The Microeconomics of Insurance

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The Microeconomics of Insurance

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Abstract

In this relatively short survey, we present the core elements of the microeconomic analysis of insurance markets at a level suitable for senior undergraduate and graduate economics students. The aim of this analysis is to understand how insurance markets work, what their fundamental economic functions are, and how efficiently they may be expected to carry these out.

Contents

1

Introduction

When we consider some of the possible ways of dealing with the risks that inevitably impinge on human activities — lucky charms, prayers and incantations, sacrifices to the Gods, consulting astrologists — it is clear that insurance is by far the most rational. Entering into a contract under which one pays an insurance premium (a sum that may be small relative to the possible loss), in exchange for a promise of compensation if a claim is filed on occurrence of a loss, creates economic value even though nothing tangible is being produced. It is clearly also a very sophisticated transaction, which requires a well-developed economic infrastructure. The events which may give rise to insurable losses have to be carefully specified, the probabilities of the losses have to be assessed, so that premiums can be set that do not exceed the buyer's willingness to pay and make it possible for the insurer to meet the costs of claims and stay in business, while, given the fiduciary nature of the contract, buyers must be confident that they will actually receive compensation in the event of a claim. Insurance in its many and varied forms is a central aspect of economic activity in a modern society.

In this relatively short survey, we present the core elements of the microeconomic analysis of insurance markets, at a level suitable for senior undergraduate and graduate economics students. The aim of this analysis is to understand how insurance markets work, what their fundamental economic functions are, and how efficiently they may be expected to carry these out. We can give a brief outline of the coverage of the survey with the help of one simple model.

Consider an individual who has to decide how much insurance cover to buy. Formally, she maximizes her expected utility by choosing the optimal cover or indemnity C:

$$E[U] = (1-\pi)u(W - P(C)) + \pi u(W - P(C) - L + C).$$

Here we assume that the individual has a von Neumann–Morgenstern utility function[1] $u(\cdot)$ which is increasing and strictly concave. Strict concavity implies that the individual is risk averse. π is the probability that a loss of size L occurs. W is her wealth in the event of no loss. P is the insurance premium paid, which can in general be thought of as a function of C, the cover.

As a simple example, assume you have a van Gogh with a market value of \$10 million hanging in your living room, and the probability of having the painting stolen is say $\pi = 0.001$, or one in a thousand. In this case $L = \$10$ million. You can buy insurance cover C by paying the premium $P(C) = pC$. For every \$1 you want to get paid in case of a loss, you have to pay $p \times \$1$. p is called the premium rate. Thus, if the premium rate is 0.002, or \$2 per \$1000 of cover, and you want to get all of your \$10 million back, you have to pay \$20,000 up front as a premium to the insurance company. Note that if the van Gogh is stolen, you have paid the premium already, so net you receive \$9,980,000 or $C - P(C)$.

This simple model is the starting point for all the discussion in the following chapters. In the first part of Section 2, we deal exclusively with this model and we investigate how the demand for insurance depends on the premium rate p, wealth W, the size and probability of the loss L and π, respectively, and the degree of risk aversion as reflected in the concavity of $u(\cdot)$.

[1] We assume throughout this survey that the reader is familiar with the basic elements of the economics of uncertainty. For treatments of this see Gravelle and Rees (2004, Chap. 17), (Gollier, 2001, Chap. 1–3), and Eeckhoudt et al. (2005).

However, there are limitations to the applicability of this model. Many real world features of insurance contracts such as deductibles, contracts with experience rating and coinsurance require more elaborate models. We will now discuss these limitations and indicate where the sections in this survey deal with the features which this simple model does not adequately take into account. (We use arrows to show where the modified models differ from the basic model above.)

