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

Martin Nell

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

Andreas Richter

Assistant Professor of Insurance
Illinois State University
phone: +1 309 4383316, fax: +1 309 4385510
arichter@ilstu.edu

Jörg Schiller

Assistant Professor of Organization Theory
WHU – Otto Beisheim Graduate School of Management, Vallendar, Germany
joerg.schiller@whu.edu

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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 market structure in markets with insured customers, and, on the other hand, the resulting backlash on optimal insurance contracting.

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 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 suggests, insurance design has a major impact upon repair markets. Data indicate that repair markets are often imperfect and, thus, prices exceed marginal costs. A straightforward rationale for this is market power which can result from product differentiation. For the single consumer, transaction costs incurred in the process of consuming repair goods often 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.

An illustrative example – The German car rental market

It can often be observed that in repair markets price discrimination between insured and uninsured consumers exist and that prices are significantly higher for insured consumers. As an example for this, consider the German car rental market.

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

In this market a major segment of insured consumers can be identified: 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 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 are collected for different car classes and different zip code areas and consist 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.

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

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.

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.

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]

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 services or car repair services typically have an oligopolistic or atomistic

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

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.

structure, the results of *Frech and Ginsburg* (1975) do not capture the situation in most of the repair markets 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 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). *Hellerstein* (1998) concentrates on a physician's position as an agent. Even though her findings do not indicate that an individual patient's insurance coverage affects the prescription patterns of a particular physician, she shows that the distribution of types of coverage among a physician's patients is important for the likelihood of prescribing generics (as opposed to trade-name drugs). 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. *Feldstein* suggests that this 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, which concentrates on the structure of an insurance market, where no information asymmetries or transaction costs are present and coverage is provided at actuarially fair rates.

The reason why the interaction between insurance and repair markets has not yet been studied more extensively, 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" (*Arrow*, 1965, p. 45). 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.

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

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 on indescribable contingencies in insurance. We are interested in the impact of incomplete insurance contracts on 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 in the insurance market.

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 further constraints. The main task for the insurer in the considered context is to balance the trade off between the risk allocation and the insurance induced price effect on 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 marginal impact on the repair market and its price level. Consequently, the equilibrium coinsurance will increase in the market share of a particular insurer or decrease in the number of insurance companies respectively.

The remainder of the paper is organized as follows. Section 2 introduces the model. In Section 3 we present different 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 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. The consumers with an initial wealth of w_0 face the risk of a loss with probability π. In case of a loss the 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 of *Salop* (1979), where consumers are uniformly and continuously distributed along a circle with a perimeter equal to $1/\pi$.[8] Consumers have a utility function $U = u(w) - tx$, where the utility is additively separable in the repair service and the transportation costs. w represents the final wealth of consumers excluding any transportation cost. The consumers are assumed to be risk averse with respect to the repair risk and risk neutral concerning the transportation cost. Therefore, $u(\cdot)$ is a twice-differentiable utility function with $u'(\cdot) > 0, u''(\cdot) < 0$. In the insurance market m risk-neutral insurers, denoted $i = 1,...,m$, simultaneously offer contracts $C_i = (\alpha_i, \delta_i)$ with a coinsurance rate δ_i and a resulting indemnity of $(1-\delta_i)p_j$ at the fair premium $\alpha_i = \pi \cdot (1-\delta_i)p_j$. We further assume that consumers suffering

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

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

Since in this model market entry and price are decisions variables, but suppliers' business locations (or more general: product differentiation) are not, an assumption is needed concerning the post-entry distribution of suppliers on the circle. We assume maximum product differentiation, i.e., for the specific model context of this paper, that suppliers are equidistantly spread around the circle. This premise is founded on the results of *D'Aspremont et al.* (1979), who have shown that in the *Hotelling* (1929) linear city framework suppliers would choose maximum product differentiation (contrasting Hotelling's original results), i.e. they would locate their businesses as far from each other as possible. As the persistence of this result for the case of insured consumers is not obvious, we address this issue in the Appendix.

