LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

FAKULTÄT FÜR BETRIEBSWIRTSCHAFT
MUNICH SCHOOL OF MANAGEMENT

MRIC | MUNICH RISK AND INSURANCE CENTER

Endogenous Information and Adverse Selection under Loss Prevention

Deutscher Verein für Versicherungswissenschaft

Jahrestagung 2013

Richard Peter, Andreas Richter, Paul Thistle

Agenda

1. **Motivation**

2. Related Literature

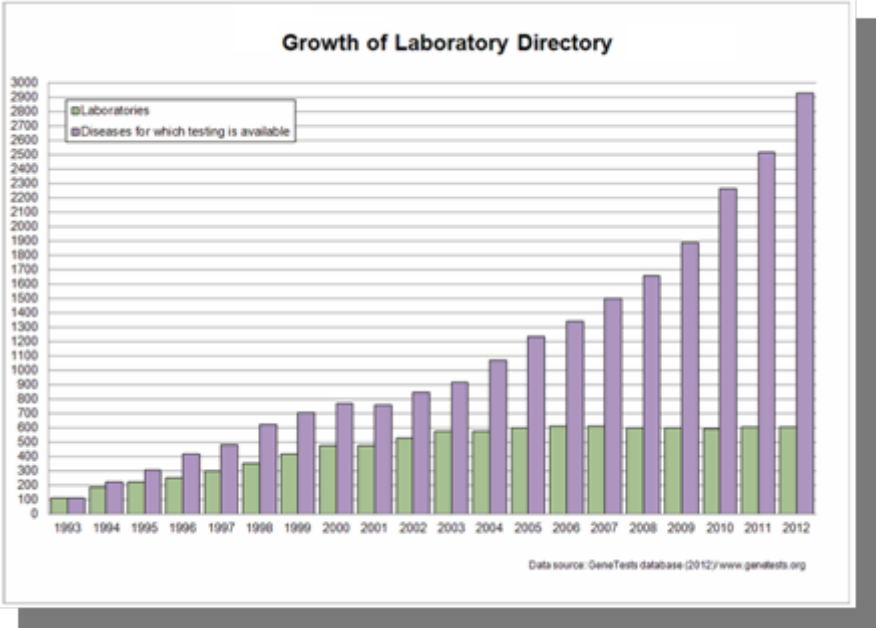
3. The Basic Model

4. Adverse Selection

5. Conclusion

Motivation

- Possibilities of genetic testing continue to increase.
  - Increased knowledge about the relationship between genetics and diseases
  - More than 2900 diseases for which tests are available
  - $ 1000 genome project (Davies, 2010)
  - Mail-order genetic tests



Motivation

- In many countries, however, the use of genetic information for insurance purposes is restricted or prohibited.
  - GINA in the US
  - “Gendiagnostikgesetz” in Germany
- Is this good or bad regulation?
  - Informational incentives
  - Allocative efficiency

Motivation

- If information regarding risk may be used for insurance rate-making, situations can arise in which it is rational for the potential insured not to acquire information.
- Standard models focus on information regarding exogenous risk factors.
- However, in many situations risk also depends on environmental factors that can at least to some extent be influenced by the consumer.
  - Lifestyle, surveillance, and medication decisions in life and health insurance
  - Such factors typically affect all risk types
  - Influence (e.g. the effectiveness of treatment) may vary strongly over different types
- Is banning or restricting the use of test results good or bad regulation in light of the (partial) endogeneity of risks?

Agenda

1. Motivation
2. **Related Literature**
3. The Basic Model
4. Adverse Selection
5. Conclusion

Related Literature

- The value of (endogenous) information
  - Savage (1954): The value of information is non-negative.
  - Milgrom and Stokey (1982), Marshall (1974): Subsequently generated information has zero social value.
  - Crocker and Snow (1992): If insurers observe informational status, premium risk might arise. Hence, the private value of information is negative, consumers stay rationally ignorant.
  - Doherty and Thistle (1996): Inability of insurers to observe informational status may help to restore incentives for information acquisition. Concealment of informational status or consent law may improve on public health externality.

