When prices hardly matter:

Incomplete insurance contracts and markets for repair goods

Martin Nell, Andreas Richter, Jörg Schiller

Discussion Paper 2006-2

September 2006

LMU
LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN
MUNICH SCHOOL OF MANAGEMENT

Online at http://epub.ub.uni-muenchen.de/

When prices hardly matter:
Incomplete insurance contracts and markets for repair goods

Martin Nell

Institute for Risk and Insurance
University of Hamburg, Germany
phone: +49 40 428384014, fax: +49 40 428385505
martin.nell@rrz.uni-hamburg.de

Andreas Richter

Institute for Risk and Insurance Management
Munich School of Management
Ludwig-Maximilians-University Munich, Germany
phone: +49 89 21802171, fax: +49 89 2180993755
richter@bwl.uni-muenchen.de

Jörg Schiller

WHU – Otto Beisheim School of Management, Vallendar, Germany
phone: +49 261 6509302, fax: +49261 6509509
joerg.schiller@whu.edu

This draft: September 8, 2006

Abstract

This paper looks at markets characterized by the fact that the demand side is insured. In these markets a consumer purchases a good to compensate consequences of unfavorable events, such as an accident or an illness. Insurance policies in most lines of insurance base indemnity on the insured's actual expenses, i.e., the insured would be partially or completely reimbursed when purchasing certain goods. In this setting we discuss the interaction between insurance and repair markets by focusing, on the one hand, upon the development of prices and the structure of markets with insured consumers, and, on the other hand, the resulting backlash on optimal insurance contracting. We show that even in the absence of ex post moral hazard the extension of insurance coverage will lead to an increase in prices as well as to a socially undesirable increase in the number of repair service suppliers, if repair markets are imperfect.

Keywords: insurance, incomplete contracts, repair markets

JEL classification: C72, D43, G22

1. Introduction

This paper is concerned with markets characterized by the fact that the demand side is insured. In these markets, which will be referred to as *repair markets*, a consumer purchases a good or repair service to compensate consequences of certain unfavorable events, such as an accident or an illness. Examples are segments of the markets for car repair services and rental cars as well as the markets for medical services and pharmaceutical products.

The fact that consumers are insured, would by itself not cause economic problems so long as insurance companies are able to write complete contingent contracts assigning indemnity payments directly to any possible "state of the world". Typically, though, the set of potential states of the world is rather complex implying that writing complete contracts would either be impossible or cause disproportionate transaction costs.[1] For example, a complete contract in auto insurance would have to precisely define the indemnity payable in case of any possible damage to the involved autos. As the latter is usually not a realistic option, insurance policies in most lines of insurance base indemnity on the insured's actual expenses, i.e., the insured would be partially or completely reimbursed when purchasing certain goods.

In perfect repair markets the fact that consumers are insured would have no impact on the actual prices, since prices correspond to marginal cost. However, as empirical work, e.g. by *Feldstein* (1970), *Zweifel* and *Crivelli* (1996) and *Pavcnik* (2002) suggests, insurance design has a major impact upon repair markets. Therefore, it is intuitive to suppose that repair markets are imperfect since prices usually exceed marginal costs. A straightforward rationale for the latter is market power which can result from heterogeneous preferences or tastes. For the single consumer, transaction costs incurred in the process of consuming repair goods often

---

[1] See, for example, Anderlini and Felli (1994), Segal (1999), Maskin (2002).

differ across suppliers, for instance depending on the location of suppliers relative to the consumer. In the context of car repair shops or rental cars, an illustration of this can be seen in spatial preferences. Another example can be observed in markets for pharmaceutical products and health services, where market power results from consumers' designated preferences for certain suppliers. Given such preferences, it is an important task to analyze the implications of insurance for consumers' demand decisions in imperfect repair markets.

If repair markets are imperfect and consumers are insured, prices of repair goods are directly affected by insurance arrangements. Consequently, an extension of coverage will lead to increasing prices for repair goods. Note that this line of argument is valid even in the absence of any ex post moral hazard problems: Consider a situation where coverage is based upon consumers' expenses and insurance companies are able to effectively control quality of repair goods purchased. In such a situation consumers' product choice will also be less price sensitive and will therefore lead to a price increase, if they have certain preferences among suppliers.

An illustrative example – The German car rental market

In repair markets price discrimination between insured and uninsured consumers is quite common and prices are significantly higher for insured consumers. As an example for this, consider the German car rental market.

In this market a major segment of insured consumers can easily be identified by rental car suppliers: The business in accident substitute rental cars accounts for roughly 30 % of the entire market.[2] Consumers in this segment temporarily substitute a vehicle that was damaged in an accident. They are either compensated by their collision loss insurer or they have a valid

---

[2] See Bundesverband der Autovermieter e.V. [Association of Car Rental Companies], Autovermietung, Düsseldorf 1998.

claim for a substitute car against the other party or, effectively, the other party's liability insurer.[3] Therefore, this segment consists exclusively of consumers whose rental car expenses are covered by an insurance company, while consumers' expenses in the remaining share of the market are uninsured.

In the 1990s, differences in rates for substitute and non-substitute rental cars in the German market could be easily investigated, as pricing information for these segments were determined and published on a regular basis.[4] The data were collected for different car classes and different zip code areas and consisted of information from the most popular tariffs. The following table lists average rates from the years 1997 through 1999 for the most frequently rented car class in 100 randomly chosen zip code areas.