1. *State dependent utility function*

$$E[U] = (1-\pi)\overbrace{\;u\;}^{\Downarrow}(W - P(C)) + \pi\overbrace{\;v\;}^{\Downarrow}(W - P(C) - L + C).$$

For some applications it is not sensible to assume that people have the same utility whether a loss has incurred or not, even if they are fully financially compensated for the loss. Assume that you own a gold bar that is stolen, but fully covered by an insurance policy. In this case you probably will not mind the loss. You just go out and buy yourself another gold bar. In the case of your van Gogh being stolen this might be different. If you are very attached to this painting, you will feel worse off even if the insurance company pays out the full price you have paid for it. The reason is that a particular van Gogh is not a tradable good which can be rebought in the market. Another example is health insurance — if you break your leg skiing, even with full insurance to cover the medical expenses you will feel worse than when you are healthy. These aspects are discussed in detail in Section 2, where we consider the demand for insurance in the presence of state dependent utility functions.

2. *Is there only one risk?*

$$E[U] = E_{\tilde{W}}[(1-\pi)u(\overbrace{\;\tilde{W}\;}^{\Downarrow} - P) + \pi u(\overbrace{\;\tilde{W}\;}^{\Downarrow} - P - L + C)].$$

In the simple model above,[2] the van Gogh is either stolen or not. However, in general individuals face more than one risk. Standard additional

[2] The symbol $E_{\tilde{W}}$ denotes the expected value taken with respect to the distribution of the random variable $\tilde{W}$.

risks like car accidents, illness, fire, etc. can be covered by separate insurance contracts. But there are also uninsurable risks around — for example income risk, as the return on shares and bonds you own is uncertain, or because your job is not secure. You might not know for sure how much money you are going to inherit from a benevolent grandmother, whether you will marry into money or not .... This feature is known as *background risk*. Also in Section 2 we analyze the situation where individuals face additional uninsurable risks (like the $\tilde{W}$ in the equation above). Now the demand for insurance will depend on whether those risks reinforce each other or whether they tend to offset each other so that they can be used as a hedging mechanism.

3. *Where does $P(C)$ come from?*

$$E[U] = (1-\pi)u(W - \overbrace{P(C)}^{\Downarrow}) + \pi u(W - \overbrace{P(C)}^{\Downarrow} - L + C).$$

In the simple model we have assumed that the individual faces some exogenous given premium function $P(C) = pC$. But who determines the premium? On what factors does it depend? In Section 3 where we discuss the supply of insurance, this will become clear. We consider premium setting on a competitive market. We will also discuss how insurance shareholders react to risks by *diversifying* their risks (risk spreading) and how insurance enables the insured to *pool* their risks. Finally, we discuss some aspects of the important subject of the regulation of insurance markets.

4. *Is there only one loss level possible?*

$$E[U] = (1-\pi)u(W - P) + \pi \overbrace{\sum_i \pi_i}^{\Downarrow} u(W - P - \overbrace{L_i + C_i}^{\Downarrow}).$$

In many situations a single loss level does not seem appropriate. Certainly, your van Gogh is either stolen or not, but in the case of a fire, for example, it could be partly or completely damaged. If you have a car accident, the damage can vary between some hundred dollars and many hundreds of thousands. Similarly in aviation insurance: A claim could have the size of a few hundred dollars for a damaged suitcase, but can increase to many millions of dollars for loss of a plane. As a matter of fact, one of the largest liability claims in the history of flight insurance resulted from the blowing up of the PanAm Boeing 747 over Lockerbie, Scotland. So far more than \$510 million has been paid. More than one loss level is discussed with the help of the model of Raviv, which we present in Section 3. This model provides a synthesis of the demand for and supply of insurance in the case of many loss levels. In this model we will see *deductibles* and *coinsurance* emerging. By deductibles it is meant that the first D dollars of the loss have to be paid by the insured. Coinsurance applies if an additional dollar of loss is only partially covered. This might be the case if for example the insurance covers a fixed percentage of the loss.