Related Literature

- Genetic information, risk classification, and adverse selection
  - Hoy (1982): Effects of risk classification on societal welfare.
  - Tabarrok (1994): Proposes genetic insurance to eliminate premium risk and the threat of uninsurability.
  - Lapham, Kozma and Weiss (1996): Fear of being denied access to insurance might deter testing.
  - Subramanian et al. (1999), Armstrong et al. (2003), Viswanathan et al. (2007), Hoy and Witt (2007): Find moderate adverse selection costs for life-insurance policies due to the ban / non-utilization of test results on BRCA1/2 mutations for rate-making.
  - Hoy and Lambert (2000): Using genetic information for rate-making can increase or decrease aggregate discrimination.
  - Strohmenger and Wambach (2000): Study the impact of risk classification through genetic tests in a situation where the treatment costs exceed the patient's willingness to pay.
  - Joly, Braker and Le Huynh (2010): Extensive survey of political approaches towards genetic discrimination all over the world.
  - Durnin, Hoy and Ruse (2012): Discuss the impact of banning genetic information for rate-making on both, market efficiency and the extent of discrimination.

Related Literature

- Productive use of test information
  - Doherty and Posey (1998): Introduce a treatment option for those who are tested high risks.
  - Filipova and Hoy (2009): Study the impact of genetic information on surveillance decisions.

Agenda

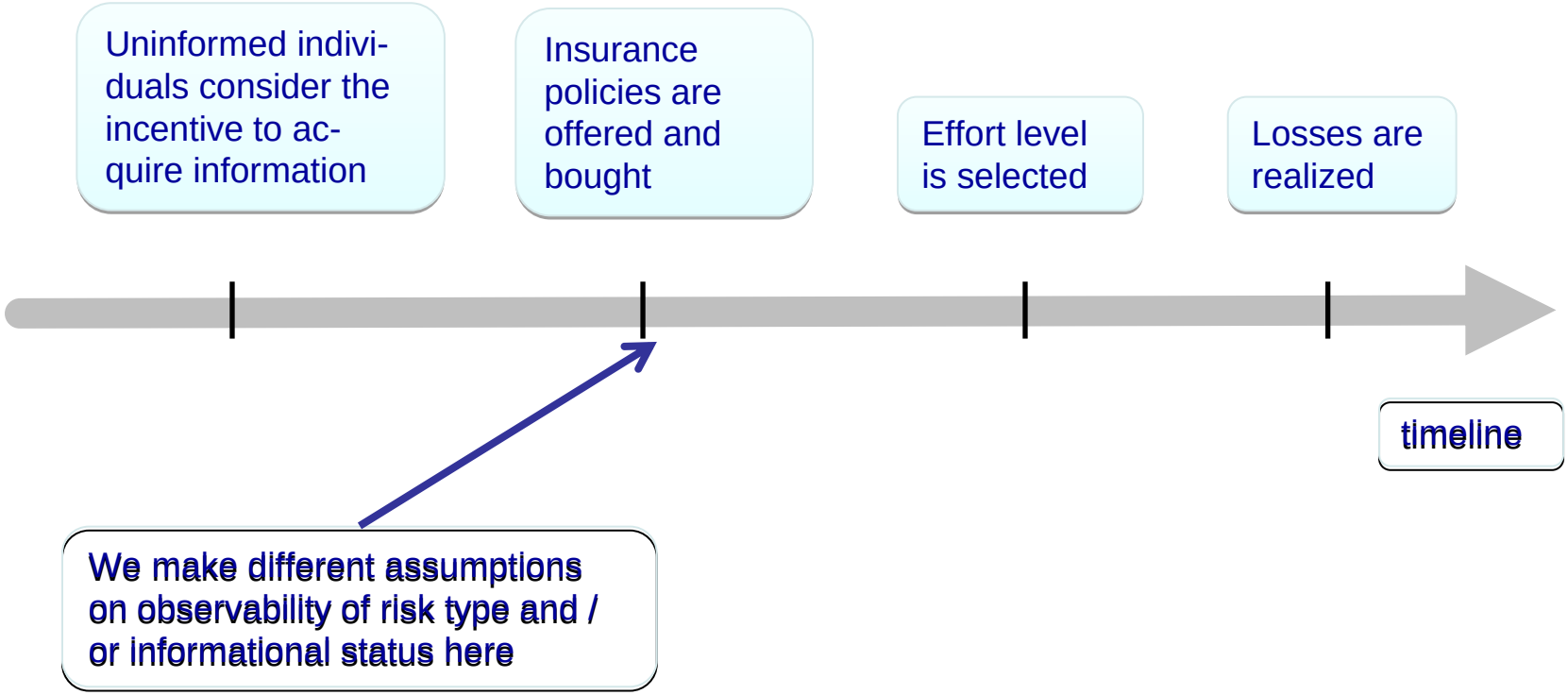
1. Motivation
2. Related Literature
3. **The Basic Model**
4. Adverse Selection
5. Conclusion