Table 1: Average rates in the German rental car market 1997-1999

(car class „5“, 100 randomly chosen zip code areas)

Year	**Daily Rate**			**Weekly Rate**		
	Substitute Cars	*Non-Substitute Cars*	*Difference*	*Substitute Cars*	*Non-Substitute Cars*	*Difference*
1997	346.15 DM (29.87)[5]	277.22 DM (45.56)	24.9 %	2025.56 DM (260.68)	1640.95 DM (301.28)	23.4%
1998	359.60 DM (33.54)	312.02 DM (42.11)	15.2 %	2144.28 DM (336.05)	1812.27 DM (293.47)	18.3%
1999	374.59 DM (32.97)	319.71 DM (44.16)	17.2 %	2262.56 DM (312.61)	1903.52 DM (321.4)	18.9%

Source: Schwacke-Bewertung GmbH & Co KG, SchwackeLISTE-Automietpreisspiegel, Osnabrück 1997, 1998, 1999.

[3] Please note that auto liability insurance (without any coinsurance) is mandatory in Germany. Therefore, in almost any case, this liability claim is covered through insurance.

[4] The EurotaxSchwacke GmbH company regularly published a survey concerning the prices for rental cars in Germany, which distinguished between the accident substitute business and the so called free business and reported them separately.

[5] The values given in brackets are the empirical standard deviations.

During the sample period, rates in the substitute car business exceeded the rates for non-substitute cars by 15.2 – 24.9 %. More precisely, these numbers can be considered lower bounds for the actual price differences, as the non-substitute tariffs were adjusted by means of a general additional collision coverage component.[6] The price differences displayed in Table 1 can not be explained by ex post moral hazard, since the quantity and the quality of substitute cars can easily be observed by insurance companies.

Surprisingly, only few theoretical papers so far have dealt with the interdependencies between insurance and repair markets. *Frech* and *Ginsburg* (1975), for example, address the question of how, in a monopolistic health care market, different types of insurance benefits affect price and quantity. They find, among other results, that in any case both parameters will increase, with prices tending to infinity for the case of complete insurance. However, since, e.g., the markets for medical or car repair services typically have an oligopolistic or atomistic structure, the results of *Frech and Ginsburg* (1975) do not capture the situation in most of the repair markets and particularily the externality problem we are interested in. *Gaynor et al.* (2000) analyze the interdependence between the degree of competition in health care markets and the extent of excess consumption due to insurance. Their results indicate that even in the presence of insurance-induced changes in price elasticity, consumers benefit from increased competition in health care markets.

The existing related empirical literature, which also for the most part addresses the demand for health care and pharmaceutical products, is extensive. Most of the findings are straightforward and correspond to the theoretical results mentioned above. For instance, *Newhouse et al.* (1993) found that patients with full insurance coverage used significantly

---

6 This extra price component was added, since rates in the German substitute car market generally include liability as well as collision and comprehensive coverage, while rates for non-substitute cars often only include liability insurance and certain additional partial coverage, but the available data did not include the actual precise range of insurance coverage. Therefore, for the non-substitute car rates as given in the table, there is a tendency of overstating the correct values.

more health care than those who had to co-pay directly. (The study also showed that the different insurance plans the participating households had been assigned did not significantly affect their health situation). In a recent paper, *Pavcnik* (2002) analyzes how a reduction of insurance coverage influences pharmaceutical product prices. Her results show that these prices decrease considerably as patients' out-of-pocket expenses increase.

Several studies by *Feldstein* show that physicians in medical markets raise their fees and improve their products when insurance coverage becomes broader, and even non-profit hospitals respond to an increase in insurance by increasing the sophistication and the price of their service (*Feldstein* 1970, 1971). More importantly and probably somewhat puzzlingly at first glance, empirical analysis indicates that a reduction of the actual demand of insurance coverage would induce a welfare gain, i.e. individuals purchase too much insurance (*Feldstein* 1973, the issue was revisited by *Feldman* and *Dowd* 1991). This is surprising, as one would expect that working insurance markets provide the optimal amount of coverage even in the presence of moral hazard. In particular, the existence of ex post moral hazard can not explain why insurance companies offer insurance contracts with more coverage than the socially desirable amount. Given the above mentioned empirical findings *Feldstein* emphasizes: "(…) even the uninsured individual will find that his expenditure on health services is affected by the insurance of others" and furthermore suggests that the over-insurance result is due to a prisoner's dilemma, as "People spend more on health because they are insured and buy more insurance because of the high cost of health care".[7] One of the goals of this paper is to provide a theoretical explanation for this finding by showing that companies in competitive insurance markets will face an externality problem, if repair markets are imperfect and insurance contracts are incomplete. Therefore, the risk allocation and the price increasing

---

[7] Feldstein (1973), p. 252.

effects of insurance coverage are suboptimally balanced, and subsequently, insurance contracts entail too much coverage.

The reason why the interaction between insurance and repair markets has not yet been studied more extensively from a theoretical point of view presumably can be seen in the typical perception of insurance in the economics literature: Insurance contracts are usually interpreted as a specific kind of financial contract, in which the insured – in return for the premium – acquires a claim upon future state-contingent payments. Most precisely, this has been stated by Arrow: “insurance is the exchange of money now for money payable contingent on the occurrence of certain events”[8]. According to this view, insurance contracts are considered complete in the sense that the amount of indemnity can be directly tied to the occurrence of states of the world. However, as has been stated above, this is not what we observe in important lines of insurance, where the insured, in case of a loss, receives coverage based upon his or her actual repair expenses. Therefore, these insurance contracts are incomplete, as the insurer’s payments are not unambiguously given and, in particular, depend on the prices for repair services.