5. *Is π known?*

$$E[U_i] = (1 - \overbrace{\pi_i}^{\Downarrow})u(W - P) + \overbrace{\pi_i}^{\Downarrow}u(W - P - L + C).$$

When determining the premium rate from the point of view of the insurer it is usually assumed that the probability of loss π is known. However, this may not necessarily be the case. You probably know much better than your insurer whether you are a cautious or a crazy driver, whether you have a healthy lifestyle or not, and so on. This is modeled by assuming that the insured knows her own π_i and the insurance company only has some information about the overall distribution of the π_i in the population. In those cases high risk types with a large π_i try to mimic low risk types and buy insurance which is not designed for them, causing losses for the insurer. This is known as *adverse selection*. In Section 4, we discuss the seminal paper by Rothschild and Stiglitz and other models which deal with this topic. The phenomenon of adverse selection allows us to understand why in some cases insurers offer several different contracts for the same risk. For your car insurance, for example, you might buy a contract with no deductible and a high premium rate or with a deductible and a lower premium rate. Offering a choice of contracts with different premium rates is a discriminating mechanism, which only makes sense if people differ in some unobservable characteristic. This analysis also allows us to discuss another feature which is commonly observed: *Categorical discrimination*. What are the pros and cons of conditioning a particular contract on gender or age, for example? Is it efficient to sell different contracts to males and females or to young and old drivers?

6. *Is the loss probability exogenous or endogenous?*

$$E[U] = (1 - \overbrace{\pi(e)}^{\Downarrow})u(W - P) + \overbrace{\pi(e)}^{\Downarrow}u(W - P - L + C) - \overbrace{c(e)}^{\Downarrow}.$$

In many situations the loss probability can be influenced *ex ante* by the insured. The degree of attentiveness you devote to the road is something you have control of. By increasing your concentration the loss probability is reduced: the derivative of the probability $\pi'(e) < 0$. However, the more you concentrate the less time you have for phone calls with your mobile phone, listening to the radio, etc., so there are costs of concentrating $(c(e))$ which increase if one employs more effort: marginal cost of effort $c'(e) > 0$. If a person is completely insured, she might not employ any effort as she is not liable for any damage. This problem is known as *ex ante moral hazard* and is discussed in detail in Section 5. Here we will find another reason why insurance companies may offer contracts with *partial insurance cover*. We also discuss there *ex-post* moral hazard, the situation, held to be prevalent in health insurance markets, in which the fact that health costs are covered by insurance may lead to demand for them being greater than the efficient level.

7. *Is the size of the loss observable?*

$$E[U] = (1 - \pi)u(W - P) + \pi u(W - P - \overbrace{L}^{\Downarrow} + C).$$

In some situations neither the occurrence of a loss nor the size of the loss is easily observable by the insurance firm. In those situations the insured might be tempted to overstate the size of a loss or to claim a loss which has not occurred. *Insurance fraud* is discussed at the end of Section 5. For obvious reasons the actual size of insurance fraud is difficult to measure. However estimates based on questionnaires suggest that for personal liability insurance around 20% of all claims are fraudulent.

We will discuss how contractual and institutional arrangements might cope with this problem.

8. *Why only one period?*

$$\begin{aligned} E[U] = {} & (1-\pi)u(W-P_0) + \pi u(W-P_0-L+C_0) \\ & + \overbrace{(1-\pi)[(1-\pi)u(W-P_N) + \pi u(W-P_N-L+C_N)]}^{\Downarrow} \\ & + \overbrace{\pi[(1-\pi)u(W-P_L) + \pi u(W-P_L-L+C_L)]}^{\Downarrow}. \end{aligned}$$

If insurance is sold under perfect information, it does not make any difference whether many single-period contracts or one many-period contract are sold. In reality however, we observe many contracts which have a dynamic component, such as *experience rating* contracts in the car or health insurance industry. In those cases, individuals pay a different premium in the future period depending on whether a loss has occurred or not (P_L or P_N, respectively). This phenomenon can be explained by the existence of asymmetric information, as in the adverse selection or moral hazard models mentioned above. In Section 4, we consider this issue in the context of adverse selection and show how experience rating may appear endogenously. Also in Section 5, as part of the discussion on moral hazard, *dynamic contracts* are considered. Another topic which is relevant when one discusses multi-period contracts is the issue of *renegotiation and commitment*. The crucial point here is that even if *ex ante* both the insurer and the insured agree to a longer lasting contract, *ex-post* it might be of advantage for both parties to change the terms of the contract in some circumstances.