The Basic Model

- Risk averse consumers, vNM utility function u ($u' > 0$, $u'' < 0$)
- Initial wealth w, subject to a random loss of l, occurring with probability p
- x is the extent of prevention which is observable
  - Prevention comes at a cost of c(x) with $c' > 0$, $c'' > 0$; costs are assumed to be separable.
  - Individuals are equipped with different prevention technologies ($p_H(x)$ for high-risks, $p_L(x)$ for low-risks, such that $p_H(x) > p_L(x)\ \forall x$).
  - Loss probabilities are assumed to be decreasing and convex in x, i.e., $p_i' < 0$, $p_i'' > 0$.
- There is a fraction θ_H of high-risks in the population, and a fraction θ_L of low-risks, with $\theta_H + \theta_L = 1$.
- Individuals might not be informed about their risk type yet, $p_U = \theta_H\, p_H(x) + \theta_L\, p_L(x)$, (U denotes “uninformed”).

The Basic Model

- Time Structure / Sequence of Play



The Basic Model

- Let insurance coverage be available at actuarially fair rates; the individual solves

$$\max_{\alpha,x}\left\{p_i(x)u(w-\alpha p_i(x)l-(1-\alpha)l)+(1-p_i(x))u(w-\alpha p_i(x)l)-c(x)\right\}$$

- Hence, separation holds, i.e., full insurance is optimal independent of the effort level selected. Effort satisfies

$$-p_i'(x)lu'(w-p_i(x)l)=c'(x)$$

- Effort levels under full insurance are denoted by $\hat{x}_i$
- Effort without insurance is denoted by x_i^*

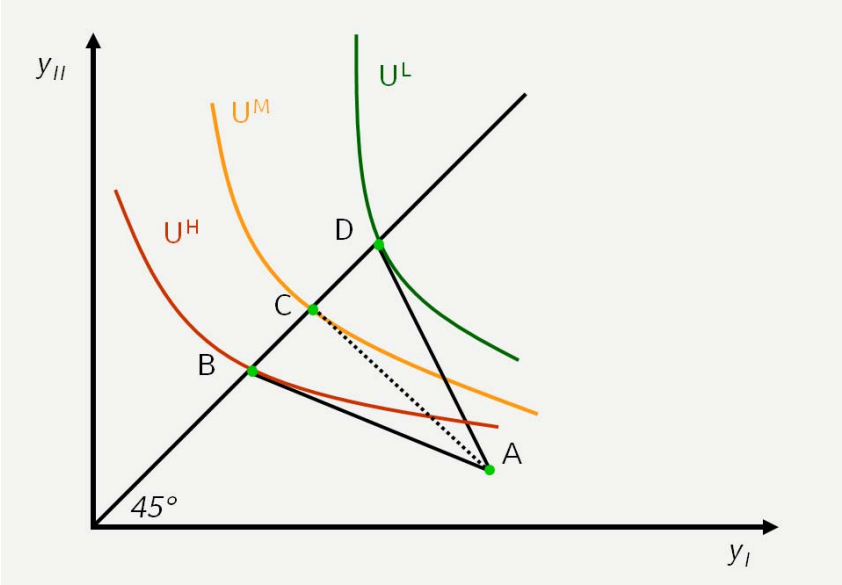
The Basic Model

Proposition 1: Let informational status and risk type be observable. The value of information can be positive or negative. It is positive if the premium for the uninformed is sufficiently above the average (informed) premium and prevention expenditures of the uninformed are sufficiently above average spendings on prevention.

- This result generalizes the result by Doherty and Posey (1998) and is related to Bajtelsmit and Thistle (2008).
- We denote by I_1 the value of information in this benchmark case.

The Basic Model

- In a situation without prevention opportunities, a first-best efficient insurance market deters information acquisition, as uninformed insured are exposed to premium risk. (Doherty and Thistle, 1996).



- Prevention creates additional opportunities to mitigate the risk once type has been learned. Depending on efficiency of prevention this might alleviate classification risk up to the point that information becomes valuable.