In this paper, we discuss the interaction between insurance and repair markets by focusing, on the one hand, upon the development of prices and the number of suppliers in markets with insured consumers, and, on the other hand, the resulting backlash on optimal insurance contracting. To keep things as simple as possible, we assume that no information asymmetries exist and that insurance is available at actuarially fair premiums. Frictions, however, exist in the repair market. We consider a repair market with product differentiation which provides the single supplier with a certain spatial market power. The model framework employed here is based upon an approach introduced by *Salop* (1979). Basically, the focus is

[8] Arrow (1965), p. 45.

on indescribable contingencies in insurance arrangements. We are interested in the impact of incomplete insurance contracts on imperfect repair markets. As the introduction of incomplete contracts means a substantial imperfectness and because our analysis is supposed to concentrate on this problem, we will abstain from other imperfections, especially any ex post moral hazard problems in insurance markets.

In contrast to the existing literature, we also study a new aspect of the problem concerning the optimal structure of insurance markets: A pareto-efficient insurance contract maximizes the expected utility of consumers under certain constraints. The main task for the insurer in the considered context is to balance the trade off between risk allocation and the insurance-induced price effect in the repair market. But the limiting effect of a coinsurance rate on the repair market price level depends on the market share of the offering insurance company. In an atomistic market a single insurer's contract design only has a negligible impact on the repair market and its price level. Consequently, the equilibrium coinsurance rate will increase in the market share of a particular insurer or decrease in the number of insurance companies respectively. Thus, insurance companies are indeed facing a prisoner's dilemma problem as suggested by *Feldstein*.

The remainder of the paper is organized as follows. Section 2 introduces the model. In Section 3 we present benchmarks for the following analysis. Section 4 discusses the impact of incomplete insurance contracts on the structure of the repair market, while section 5 addresses effects in the insurance market. Section 6 deals with the externality problem in competitive insurance markets and Section 7 concludes.

2. The model framework

Our analysis focuses on the optimal insurance design and the number of firms in repair markets with insured consumers. We assume that consumers have heterogeneous preferences.

These preferences are interpreted as being caused by consumers' spatial distribution. We consider *n* suppliers, denoted $j = 1,...,n$ that offer a good respectively a repair service. Each company offers a repair service at the price p_j and the suppliers compete in prices a la Bertrand.[9] Consumers with an initial wealth of w_0 face the risk of a loss with probability π. In case of a loss suppliers offer one repair unit, which fully restores the loss, but consumers face transportation cost *t* that increases in the distance *x* to the supplier. The model framework is based upon the circular city model by *Salop* (1979), where consumers are uniformly and continuously distributed along a circle with a perimeter equal to $1/\pi$.[10] Consumers have a twice-differentiable utility function $u(w)$ with $u'(\cdot) > 0, u''(\cdot) < 0$, where *w* represents the final wealth of consumers. Thus, consumers' preferences are only heterogeneous with respect to the repair good. In the insurance market *m* risk-neutral insurers, denoted $i = 1,...,m$, simultaneously offer contracts $C_i = (\alpha_i, I_i)$ which consist of an indemnity $I_i = (1-\delta_i)p_j$, where $\delta_i \in [0,1]$ denotes the individual contract's coinsurance rate, and an actuarially fair break-even premium $\alpha_i = \pi I_i$.

We further assume that consumers suffering from a loss always derive a surplus from consuming a unit of the repair good. Exactly one unit is purchased. Through these assumptions we abstain from the problem of ex post moral hazard (*Pauly* 1968), as the extent of purchased repair services is independent of the amount of coverage. This is plausible in situations where only one repair unit is necessary and over-consumption has no value for consumers. Assuming that uninsured consumers derive a surplus from purchasing the repair

---

[9] To make things as simple as possible, we rather model the price competition between insurance companies explicitly and only consider that every single insurance contracts leads to zero expected profits.

[10] This assumption implies that the ex post size of the repair market, after the realization of losses, is one.

service implies that insured consumers with an insurance contract C_i strictly prefer to demand the service in case of an accident.

The sequence of the considered game between insurers, consumers and suppliers is as follows: At stage 1, each of the *m* insurance companies simultaneously offers a break-even insurance contract C_i. Then at stage 2, the potential entrants in the repair market simultaneously choose whether or not to enter the market. Suppliers that entered are equidistantly distributed on the circle. As we analyze the problem of the number of suppliers entering the market, we assume that the potential entrants face fixed entry costs of $f > 0$. Because of the free entry assumption the equilibrium profit of entering firms is zero. Finally, at stage 3 the suppliers that have entered set their prices p_j, given their locations.

3. Social optima

As a reference point for the following analysis, we take a look at different benchmark situations. Let us first start with situations where complete insurance contracts are feasible. These contracts and the associated indemnity can be conditioned upon any possible state of nature. Under such ideal circumstances the optimal insurance arrangement is straightforward: since insurance companies can anticipate the (equilibrium market) price for a repair unit, the indemnity corresponds to the equilibrium price and the resulting transportation cost of each consumer.

First Best

The first best insurance contract entails (a) an optimal risk allocation and (b) minimizes the sum of standing expenses, consumers' transportation cost and repair expenses:[11]

[11] For further details concerning the determination of first and second-best prices as well as the associated numbers of suppliers see Salop (1979).

$$\min_n \left[nf + 2tn \int_0^{\frac{1}{2n}} x \, dx \right]. \tag{1}$$

The solution is characterized by the following conditions:

(a) $I_i = p_{FB} + tx_i$ with $p_{FB} = c + 1/2\sqrt{tf}$ and

(b) $n^{FB} = \frac{1}{2}\sqrt{\frac{t}{f}}$.

One of the main results of the Salop model is that in equilibrium too many suppliers enter the repair market. Thus, condition (b) is not met, if repair and insurance market are independent. However, when the structure of the repair market is endogenous, vertically integrating the repair market can potentially lead to a first best situation. By overriding the Salop competition in the repair market insurance companies can reduce the number of operating repair service suppliers. A monopoly insurer or a coalition of all insurance companies can establish a repair service network with a first best number of repair shops and consumers are fully compensated for any losses.