References

Akerlof, G. A. (1970), 'The market for lemons: Quality uncertainty in the market mechanism'. *Quarterly Journal of Economics* **84**, 488–500.

Ania, A., T. Tröger, and A. Wambach (2002), 'An evolutionary analysis of insurance markets with adverse selection'. *Games and Economic Behavior* **40**, 153–184.

Arnott, R. and J. E. Stiglitz (1988a), 'The basic analytics of moral hazard'. *Scandinavian Journal of Economics* **90**, 383–413.

Arnott, R. and J. E. Stiglitz (1988b), 'Randomization with asymmetric information'. *RAND Journal of Economics* **19**, 344–362.

Arrow, K. J. (1970), *Essays in the Theory of Risk-Bearing*. Amsterdam-London: North-Holland.

Arrow, K. J. (1974), 'Optimal insurance and generalized deductibles'. *Scandinavian Actuarial Journal* **1**, 1–42.

Asheim, G. B. and T. Nilssen (1996), 'Non-discriminating renegotiation in a competitive insurance market'. *European Economic Review* **10**, 1717–1736.

Bond, E. W. and K. J. Crocker (1997), 'Hardball and the soft touch: The economics of optimal insurance contracts with costly state verification and endogenous monitoring costs'. *Journal of Public Economics* **63**, 239–264.

Borch, K. (1962), 'Equilibrium in a reinsurance market'. *Econometrica* **30**, 424–444.

Borch, K. (1981), 'Is regulation of insurance companies necessary?'. In: H. Göppl and R. Henn (eds.): *Geld, Banken und Versicherungen,* Vol. 2. Königstein, pp. 717–731.

Brockett, P. L., R. MacMinn, and M. Carter (2000), 'Genetic testing, insurance economics and societal responsibility'. *North American Actuarial Journal* **3**(1), 1–20.

Brundin, I. and F. Salanié (1997), *Fraud in the Insurance Industry: An Organizational Approach*. Department of Economics, University of Toulouse, Mimeo.

Brys, E., G. Dionne, and L. Eeckhoudt (1989), 'More on insurance as a Giffen good'. *Journal of Risk and Uncertainty* **2**, 415–420.

Chiappori, P. A., B. Jullien, B. Salanié, and F. Salanié (2006), 'Asymmetric information in insurance: General testable implications'. *RAND Journal of Economics* **37**(4), 783–798.

Chiappori, P. A., I. Macho, P. Rey, and B. Salanié (1994), 'Repeated moral hazard: The role of memory, commitment and the access to credit markets'. *European Economic Review* **38**, 1527–1553.

Chiappori, P. A. and B. Salanié (2000), 'Testing for asymmetric information in insurance markets'. *Journal of Political Economy* **108**, 56–78.

Cho, I. and D. Kreps (1987), 'Signalling games and stable equilibria'. *Quarterly Journal of Economics* **52**, 179–222.

Cook, P. J. and D. A. Graham (1977), 'The Demand for insurance and protection: The case of irreplacable commodities'. *Quarterly Journal of Economics* **91**, 143–156.

Cooper, R. and B. Hayes (1987), 'Multi-period insurance contracts'. *International Journal of Industrial Organization* **5**, 211–231.

Crocker, K. J. and J. Morgan (1998), 'Is honesty the best policy? Curtailing insurance fraud through optimal incentive contracts'. *Journal of Political Economy* **106**(2), 355–375.

Crocker, K. J. and A. Snow (1985), 'The efficiency of competitive equilibria in insurance markets with asymmetric information'. *Journal of Public Economics* **26**, 207–219.