The sequence of the considered game between insurers, consumers and suppliers is as follows: At stage 1, each of the *m* insurance companies offers an insurance contract C_i. Then at stage 2, the potential entrants in the repair market simultaneously choose whether or not to enter the market. Referring to the maximum differentiation result from the Appendix we presume that 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 this price. Thus, the repair market is neither affected by insurance contracts nor by the structure of the insurance market.

First Best

When complete insurance contracts are feasible, a first best risk allocation can be reached via a full insurance contract. However, one of the main results of the Salop model is that in equilibrium too many suppliers enter the repair market. Thus, when the structure of the repair market is endogenous, overriding the Salop competition and vertically integrating the repair market leads to a first best situation. Since consumers are fully insured under the first best insurance contract, prices are irrelevant from a welfare perspective. The only reason for overriding the competition in the repair market is to 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 which minimize the sum of standing expenses, consumers' transportation cost and repair expenses.

$$\min_{n}\left[nf + 2tn\int_{0}^{\frac{1}{2n}} x\,dx\right]. \qquad (1)$$

Therefore, the first-best number of suppliers n^{FB} is

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

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 override the competition in the repair market. As in the first best situation, the risk allocation is still first best. However, as a consequence of the Salop model in equilibrium too many suppliers enter the market. Again, since insurance contracts condition upon the state of nature, the price effect is irrelevant. Only the increased number of suppliers 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. As we will show in the following sections, the structure of the insurance market will have a major impact on the repair market as well as on social welfare.

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 about deterministic outcomes and only those who suffered a loss purchase the repair unit. We assume that all consumers accepted the same incomplete insurance contract with a strictly positive coinsurance rate $(\delta > 0)$.[9] Because they are located symmetrically, we concentrate on a symmetric equilibrium, 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

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

holds (where *t* denotes the transportation cost per unit of distance between the consumer and a supplier).

To highlight the effects of insured consumers on the structure of repair markets, we rewrite (3) as

$$p_j + \frac{t}{\delta}x = p + \frac{t}{\delta}\left(\frac{1}{n} - x\right). \tag{4}$$

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 customer is insured and, thus, δ is below one, the market power of repair firms is increased.

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[9] Obviously, $\delta = 0$ can never be a part of an equilibrium, because in this case: the consumers' demand is completely price-inelastic, suppliers can charge an infinitely high price and the number of entering supplies also tends to infinity. Additionally, the insurance premium would exceed any initial wealth. Using a similar argument, we can easily see that there is a critical level of coinsurance $\delta_b > 0$, such that the insured's budget constraint is binding for $\delta < \delta_b$. Therefore, a positive coinsurance level, δ_p, such that the insured's participation constraint binds for $\delta < \delta_p$ also exists with $\delta_p \geq \delta_b$.

The resulting demand function of supplier j is given by

$$D_j(p_j, p) = 2x = \frac{\frac{t}{n} + \delta(p - p_j)}{t}. \tag{5}$$

Each firm j maximizes its profit function

$$\max_{p_j} \quad \Pi_j(p_j, p) = (p_j - c)\frac{\frac{t}{n} + \delta(p - p_j)}{t} - f, \tag{6}$$

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

$$p = c + \frac{t}{\delta n}. \tag{7}$$

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

$$\Pi_j(p) = \frac{t}{\delta n}\frac{1}{n} - f = \frac{t}{\delta n^2} - f = 0. \tag{8}$$

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

$$n^* = \sqrt{\frac{t}{\delta f}}. \tag{9}$$

Even without insurance, the number of suppliers in market equilibrium n^* is too high, compared to the first best optimum (*Salop* 1979), since $n^* > n^{FB}$ holds. The equilibrium price level in the repair market is

$$p^* = c + \sqrt{\frac{tf}{\delta}} \quad . \tag{10}$$

In equations (9) and (10) 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: The market power of firms is increased by insured consumers. This attracts new entrants, which leads to a decrease in profits. Since market entry causes additional standing expenses, the zero profit condition implies that prices have to be higher, if consumers are insured.