Second Best

In a second best situation, complete insurance contracts are still feasible, but due to legal or other restrictions, insurance companies are not able to enforce structural actions which influence or offset the competition in the repair market. Thus, the second best is characterized by the following condition:

(a) $I_i = p_{SB} + tx_i$ with $p_{SB} = c + \sqrt{tf}$ and

(b) $n^{SB} = \sqrt{\frac{t}{f}}$.

As in the first best situation, the risk allocation is still first best. However, as has been shown by Salop, in equilibrium too many suppliers enter the market. This leads to a welfare loss compared to the first best situation.

Third Best

A further welfare loss is incurred when insurance contracts are incomplete. The optimal incomplete insurance contract trades off the insurance-induced price effect on the repair market and risk allocation. We will derive the third best insurance contract in the following two sections.

4. Effects in the repair market

Starting with the price competition at stage 3, we assume that n suppliers have entered the market. In this situation, consumers decide upon deterministic outcomes and only those who suffered a loss purchase the repair unit. We assume in the first instance that all consumers accepted the same incomplete insurance contract with a strictly positive coinsurance rate $(\delta > 0)$.[12] Subsequently, we concentrate on symmetric equilibria, where all suppliers charge the same price p. Each firm has only two surrounding competitors. In order to derive a single supplier's demand function, let us consider supplier *j*. A consumer located between supplier *j* and one of its neighbors (offering a repair unit at the price *p*) at the distance $x \in [0,1]$ from supplier *j* is indifferent between the two competitors, if

$$\delta\, p_j + tx = \delta\, p + t\left(\frac{1}{n} - x\right) \tag{2}$$

holds.

---

[12] In section 5 it will be shown that $\delta = 0$ can never be a part of an equilibrium.

To highlight the effects of insured consumers on the structure of repair markets, we rewrite (2) as

$$p_j + \frac{t}{\delta} x = p + \frac{t}{\delta}\left(\frac{1}{n} - x\right). \tag{3}$$

The transportation cost rate t indicates the suppliers' market power, as it determines to what extent prices of repair services can exceed marginal cost. If a consumer is insured and, thus, δ is below one, the market power of repair firms is increased.

The resulting demand function of supplier j is given by

$$D_j(p_j, p) = 2x = \frac{\frac{t}{n} + \delta(p - p_j)}{t}. \tag{4}$$

Each firm j maximizes its profit function

$$\max_{p_j} \quad \Pi_j(p_j, p) = (p_j - c)\frac{\frac{t}{n} + \delta(p - p_j)}{t} - f, \tag{5}$$

where c denotes the per-unit cost of providing the repair good. The first order condition for a profit maximum in a symmetric equilibrium with $p_j = p$ is

$$p = c + \frac{t}{\delta n}. \tag{6}$$

The price level in the repair market decreases in the number of entering firms and in the coinsurance rate. The number of entering firms is therefore endogenously determined by the following zero profit constraint

$$\Pi_j(p) = \frac{t}{\delta n^2} - f = 0. \tag{7}$$

In the context of free market entry the number of firms in equilibrium is given by

$$n^* = \sqrt{\frac{t}{\delta f}}\,. \tag{8}$$

Even without insurance, the number of suppliers in market equilibrium n^* is too high compared to the first best situation. Given a strictly positive coinsurance $\delta > 0$, the number of operating service suppliers is higher than the first and the second best optimum (*Salop* 1979), $n^* > n^{SB} > n^{FB}$. The equilibrium price level in the repair market is

$$p^* = c + \sqrt{\frac{tf}{\delta}}\ . \tag{9}$$

In equations (8) and (9) the case of uninsured consumers refers to $\delta = 1$. Thus, insurance leads to an increase in the number of suppliers as well as in the market price. The intuition behind these results is straightforward: Insurance increases the marginal profit with respect to the price, as δ declines. The increased marginal profit of firms attracts additional entrants and reduces, therefore, the segment size $1/n$ covered by an individual supplier. The increase in the number of operating firms in the repair market offsets the market entry incentives which are due to the increase in marginal profits. In other words, insurance arrangements make related repair markets more attractive for entrants and further increase the socially undesirable level of fixed cost in the repair market even though the expected transportation costs decline.

5. Effects in the insurance market

Now we are able to determine the third best insurance contract. Due to the complexity of the states of nature, insurers are assumed to be unable to fully specify the behavior of consumers and suppliers in the case of a loss. Consequently, insurance contracts can only be conditioned upon the consumer's expenses for the repair good. For simplicity reasons we further assume transportation costs to be uninsurable.

The third best insurance contract maximizes the expected utility of an average consumer under the constraint that insurance contracts break even. The optimal insurance contract and in particular the coinsurance rate δ^{TB} trades off the insurance-induced price effect and risk allocation. Therefore, δ^{TB} is specified by the following expected utility maximization problem:

$$\begin{aligned}\max_{\delta} \quad EU(\delta) &= (1-\pi)\,u\left(\underbrace{w_0 - \pi(1-\delta)\left(c+\sqrt{\frac{tf}{\delta}}\right)}_{:=w_n}\right)\\ &+ \pi\,u\left(\underbrace{w_0 - \pi(1-\delta)\left(c+\sqrt{\frac{tf}{\delta}}\right) - \delta\left(c+\sqrt{\frac{tf}{\delta}}\right) - \frac{1}{4}\sqrt{\delta tf}}_{:=w_l}\right).\end{aligned} \tag{10}$$