Crocker, K. J. and A. Snow (1986), 'The efficiency effects of categorical discrimination in the insurance industry'. *Journal of Political Economy* **94**, 321–344.

Crocker, K. J. and A. Snow (1992), 'The social value of hidden information in adverse selection economies'. *Journal of Public Economics* **48**, 317–347.

Cummins, D. (1991), 'Statistical and financial models of insurance pricing and the insurance firm'. *Journal of Risk and Insurance* **58**, 261–302.

D'Arcy, S. P. and N. Doherty (1990), 'Adverse selection, private information and lowballing in insurance markets'. *Journal of Business* **63**, 145–164.

Dasgupta, P. and E. Maskin (1986), 'The existence of equilibrium in discontinuous economic games, II: Applications'. *Review of Economic Studies* **53**, 27–41.

Dionne, G. (1983), 'Adverse selection and repeated insurance contracts'. *Geneva Papers on Risk and Insurance* **8**, 316–332.

Dionne, G. (2000), *Handbook of Insurance*. Kluwer.

Dionne, G. and N. A. Doherty (1994), 'Adverse selection, commitment, and renegotiation: Extension to and evidence from insurance markets'. *Journal of Political Economy* **102**, 209–235.

Doherty, N. A. and H. Schlesinger (1990), 'Rational insurance purchasing: Consideration of contract nonperformance'. *Quarterly Journal of Economics* **105**, 143–153.

Doherty, N. A. and P. D. Thistle (1996), 'Adverse selection with endogenous information in insurance markets'. *Journal of Public Economics* **63**, 83–102.

Dulleck, U. and R. Kerschbamer (2006), 'On doctors, mechanics and computer specialists — The economics of credence goods'. *Journal of Economic Literature* **44**, 5–42.

Eeckhoudt, L. and C. Gollier (2000), 'The effects of changes in risk on risk taking: A survey'. In: G. Dionne (ed.): *Handbook of Insurance*. Kluwer, pp. 117–130.

Eeckhoudt, L., C. Gollier, and H. Schlesinger (2005), *Economic and Financial Decisions under Risk*. Princeton University Press.

Ehrlich, I. and G. Becker (1972), 'Market insurance, self insurance and self protection'. *Journal of Political Economy* **80**, 623–648.

Emons, W. (1997), 'Credence goods and fraudulent experts'. *RAND Journal of Economics* **28**, 107–119.

Fagart, M.-C. and P. Picard (1999), 'Optimal insurance under random auditing'. *Geneva Papers on Risk and Insurance Theory* **24**, 29–54.

Finsinger, J. and M. Pauly (1984), 'Reserve levels and reserve requirements for profit maximising insurance firms'. In: G. Bamberg and K. Spremann (eds.): *Risk and Capital*. Berlin: Springer.

Fudenberg, D., B. Holmström, and P. Milgrom (1990), 'Short term contracts and long term agency relationships'. *Journal of Economic Theory* **51**, 1–31.

Fudenberg, D. and J. Tirole (1990), 'Moral hazard and renegotiation in agency contracts'. *Econometrica* **58**, 1279–1319.

Gollier, C. (2001), *The Economics of Risk and Time*. The MIT Press.

Gollier, C. and H. Schlesinger (1996), 'Arrow's theorem on the optimality of deductibles: A stochastic dominance approach'. *Economic Theory* **7**, 359–363.

Gravelle, H. and R. Rees (2004), *Microeconomics*. Prentice Hall, Third edition.

Grossman, H. (1979), 'Adverse selection, dissembling and competitive equilibrium'. *Bell Journal of Economics* **10**, 330–343.

Grossman, S. and O. Hart (1983), 'An analysis of the principal-agent problem'. *Econometrica* **51**, 7–45.

Harris, M. and R. M. Townsend (1981), 'Resource allocation under asymmetric information'. *Econometrica* **49**(1), 33–64.

Hellwig, M. F. (1987), 'Some recent developments in the theory of competition in markets with adverse selection'. *European Economic Review* **31**, 319–325.

