005; Sandroni and Squintani, 2007; Huang et al., 2010).

- None has addressed consumer mistakes to date.

## The Model

- Our model draws on the set-up developed by Rothschild and Stiglitz (1976).

- **Demand side:**
  - U — increasing and concave vNM utility function
  - W, L — initial wealth and loss size
  - $p^L < p^H$ — probability of loss for low and high risks
  - $\lambda^L, \lambda^H$ — share of low and high risks in the population
  - $\varepsilon_L, \varepsilon_H$ — propensity to make mistakes by low and high risks

- **Supply side:**
  - Price and quantity competition is possible.
  - Due to perfect competition insurers break even contract-wise.

## The Model

- The market is in **equilibrium**,
  - (i) if no contract in the equilibrium set makes negative expected profits and
  - (ii) if there is no contract outside the equilibrium set that, if offered, will make a nonnegative profit.

- Sequence of play

## The Model

- The breakeven constraints imply that insurers **anticipate** mistakes in their pricing behavior. Said differently, the probability of loss in the group of purchasers of the high- (low-)risk policy needs to match the per-unit price of coverage and vice versa.

- As such, the following parameters matter:

$$\tilde{p}^L = \frac{\lambda^H \varepsilon_H p^H + \lambda^L (1-\varepsilon_L) p^L}{\lambda^H \varepsilon_H + \lambda^L (1-\varepsilon_L)} \quad \text{and} \quad \tilde{p}^H = \frac{\lambda^H (1-\varepsilon_H) p^H + \lambda^L \varepsilon_L p^L}{\lambda^H (1-\varepsilon_H) + \lambda^L \varepsilon_L}.$$

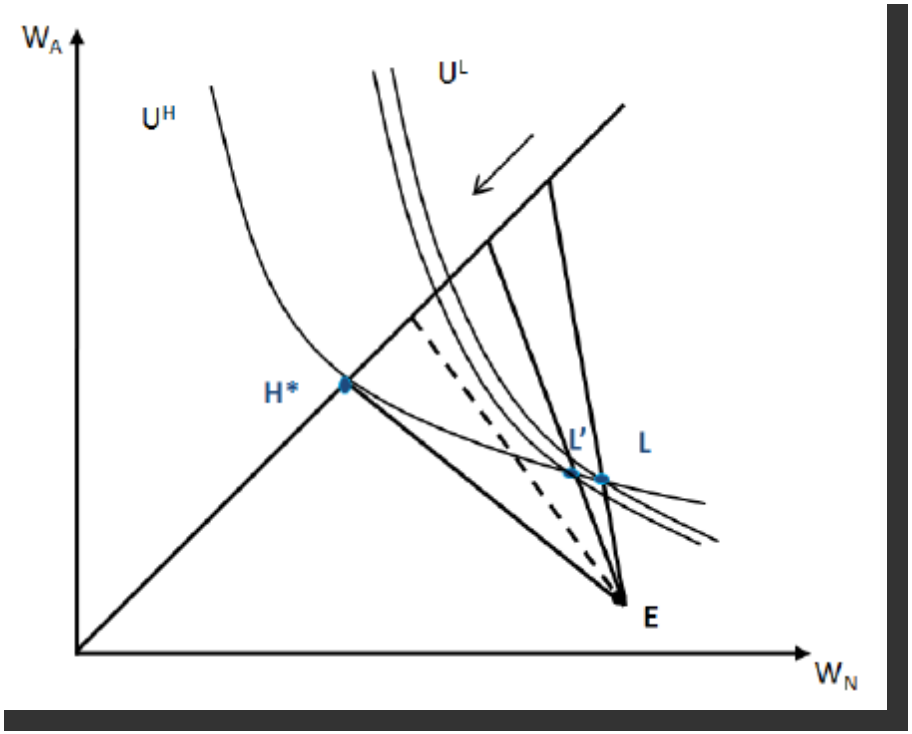
- It is straightforward to show that
  - $\tilde{p}^L$ ($\tilde{p}^H$) is increasing (decreasing) in mistakes by low and high risks.
  - $\tilde{p}^L(0,0) = p^L$, $\tilde{p}^H(0,0) = p^H$, $\tilde{p}^L(0.5,0.5) = \bar{p}$, and $\tilde{p}^H(0.5,0.5) = \bar{p}$ with $\bar{p}$ being the probability of loss of the population average.

## Results

- Assume that risk type is **observable**.
- Without mistakes everybody would receive their respective full coverage contract.
- Assume that agents make mistakes.
  - **Low risks** who think they are high risks would buy the high-risk policy. This is profitable for insurers. As profits are competed away, all low risks will be offered the low-risk policy.
  - **High risks** who think they are low risk might prefer to remain uninsured rather than buying the high-risk policy. If not, they buy the high-risk policy as well.
- The effects of mistakes, if any, are that some high risks remain uninsured.
  - This would constitute a **Pareto-deterioration**.
  - Under symmetric information, mistakes never have desirable consequences.