The first order condition for an interior solution is given by

$$\begin{aligned}\frac{\partial EU}{\partial \delta} &= (1-\pi)\pi\,u'(w_n)\left[\left(c+\sqrt{\frac{tf}{\delta^{TB}}}\right)+\frac{1}{2}\left(1-\delta^{TB}\right)\sqrt{\frac{tf}{\left(\delta^{TB}\right)^3}}\right]\\ &+ \pi\,u'(w_l)\left[\pi\left(c+\sqrt{\frac{tf}{\delta^{TB}}}\right)+\frac{1}{2}\pi\left(1-\delta^{TB}\right)\sqrt{\frac{tf}{\left(\delta^{TB}\right)^3}}\right.\\ &\left.-\left(c+\sqrt{\frac{tf}{\delta^{TB}}}\right)+\frac{1}{2}\delta^{TB}\sqrt{\frac{tf}{\left(\delta^{TB}\right)^3}}-\frac{1}{8}\sqrt{\frac{tf}{\delta^{TB}}}\right]=0\end{aligned} \tag{11}$$

The following two propositions characterize the third best insurance contract.

Proposition 1

A third best optimal insurance contract can not entail full coverage $\left(\delta^{TB} > 0\right)$.

Proof:

As w_n is obviously strictly increasing in δ, the third-best solution is characterized by

$$\frac{\partial w_l}{\partial \delta} = \pi\left(c + \sqrt{\frac{tf}{\delta}}\right) - \left(c + \sqrt{\frac{tf}{\delta}}\right) + \frac{1}{2}\pi(1-\delta)\sqrt{\frac{tf}{\delta^3}} + \frac{1}{2}\delta\sqrt{\frac{tf}{\delta^3}} - \frac{1}{8}\sqrt{\frac{tf}{\delta}} < 0. \quad (12)$$

Rearranging yields the condition

$$(1-\pi)\left(c + \sqrt{\frac{tf}{\delta}}\right) + \frac{1}{8}\sqrt{\frac{tf}{\delta}} > \frac{1}{2}\left(\delta + \pi(1-\delta)\right)\sqrt{\frac{tf}{\delta^3}} \quad (13)$$

Multiplying (13) by δ leads to

$$(1-\pi)\left(\delta c + \sqrt{\delta tf}\right) + \frac{1}{8}\sqrt{\delta tf} > \frac{1}{2}\left(\delta + \pi(1-\delta)\right)\sqrt{\frac{tf}{\delta}} \quad (14)$$

The LHS of (14) tends to zero and the RHS of (14) tends to infinity for δ converging to zero. Thus, for a given loss probability π, production costs c and transportations costs t, there will always be a critical coinsurance rate $\delta^c > 0$ such that the impact of a marginal increase in coverage in the state of loss is zero. Since consumers' wealth in the no loss state is strictly increasing in δ, the third best coinsurance rate δ^{TB} has to be greater than δ^c.

q.e.d.

The intuition of Proposition 1 is straightforward: The optimal insurance contract trades off the benefit of an improved risk allocation and the costs of the insurance-induced price effect. On the one hand, the marginal benefit from an improved risk allocation due to an additional increase in insurance coverage is decreasing in coverage and diminishes if consumers are fully insured. On the other hand, the marginal price effect is strictly increasing in coverage and tends to infinity as the coinsurance rate tends to zero. Consequently, the third best contract cannot provide full insurance.

Now we turn to the question of whether the optimal insurance contract entails any coverage at all ($\delta^{TB} < 1$).

Proposition 2

If consumers are sufficiently risk-averse, the third best contract entails partial insurance $\left(0 < \delta^{TB} < 1\right)$. *Otherwise the third best contract does not provide any coverage* $\left(\delta^{TB} = 1\right)$.

Proof:

A necessary condition for $\delta^{TB} < 1$ is that the marginal expected utility at $\delta = 1$ is negative.

$$\left.\frac{\partial EU}{\partial \delta}\right|_{\delta=1} = (1-\pi)\pi\, u'(w_n)\big|_{\delta=1}\left(c+\sqrt{tf}\right) + \pi\, u'(w_n)\big|_{\delta=1}\left[\pi\left(c+\sqrt{tf}\right) - \left(c+\sqrt{tf}\right) + \frac{1}{2}\sqrt{tf} - \frac{1}{8}\sqrt{tf}\right] < 0 \tag{15}$$

Rearranging terms yields the condition

$$\left.\frac{u'(w_n)}{u'(w_l)}\right|_{\delta=1} < \frac{(1-\pi)\left(c+\sqrt{tf}\right) - \left(\frac{3}{8}\right)\sqrt{tf}}{(1-\pi)\left(c+\sqrt{tf}\right)} \tag{16}$$

The RHS of (16) is strictly smaller than one. The LHS is strictly between zero and one and decreases in the consumer’s absolute risk aversion. Therefore, (16) can only be met if consumers are sufficiently risk-averse.