5. Effects in the insurance market

Let us now concentrate on the third best situation with incomplete insurance contracts. Due to the complexity of the states of nature, insurers are unable to fully specify the behavior of customers and suppliers in the case of a loss. Consequently, insurance contracts can only be conditioned upon the consumer's demand for the repair good. As a starting point for our analysis, we explore the third best insurance contract. In a third best situation a social planner offers incomplete contracts with a coinsurance rate δ^{TB}. This coinsurance rate trades off the insurance-induced price effect and risk allocation.

Evidently, a monopoly insurer offers the same coinsurance rate as the social planner. Thus, in the considered context an insurance monopoly is never inferior to any other market structure. However, as we will show in Proposition 1, the equilibrium coinsurance rate will decrease in the number of insurance companies. Consequently, the insurance monopoly is even strictly superior to any other market structure.

As long as the participation constraint does not bind, the third best coinsurance rate under the considered circumstances is specified by the following expected utility maximization problem:

$$\begin{aligned}\max_{\delta}\quad &(1-\pi)\,u\left(w_0-\pi(1-\delta)\left(c+\sqrt{\frac{tf}{\delta}}\right)\right)\\ &+\pi\left\{u\left(w_0-\pi(1-\delta)\left(c+\sqrt{\frac{tf}{\delta}}\right)-\delta\left(c+\sqrt{\frac{tf}{\delta}}\right)\right)-\frac{1}{4}\sqrt{\delta tf}\right\}.\end{aligned} \tag{11}$$

The first order condition for an interior solution is given by

$$\begin{aligned}\frac{\partial EU}{\partial\delta}=&(1-\pi)\pi\,u'(w_n)\left[\left(c+\sqrt{\frac{tf}{\delta^{TB}}}\right)+\frac{1}{2}\left(1-\delta^{TB}\right)\sqrt{\frac{tf}{\left(\delta^{TB}\right)^3}}\right]\\ &+\pi\left\{u'(w_l)\left[\pi\left(c+\sqrt{\frac{tf}{\delta^{TB}}}\right)+\frac{1}{2}\pi\left(1-\delta^{TB}\right)\sqrt{\frac{tf}{\left(\delta^{TB}\right)^3}}\right.\right.\\ &\left.\left.-\left(c+\sqrt{\frac{tf}{\delta^{TB}}}\right)+\frac{1}{2}\delta^{TB}\sqrt{\frac{tf}{\left(\delta^{TB}\right)^3}}\right]-\frac{1}{8}\sqrt{\frac{tf}{\delta^{TB}}}\right\}=0.\end{aligned} \tag{12}$$

or

$$\frac{(1-\pi)\left(c+\sqrt{\frac{tf}{\delta^{TB}}}\right)+\frac{1}{8u'(w_l)}\sqrt{\frac{tf}{\delta^{TB}}}-\frac{1}{2}\left(\pi\left(1-\delta^{TB}\right)+\delta^{TB}\right)\sqrt{\frac{tf}{\left(\delta^{TB}\right)^3}}}{(1-\pi)\left(c+\sqrt{\frac{tf}{\delta^{TB}}}\right)+\frac{1}{2}(1-\pi)(1-\delta^{TB})\sqrt{\frac{tf}{\left(\delta^{TB}\right)^3}}}=\frac{u'(w_n)}{u'(w_l)} \tag{13}$$

respectively, where w_n denotes the final wealth of consumers in the state of no loss and w_l denotes the final wealth in the loss state.

We know that $\delta^{TB} > 0$ and therefore $\frac{u'(w_n)}{u'(w_l)} < 1$ holds.[10] The third best insurance contract entails less than full coverage, in order to limit the price effect on the repair market. The structure of this result is quite similar to what can be observed in standard insurance moral hazard models.[11] Optimal contracts derived from those model frameworks also entail only partial coverage, since, like in our model, a trade-off exists between risk allocation and the avoidance of inefficiently high losses. However, while in the moral hazard context these inefficiently high losses are due to reduced carefulness as a consequence of asymmetric information, in our framework they result only from the coverage-induced increase in prices.