## Results

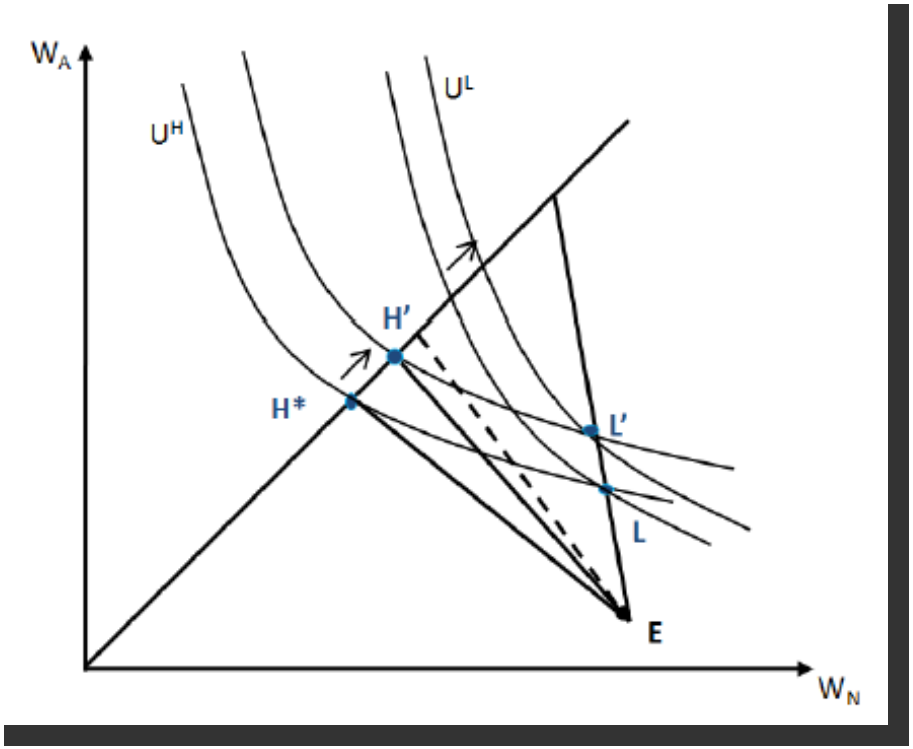
- Assume that only high risks make mistakes.




- High risks remain unaffected (independent of whether they make a mistake or not).
- Low risks are worse off because the available coverage is further restricted.
- The equilibrium non-existence problem is aggravated.
- Pareto-deterioration; welfare is strictly lower.
- The nature of equilibrium is unaffected (B).

## Results

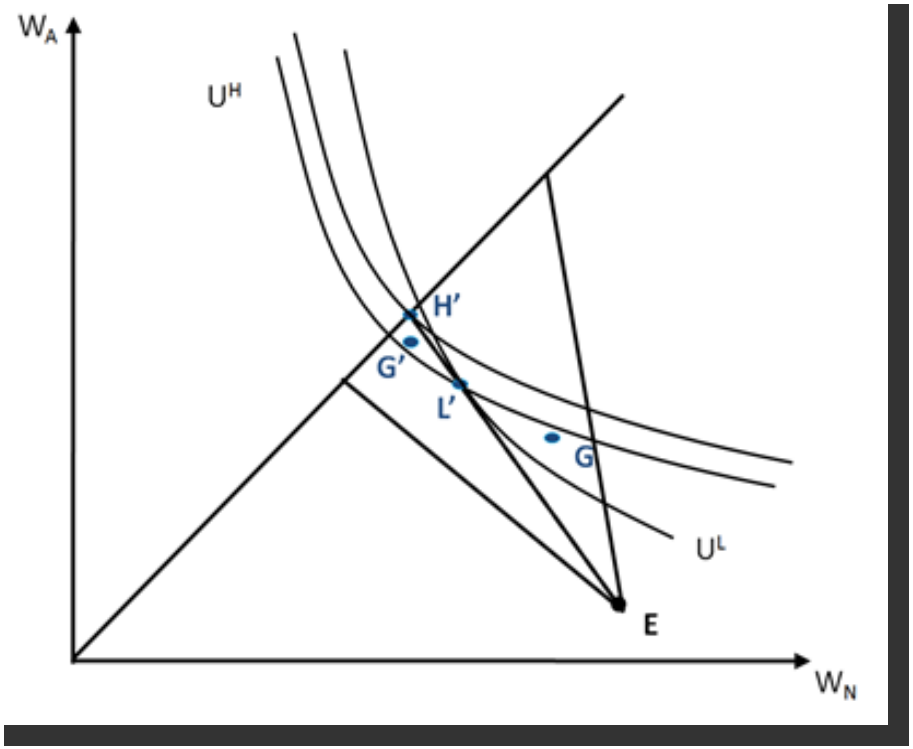
- Assume that only low risks make mistakes.