If consumers are sufficiently risk-averse, δ^{TB} is implicitly defined by

$$\frac{(1-\pi)\left(c+\sqrt{\frac{tf}{\delta^{TB}}}\right)+\frac{1}{8}\sqrt{\frac{tf}{\delta^{TB}}}-\frac{1}{2}\left(\pi(1-\delta^{TB})+\delta^{TB}\right)\sqrt{\frac{tf}{\left(\delta^{TB}\right)^{3}}}}{(1-\pi)\left(c+\sqrt{\frac{tf}{\delta^{TB}}}\right)+\frac{1}{2}(1-\pi)(1-\delta^{TB})\sqrt{\frac{tf}{\left(\delta^{TB}\right)^{3}}}}=\frac{u'(w_n)}{u'(w_l)} \qquad (17)$$

Consumers prefer to stay uninsured with $\delta^{TB}=1$ if

$$\left.\frac{u'(w_n)}{u'(w_l)}\right|_{\delta=1} \geq \frac{(1-\pi)\left(c+\sqrt{tf}\right)-\left(\frac{3}{8}\right)\sqrt{tf}}{(1-\pi)\left(c+\sqrt{tf}\right)} \qquad (18)$$

The LHS of (18) increases as the consumer's risk aversion decreases. For a virtually risk-neutral consumer, the LHS converges to one. Therefore, the third best contract for a weakly risk-averse consumer does not provide any coverage.

q.e.d

Starting from the point where consumers are initially uninsured, a marginal increase in coverage increases the price for a repair unit and decreases transportation costs due to additional entries in the repair market. However, the overall costs for consumers are increasing, since the price effect outweighs the transportation costs effect. Thus, consumers are only better off with insurance coverage, if the benefit from improved risk allocation exceeds the increase in total costs. The benefit of risk allocation depends on the degree of consumers' risk aversion and therefore weakly risk-averse consumers prefer to stay uninsured.

Our results are mainly in line with standard moral hazard models like Shavell (1979). Optimal contracts derived from the latter model framework generally entail only partial coverage, due to a trade-off between risk allocation and appropriate loss prevention incentives. However, three important features distinguish our results from those of standard moral hazard models: First of all, in a moral hazard context the limitation of insurance coverage is a result of asymmetric information and reduced carefulness of policyholders. In our model it is only due to incomplete insurance contracts and the associated coverage-induced increase in prices. Secondly, the fact that weakly risk-averse consumers in our model may prefer to stay uninsured is in contrast to results from standard moral hazard models where risk-averse consumers always prefer to purchase some insurance coverage. Starting from a position of no coverage, in standard moral hazard models insurance does not affect policyholders' incentives at the margin. In contrast, in our model a marginal increase of coverage has a first order effect which is due to a coverage-induced price increase. Finally, and probably most importantly: At first glance, one would expect the contracting parties (in a moral hazard setting) to agree at least upon a second-best optimal insurance contract. In our model this is generally not the case, as the offered coinsurance rate considerably affects the market price for the repair service and therefore has an impact on other insurance arrangements. Hence, each individual insurer faces an externality problem, which we will tackle in the next section.

6. Market structure and externalities in the insurance market

In what follows we assume that an interior solution with $0 < \delta^{TB} < 1$ exists. Optimal insurance contracts in standard moral hazard models efficiently solve the incentive problem between the two contracting parties and do not have any impact on other insurance arrangements. However, in the problem studied here each individual incomplete insurance contract affects the market price for the repair service and therefore the optimal contracting in other insurance relationships, as the following proposition illustrates.

Proposition 3

The equilibrium coinsurance rate δ^* increases strictly in the market share of insurance companies.

Proof: See the Appendix

The capability to reduce the price effect in repair markets induced by insured consumers declines in the number of insurers, as the fraction of the market affected by a single insurer's coinsurance rate variation decreases. Consider an atomistic market structure. In this situation, insurance contracts offered by a single insurer have a negligible impact on the price level on the repair market. Therefore, in a competitive insurance market with $m \geq 2$ a problem of externalities arises and the symmetric Nash equilibrium in which all insurance companies split the market equally is neither pareto-optimal nor second-best. The difference between the equilibrium coinsurance rate δ^* and δ^{TB} is the greater the higher the number of insurers. In this sense, a reduction of coverage in a competitive insurance market improves welfare. Thus, by explicitly considering externality problems in competitive insurance markets our model provides a theoretical explanation for *Feldstein*'s empirical results.

Given the externality problems associated with incomplete insurance contracts, the question arises how this externality should be addressed. Considering our results, one obvious solution might be an insurance monopoly.[13] A monopoly insurer completely takes the impact of the level of coverage on the repair market price level into account and, thus, offers contracts that entail a coinsurance rate δ^{SB}. Obviously, however, a monopoly is a strong

[13] In other contexts authors also have recently argued that insurance monopolies for certain areas achieve better results than competitive markets. See, for instance, the empirical findings by *Ungern-Sternberg* (1996) for the case of homeowner's insurance and the discussion of interdependent security problems by *Kunreuther and Heal* (2003). However, as noted by *Bonato and Zweifel* (2002), monopoly insurers in a moral hazard context may mandate an excessive level of loss prevention. Therefore, other effects limit the superiority of such an insurance market structure.

market intervention that would be associated with major additional issues that may negatively affect welfare. Particularly, the socially desirable rent distribution would have to be implemented. For instance, authorities could regulate prices implying the insurer charges only actuarially fair premiums. Taking the problems associated with an insurance monopoly into account, a vertical integration of insurance and repair markets seems to be a much more appropriate approach. An insurer could itself offer certain repair goods or it could co-operate with a supplier of these goods. In this case the coverage induced increases in prices as well as in the number of suppliers in the repair market can be avoided.[14] Vertical integration is, e.g., fairly well-developed in the American health insurance market (Managed Care), while in the European health sector as well as in auto insurance it can only be observed in its infancy.

7. Conclusion

In numerous lines of insurance, such as, for instance, health or auto insurance, indemnities are based on the actual extent of repair services the insured purchases. Insurance coverage of this kind, however, has a major impact upon associated repair markets, if the latter are not perfect: The price level for repair services as well as the number of suppliers increase. The rising price level again affects the optimal insurance contract design, since even in perfect insurance markets with complete information an optimal contract would assign a share of the loss to the insured. It cannot be expected, though, that insurers in a competitive market offer the optimal contract, as the price increase induced by insurance coverage would not occur only for the single insurer but affects all insurers in the market. This means that an externality exists. Therefore, insurers will offer contracts with less coinsurance and thus more coverage than socially desirable.