Hellwig, M. F. (1988), 'A note on the specification of interfirm communication in insurance markets with adverse selection'. *Journal of Economic Theory* **46**, 154–163.

Hermalin, B. and M. Katz (1991), 'Moral hazard and verifiability'. *Econometrica* **59**, 1735–1754.

Hirshleifer, J. (1971), 'The private and social value of information and the reward to inventive activity'. *American Economic Review* **61**(4), 561–574.

Holmström, B. (1979), 'Moral hazard and observability'. *Bell Journal of Economics* **10**, 74–91.

Holmström, B. (1982), 'Moral hazard in teams'. *Bell Journal of Economics* **13**, 324–340.

Hoy, M. and M. Polborn (2000), 'The value of genetic information in the life insurance market'. *Journal of Public Economics* **78**(3), 235–252.

Hoy, M. and A. Robson (1981), 'Insurance as a giffen good'. *Economics Letters* **8**, 47–51.

Hoy, M. and M. Ruse (2005), 'Regulating genetic information in insurance markets'. *Risk Management & Insurance Review* **8**(2), 211–237.

Inderst, R. and A. Wambach (2001), 'Competitive insurance markets under adverse selection and capacity constraints'. *European Economic Review* **45**, 1981–1992.

Jaynes, G. D. (1978), 'Equilibria in monopolistically competitive insurance markets'. *Journal of Economic Theory* **19**, 394–422.

Jewitt, I. (1988), 'Justifying the first-order approach to principal-agent problems'. *Econometrica* **57**, 1177–1190.

Khalil, F. C. (1997), 'Auditing without commitment'. *RAND Journal of Economics* **28**, 629–640.

Kunreuther, H. and M. Pauly (1985), 'Market equilibrium with private knowledge: An insurance example'. *Journal of Public Economics* **26**, 269–288.

Lacker, J. M. and J. A. Weinberg (1989), 'Optimal contracts under costly state falsification'. *Journal of Political Economy* **97**(6), 1345–1363.

Ma, C. T. A. (1994), 'Renegotiation and optimality in agency contracts'. *Review of Economic Studies* **61**, 109–129.

Magill, M. and M. Quinzii (1996), *Theory of Incomplete Markets,* Vol. 1. MIT Press.

Malcomson, J. and F. Spinnewyn (1988), 'The multiperiod principal-agent problem'. *Review of Economic Studies* **55**, 391–408.

Mas-Colell, A., M. D. Whinston, and J. R. Green (1996), *Microeconomic Theory*. Oxford University Press.

Milgrom, P. and N. Stokey (1982), 'Information, trade and common knowledge'. *Journal of Economic Theory* **26**, 17–27.

Mirrlees, J. A. (1971), 'An exploration in the theory of optimal income taxation'. *Review of Economic Studies* **38**(2), 175–208.

Miyazaki, H. (1977), 'The rat race and internal labour markets'. *Bell Journal of Economics* **8**, 394–418.

Mookherjee, D. and I. Png (1989), 'Optimal auditing, insurance and redistribution'. *Quarterly Journal of Economics* **104**, 399–415.

Moore, J. and R. Repullo (1988), 'Subgame perfect implementation'. *Econometrica* **56**, 1191–1220.

Mossin, J. (1968), 'Aspects of rational insurance purchasing'. *Journal of Political Economy* **79**, 553–568.

Munch, P. and D. Smallwood (1981), 'Theory of solvency regulation in the property and casualty industry'. In: G. Fromm (ed.): *Studies in Public Regulation*. Cambridge: MIT Press, pp. 119–180.

Myerson, R. B. (1979), 'Incentive compatibility and the bargaining problem'. *Econometrica* **47**, 61–73.

Peltzman, S. (1975), 'The effects of automobile saftety regulation'. *Journal of Political Economy* **83**, 677–726.