Agenda

1. Motivation
2. Related Literature
3. The Basic Model
4. **Adverse Selection**
5. Conclusion

Adverse Selection

- What happens if the insurance company is unable to distinguish between H-types and L-types?
- H-types are offered full coverage, as in Rothschild and Stiglitz (1976).
- Assume that L-types were also offered full coverage.
- H-types would then mimic L-types. This also concerns effort levels, as effort is assumed to be observable.

$$u(w - p_L(\hat{x}_L)l) - c(\hat{x}_L) > u(w - p_L(\hat{x}_H)l) - c(\hat{x}_H)$$

$$> u(w - p_H(\hat{x}_H)l) - c(\hat{x}_H)$$

- The insurer would experience losses.

Adverse Selection

- Assume now that L-types are denied coverage.
- H-types would then stick to their full coverage contract.

$$u(w - p_H(\hat{x}_H)l) - c(\hat{x}_H) > u(w - p_H(x_L^*)l) - c(x_L^*)$$
$$> p_H(x_L^*)u(w-l) + (1 - p_H(x_L^*))u(w) - c(x_L^*)$$

- As effort exercised by L-types varies continuously in the level of coverage, there will be at least one level of coverage for which H-types are indifferent between their contract and mimicry.
- Hence, self-selection à la Rothschild and Stiglitz (1976) can be implemented.

Adverse Selection

Proposition 2: Let informational status be observable; the endogenous value of information is smaller if risk type is unobservable than when it is observable, i.e. $I_2 < I_1$
(where I_2 is the value of information with informational status observable and risk type unobservable)

- Remember that I_1 was ambiguous!
  - If $I_2 < 0 < I_1$, allowing the use of test results (for insurance pricing) remedies insufficient information acquisition.
  - If $I_2 < I_1 < 0$, information is never valuable.
  - If $0 < I_2 < I_1$, both regimes provide sufficient incentives to gather information.
- Incorporating loss prevention opportunities for the different types introduces an additional "degree of freedom".

Adverse Selection

Proposition 3: Assume risk type can be revealed by consumers; the endogenous value of information I_3 is higher if informational status is not observable than when it is observable, i.e. $I_3 > I_1$
(where I_3 is the value of information when informational status is not observable and risk type can be revealed)

- Remember that I_1 was ambiguous!
  - If $I_1 < 0 < I_3$, introducing concealment of informational status remedies insufficient information acquisition.
  - If $I_1 < I_3 < 0$, information is never valuable.
  - If $0 < I_1 < I_3$, both regimes provide sufficient incentives to gather information.
- This result generalizes the results obtained by Doherty and Thistle (1996) and Doherty and Posey (1998) that concealment of informational status will improve on the value of information.

Adverse Selection

Proposition 4: Let informational status be unobservable; the endogenous value of information is higher if risk type can be revealed than when it cannot, i.e. $I_4 < I_3$
(where I_4 is the value of information when informational status is not observable and risk type cannot be revealed)

- The value of information here can be compared to a situation where risk type is observable (I_3).
  - If $I_4 < 0 < I_3$, allowing the use of test results remedies insufficient information acquisition.
  - If $I_4 < I_3 < 0$, information is never valuable.
  - If $0 < I_4 < I_3$, both regimes provide sufficient incentives to gather information.

Agenda

1. Motivation
2. Literature Review
3. The Basic Model
4. Adverse Selection
5. **Conclusion**

Conclusion

- In many situations where information acquisition about risks is possible, loss prevention opportunities are available and highly depend on the information acquired.
- We provide a general model that includes both, adverse selection and loss prevention, and re-examine the endogenous value of information.
- Our findings are summarized in the following table:

		risk type	
		observable	unobservable
informational status	observable	$I_1 > / < 0$ (Proposition 1)	$I_1 > I_2$ (Proposition 2)
	unobservable	$I_3 > I_1$ (Proposition 3)	$I_3 > I_4$ (Proposition 4)

Conclusion

- The ordering of the values of information is not affected by the possibility of loss prevention.
- However, the sign of the reference point, i.e., sign(I_1) is ambiguous.
- Concealment of informational status may increase the value of information.
- However, it might not be necessary, as a first-best efficient risk allocation may already provide sufficient informational incentives.
- Allowing the concealment of test results may not be an adequate regulatory intervention (in terms of incentivizing information acquisition).
- Improving loss prevention techniques might increase the value of information and change the incentives to acquire information.