---

[14] Vertical integration can also be a powerful tool against ex post moral hazard.

In the light of our incomplete contract argumentation, our model setup seems to oversimplify reality, as we only consider one type of loss. However, we have to keep in mind that real insurance contracts apprehend a great variety of losses. Therefore, contracts conditioned upon each state of the world or each possible loss can hardly be written. Even if any kind of lump-sum compensation for certain losses which would reduce price effects in the repair market is socially desirable, it will hardly be feasible in most lines of insurance.

This paper is a first step toward analyzing the interdependencies between insurance and repair markets. Naturally, we had to leave important aspects for future research. From our point of view, the following problems could be rather interesting topics to be tackled:

- We assume that the product space is completely homogeneous. This means that no product is a priori better than the other. This assumption seems adequate e.g. for auto insurance, since consumers' preferences for repair services are mainly determined by availability and convenience. On the other hand, patients would often have predetermined preferences for certain pharmaceutical products, as in particular copyright-protected products. It therefore seems fruitful to also look at repair markets with heterogeneous product spaces.

- In this paper, the assumption has been used that the insured is also the consumer for the repair service. But this is not useful to characterize liability insurance where the victim, who has a claim against the insured, purchases repair services. The victim usually has a legal right to be fully compensated, such that in liability insurance the impact on repair markets should be even more significant.

- When insurers cannot write complete contracts and, thus, the price level of repair services rises, a vertical integration of insurance and repair markets seems a straightforward approach. For this reason, the introduction of vertical integration seems to be an important extension of this analysis.

Appendix

Proof of Proposition 3

We consider an insurance market with $m \geq 1$ identical insurers that compete simultaneously in contracts. For convenience we further assume that insurers who offer the same utility maximizing contract split the market equally. First we look at the effects of a single insurer's variation of the coinsurance rate δ_i on the repair market.

A consumer located between suppliers j and j+1 is indifferent between the two competitors, if

$\delta_i p_j + tx = \delta_i p + t(1/n - x)$ if the consumer is insured by the insurer *i* and

$\delta_{-i} p_j + tx = \delta_{-i} p + t(1/n - x)$ otherwise.

The fraction of consumers insured by *i* is $\frac{1}{m}$, while the fraction of consumers not insured by *i* is $\frac{m-1}{m}$.

The resulting demand function of firm j is given by

$$D_j(p_j, p) = 2x = \frac{1}{m}\frac{\frac{t}{n} + \delta_i(p - p_j)}{t} + \frac{m-1}{m}\frac{\frac{t}{n} + \delta_{-i}(p - p_j)}{t}. \tag{19}$$

For a symmetric equilibrium one obtains

$$p = c + \sqrt{\frac{t}{n\left(\frac{1}{m}\delta_i + \frac{m-1}{m}\delta_{-i}\right)}}. \tag{20}$$

The zero profit constraint implies

$$n = \sqrt{\frac{t}{f\left(\frac{1}{m}\delta_i + \frac{m-1}{m}\delta_{-i}\right)}} \tag{21}$$

and

$$p^* = c + \sqrt{\frac{tf}{\frac{1}{m}\delta_i + \frac{m-1}{m}\delta_{-i}}}\ . \tag{22}$$

Now we are able to determine the optimal contract for insurer *i*. It is given by

$$\max_{\delta_i} \quad EU(\delta_i, \delta_{-i}, m) = (1-\pi)\, u(w_n) + \pi u(w_l) \tag{23}$$

with

$$w_n := w_0 - \pi(1-\delta_i)\left(c + \sqrt{\frac{tf}{\frac{1}{m}\delta_i + \frac{m-1}{m}\delta_{-i}}}\right)$$

$$w_l := w_0 - (\pi(1-\delta_i) + \delta_i)\left(c + \sqrt{\frac{tf}{\frac{1}{m}\delta_i + \frac{m-1}{m}\delta_{-i}}}\right) - \frac{1}{4}\sqrt{\left(\frac{1}{m}\delta_i + \frac{m-1}{m}\delta_{-i}\right)tf}$$

The first order condition for an interior solution is given by

$$\frac{\partial EU(\delta_i, \delta_{-i}, m)}{\partial \delta_i} = (1-\pi)\, u'(w_n)\frac{\partial w_n}{\partial \delta_i} + \pi u'(w_l)\frac{\partial w_l}{\partial \delta_i} = 0 \tag{24}$$

Subsequently, using the implicit functions theorem we show that the equilibrium coinsurance rate δ_i^* decreases in the number of operating insurance companies, m. We consider:

$$\frac{\partial \delta_i^*}{\partial m} = -\frac{\frac{\partial^2 EU}{\partial \delta_i^* \partial m}}{\frac{\partial^2 EU}{\partial \left(\delta_i^*\right)^2}} = -\frac{\frac{\partial}{\partial m}\left((1-\pi)u'(w_n)\frac{\partial w_n}{\partial \delta_i^*} + \pi u'(w_l)\frac{\partial w_l}{\partial \delta_i^*}\right)}{\frac{\partial}{\partial \delta_i^*}\left((1-\pi)u'(w_n)\frac{\partial w_n}{\partial \delta_i^*} + \pi u'(w_l)\frac{\partial w_l}{\partial \delta_i^*}\right)} \tag{25}$$