- High risks are better off.
- Not mistaken low risks are better off because the incentive compatibility constraint is slackened.
- Mistaken low risks are worse off.
- The equilibrium non-existence problem is alleviated.
- Pareto non-comparable; at the margin, welfare is strictly larger.

## Results

- Take the extreme case that everybody assesses their risk via a coin flip.




- The equilibrium is {H', L'}.
- Cream-skimming does not work.
- Notice that incentive compatibili-ty is satisfied with both self-selec-tion constraints being non-bind-ing (NB).
- The welfare consequences are quite involved.

## Utilitarian Social Welfare

- Let us look at intermediate cases with $0 < \varepsilon_L, \varepsilon_H < 0.5$.

- Utilitarian social welfare is given by

$$SW(\varepsilon_L, \varepsilon_H) = \lambda^L[\varepsilon_L EU_L(H') + (1-\varepsilon_L)EU_L(L')] + \lambda^H[\varepsilon_H EU_H(L') + (1-\varepsilon_H)EU_H(H')].$$

- An increase in $\varepsilon_L$ has three effects:
  - More low risks are worse off (**direct effect**).
  - The high-risk contract gets cheaper (**indirect effect I**).
  - The effect on the low-risk contract depends on the equilibrium regime (**indirect effect II**).
    - (B): level of coverage increases; high risks are better off, low risks can be better or worse off.
    - (NB): level of coverage decreases; high risks and low risks are worse off.

## Utilitarian Social Welfare

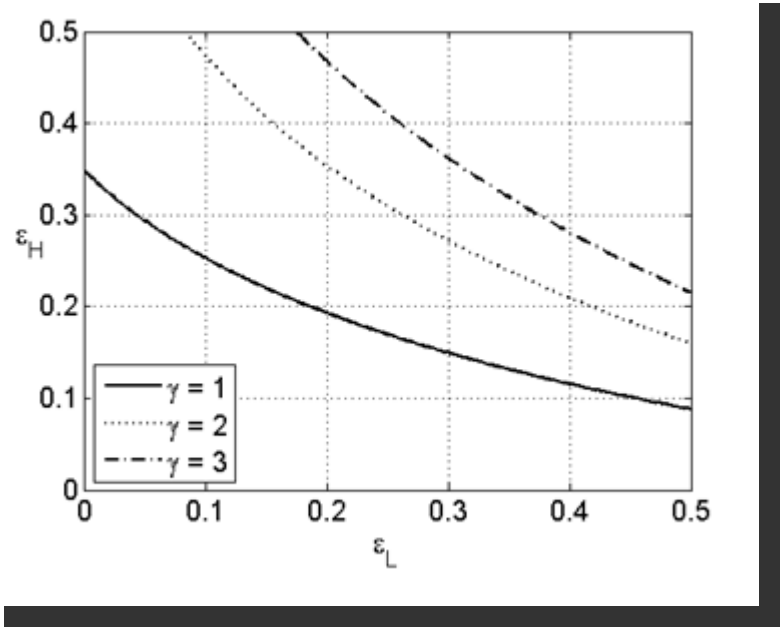
- An increase in $\varepsilon_H$ also has three effects:
  - More high risks buy the low-risk policy (**direct effect**).
    - (B): They are equally well off.
    - (NB): They are worse off.
  - The high-risk contract gets cheaper (**indirect effect I**).
  - The effect on the low-risk contract depends on the equilibrium regime (**indirect effect II**).
    - (B): level of coverage increases; high risks are better off, low risks can be better or worse off.
    - (NB): level of coverage decreases; high risks and low risks are worse off.

## Equilibrium Regime

- Finally, we characterize the locus of mistake propensities where the equilibrium regime switches from (B) to (NB).

- Numerically, the **(NB) region** is
  - negatively associated with risk aversion,
  - positively associated with the share of high risks,
  - positively associated with the probability of loss of high risks.

- The decreasing shape is obtained in any case.



## Conclusion

- We provide the first analysis of consumer mistakes on competitive insurance markets.
- Under symmetric information, mistakes have non-positive welfare consequences.
- Under asymmetric information, direct and indirect effects need to be traded off. As a result mistakes can increase social welfare due to their implicit redistributional effect when it comes to pricing insurance contracts. Zero mistakes by everybody **never** maximizes social welfare!
- Improving consumer risk assessment might have undesirable welfare consequences depending on the informational nature of the insurance market under consideration.

## Next Steps

- (Numerical) welfare assessment
- Alternative notions of equilibrium
- Insurance monopoly
- Mistakes by insurers
- …

Thank you for your attention!

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