Picard, P. (1996), 'Auditing claims in the insurance market with fraud: The credibility issue'. *Journal of Public Economics* **63**, 27–56.

Picard, P. (2000), 'Economic analysis of insurance fraud'. In: G. Dionne (ed.): *Handbook of Insurance Economics*. Boston, pp. 315–362.

Radner, R. (1981), 'Monitoring cooperative agreements in a repeated principal-agent relationship'. *Econometrica* **49**(5), 1127–1148.

Raviv, A. (1979), 'The design of an optimal insurance policy'. *American Economic Review* **69**, 84–96.

Rees, R., H. Gravelle, and A. Wambach (1999), 'Regulation of insurance markets'. *Geneva Papers on Risk and Insurance Theory* **24**, 55–68.

Riley, J. G. (1979), 'Informational equilibrium'. *Econometrica* **47**, 331–359.

Rogerson, W. (1985a), 'The first-order approach to principal-agent problems'. *Econometrica* **53**, 1357–1368.

Rogerson, W. (1985b), 'Repeated moral hazard'. *Econometrica* **53**, 69–76.

Rosenthal, R. W. and A. Weiss (1984), 'Mixed strategy equilibrium in a market with adverse selection'. *Review of Economic Studies* **51**, 333–342.

Rothschild, M. and J. Stiglitz (1976), 'Equilibrium in competitive insurance markets: An essay on the economics of imperfect information'. *Quarterly Journal of Economics* **80**, 629–649.

Rubinstein, A. and M. E. Yaari (1983), 'Repeated insurance contracts and moral hazard'. *Journal of Economic Theory* **30**, 74–97.

Schlesinger, H. (1984), 'Optimal insurance for irreplacable commodities'. *Journal of Risk and Insurance* **51**, 131–137.

Schlesinger, H. and J. M. Graf v. d. Schulenburg (1987), 'Risk aversion and the purchase of risky insurance'. *Journal of Economics* **47**, 309–314.

Smart, M. (2000), 'Competitive insurance markets with two unobservables'. *International Economic Review* **41**(1), 153–169.

Spence, M. (1978), 'Product differentiation and performance in insurance markets'. *Journal of Public Economics* **10**, 427–447.

Stiglitz, J. (1977), 'Monopoly, non-linear pricing and imperfect information: The insurance market'. *Review of Economic Studies* **44**, 407–430.

Strohmenger, R. and A. Wambach (2000), 'Adverse selection and categorical discrimination in the health insurance markets: The effects of genetic tests'. *Journal of Health Economics* **19**(2), 197–218.

Sülzle, K. and A. Wambach (2005), 'Insurance in a market for credence goods'. *Journal of Risk and Insurance* **72**, 159–176.

Tabarrok, A. (1994), 'Genetic testing: An economic and contractarian analysis'. *Journal of Health Economics* **13**, 75–91.

Tennyson, S. (1997), 'Economic institutions and individual ethics: A study of consumer attitudes toward insurance fraud'. *Journal of Economic Behaviour and Organization* **32**, 247–265.

Tirole, J. (1986), 'Hierarchies and bureaucracies: On the role of collusion in organizations'. *Journal of Law, Economics and Organization* **2**, 181–214.

Townsend, R. M. (1979), 'Optimal contracts and competitive markets with costly state verification'. *Journal of Economic Theory* **21**, 265–293.

Villeneuve, B. (2003), 'Concurrence et antisélection multidimensionnelle en assurance'. *Annales d'économie et de statistique* **69**, 119–142.

Wambach, A. (2000), 'Introducing heterogeneity in the Rothschild–Stiglitz model'. *Journal of Risk and Insurance* **67**, 579–591.

Wilson, C. (1977), 'A model of insurance markets with incomplete information'. *Journal of Economic Theory* **16**, 167–207.

Wolinsky, A. (1993), 'Competition in the market for informed expert services'. *RAND Journal of Economics* **24**, 380–398.

Zweifel, P., F. Breyer, and M. Kifmann (2007), *Health Economics*. Springer.