Because of the second order condition for a maximum, the denominator in the expression on the RHS of (25) is negative. Thus, it is sufficient to show that the nominator is also negative:

$$\frac{\partial}{\partial m}\left((1-\pi)u'(w_n)\frac{\partial w_l}{\partial \delta_i^*} + \pi u'(w_l)\frac{\partial w_n}{\partial \delta_i^*}\right) =$$
$$\underbrace{(1-\pi)u''(w_n)\frac{\partial w_n}{\partial \delta_i^*}\frac{\partial w_n}{\partial m}}_{:=(I)} + \underbrace{(1-\pi)u'(w_n)\frac{\partial^2 w_n}{\partial \delta_i^* \partial m}}_{:=(II)} + \underbrace{\pi(1-\pi)u''(w_l)\frac{\partial w_l}{\partial \delta_i^*}\frac{\partial w_l}{\partial m}}_{:=(III)} + \underbrace{\pi u'(w_n)\frac{\partial^2 w_l}{\partial \delta_i^* \partial m}}_{:=(IV)}$$
(26)

We derive

$$\frac{\partial w_n}{\partial m} = -\frac{1}{2}\pi ft(\delta_i - 1)\frac{\delta_i - \delta_{-i}}{\sqrt{mft(\delta_i - \delta_{-i} + m\delta_{-i})^3}} \tag{27}$$

and

$$\frac{\partial w_l}{\partial m} = -\frac{\delta_{-i} - \delta_i}{8m(\delta_i - \delta_{-i}(1-m))}\left[\sqrt{\frac{ft}{m}(\delta_i - \delta_{-i}(1-m))} - 4\delta_i\sqrt{\frac{mft}{(\delta_i - \delta_{-i}(1-m))}} - 4(1-\delta_i)\pi\sqrt{\frac{mft}{(\delta_i - \delta_{-i}(1-m))}}\right] \tag{28}$$

At $\delta_i^* = \delta_{-i}^*$ these partial derivatives and, therefore, expressions (I) and (III) are zero. Additionally, since

$$\left.\frac{\partial^2 w_n}{\partial \delta_i^* \partial m}\right|_{\delta_i^* = \delta_{-i}^*} = -\frac{1}{2}\frac{\pi\left(1-\delta_i^*\right)}{m^2}\sqrt{\frac{tf}{\left(\delta_i^*\right)^3}} < 0 \tag{29}$$

and

$$\frac{\partial^2 w_l}{\partial \delta_i^* \partial m} = -\frac{1}{8m^2 \delta_i^*}\left(3\sqrt{ft\delta_i^*} + 4\pi\sqrt{\frac{tf}{\delta_i^*}} - 4\pi\sqrt{ft\delta_i^*}\right) < 0 \tag{30}$$

(II) and (IV) are negative which proves the proposition.

q.e.d.

References

Anderlini, L. and L. Felli, 1994, Incomplete Written Contracts: Undescribable States of Nature, *Quarterly Journal of Economics* 109: 1085 – 1124.

Arrow, K.J., 1965, Aspects of the Theory of Risk Bearing, Yrjö Johnsson Lectures, Helsinki.

Bonato, D. and P. Zweifel, 2002, Information about Multiple Risks: The Case of Building and Content Insurance, *Journal of Risk and Insurance* 69: 469 – 487.

D'Aspremement, C., J. Gabszewicz, and J.-F. Thisse, 1979, On Hotelling's "Stability in Competition", *Econometrica* 47: 1145 – 1151.

Feldman, R. and B. Dowd, 1991, A New Estimate of the Welfare Loss of Excess Health Insurance, *American Economic Review* 81: 297 – 301.

Feldstein, M.S., 1970, The Rising Price of Physicians' Services, *Review of Economics and Statistics* 52: 121 – 133.

Feldstein, M.S., 1971, Hospital Costs Inflation: A Study in Nonprofit Price Dynamics, *American Economic Review* 61: 853 – 872.

Feldstein, M.S., 1973, The Welfare Loss of Excess Health Insurance, *Journal of Political Economy* 81: 251 – 280.

Frech, H.E. and P.E. Ginsburg, 1975, Imposed Health Insurance in monopolistic markets: a theoretical analysis, *Economic Inquiry* 13: 55 – 70.

Gaynor, M., D. Haas-Wilson and W.B. Vogt, 2000, Are Invisible Hands Good Hands? Moral Hazard, Competition, and the Second-Best in Health Care Markets, *Journal of Political Economy* 108: 992 – 1005.

Hotelling, H., 1929, Stability in Competition, *Economic Journal* 39: 41 – 57.

Kunreuther, H. and G.M. Heal, 2003, Interdependent Security, *The Journal of Risk and Uncertainty* 26: 231 – 249.

Maskin, E., 2002, On indescribable contingencies and incomplete contracts, *European Economic Review* 46: 725 – 733.

Newhouse, Joseph P. and the Insurance Experiment Group, 1993,. *Free for All? Lessons from the RAND Health Insurance Experiment*, Harvard University Press, Cambridge.

Pauly, M.V., 1968, The Economics of Moral Hazard: Comment, *American Economic Review* 58: 531 – 537.

Pavcnik, N., 2002, Do pharmaceutical prices respond to patient out-of-pocket expenses? *RAND Journal of Economics* 33: 469 – 487.

Salop, S., 1979, Monopolistic Competition with outside goods, *Bell Journal of Economics* 10: 141 – 156.

Segal, I., 1999, Complexity and Renegotiation: A Foundation for Incomplete Contracts, *Review of Economic Studies* 66: 57 – 82.,

Shavell, S., 1979, On Moral Hazard and Insurance, *Quarterly Journal of Economics* 93: 541 – 562.

Ungern-Sternberg, T. von, 1996, The limits of competition: Housing insurance in Switzerland, *European Economic Review* 40: 1111 – 1121.

Zweifel, P. and L. Crivelli, 1996, Price Regulation of Drugs: Lessons from Germany, *Journal of Regulatory Economics* 10: 257 – 273.