Since combinations of parameters exist for which the left hand side in (13) is greater than 1, we conclude that an interior solution does not always exist. To ensure the existence of an interior solution, the consumers' utility in the case of a loss $\left(u(w_l) - tx\right)$ must be decreasing in δ.

$$\begin{aligned} \frac{\partial\left(u(w_l) - tx\right)}{\partial\delta} = u'(w_l)\left\{\pi\left(c + \sqrt{\frac{tf}{\delta}}\right) - \left(c + \sqrt{\frac{tf}{\delta}}\right) + \frac{1}{2}\pi(1-\delta)\sqrt{\frac{tf}{\delta^3}} + \frac{1}{2}\delta\sqrt{\frac{tf}{\delta^3}}\right\} \\ -\frac{1}{8}\sqrt{\frac{tf}{\delta}} < 0. \end{aligned} \tag{14}$$

Rearranging this yields the condition

$$(1-\pi)\left(c + \sqrt{\frac{tf}{\delta}}\right) + \frac{1}{8u'(w_l)}\sqrt{\frac{tf}{\delta}} > \frac{1}{2}\left(\delta + \pi(1-\delta)\right)\sqrt{\frac{tf}{\delta^3}} \tag{15}$$

The insurance effect, indemnity less the insurance premium, for a constant price level has to exceed the price effect. In other words, for a given loss probability π, production costs c,

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[10] See footnote 9.

[11] See, for example, *Shavell* (1979).

transportations costs t and utility function $u(\cdot)$, there will always be a critical coinsurance rate such that the impact of a marginal increase in coverage is zero.

Note that a key difference exists between price increases in repair markets and moral hazard. In the latter problem, an optimal insurance contract efficiently solves the incentive problem between the two contracting parties and does not have any impact on other contracts. 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 1

The equilibrium coinsurance rate increases strictly in the market share of insurance companies. Therefore, an insurance monopoly is strictly superior to any other market structure.

Proof: see Appendix

The capability to reduce the price effect on 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 is not pareto-optimal. The difference between the equilibrium coinsurance rate 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. This provides a theoretical explanation for Feldstein's empirical results.

On the other hand, a monopolistic 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 of δ^{TB}. Therefore, our model provides an argument for the potential superiority of insurance monopolies in certain situations.[12] Additionally, insurance market regulation or a co-operation between insurance companies can be other beneficial approaches to limit coverage.

6. 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 the repair markets, if these markets 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.

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:

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[12] 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 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 can limit the superiority of such an insurance market structure.

- 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.[13] An insurer could itself offer certain repair goods or it could co-operate with a supplier of these goods. 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. For this reason, the introduction of vertical integration seems to be an important extension of this analysis.

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

Appendix

Proof of Proposition 1

We consider an insurance market with $m \geq 1$ identical insurers that compete simultaneously in contracts. 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 customers not insured by *i* is $\frac{m-1}{m}$.

The resulting demand function of firm j is given by

$$D_j(p_j, p) = 2x = \frac{1}{m}\frac{\frac{t}{n} + \delta_i(p - p_j)}{t} + \frac{m-1}{m}\frac{\frac{t}{n} + \delta_{-i}(p - p_j)}{t}. \tag{16}$$

For a symmetric equilibrium one obtains

$$p = c + \sqrt{\frac{t}{n\left(\frac{1}{m}\delta_i + \frac{m-1}{m}\delta_{-i}\right)}}. \tag{17}$$

The zero profit constraint implies

$$n = \sqrt{\frac{t}{f\left(\frac{1}{m}\delta_i + \frac{m-1}{m}\delta_{-i}\right)}} \tag{18}$$

and

$$p^* = c + \sqrt{\frac{tf}{\frac{1}{m}\delta_i + \frac{m-1}{m}\delta_{-i}}}\ . \tag{19}$$

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

$$\begin{aligned}
\max_{\delta_i} \quad & (1-\pi)\, u\left(w_0 - \pi(1-\delta_i)\left(c + \sqrt{\frac{tf}{\frac{1}{m}\delta_i + \frac{m-1}{m}\delta_{-i}}} \right)\right) \\
& + \pi \left\{ u\left(w_0 - \pi(1-\delta_i)\left(c + \sqrt{\frac{tf}{\frac{1}{m}\delta_i + \frac{m-1}{m}\delta_{-i}}} \right) \right. \right. \\
& \left. \left. - \delta_i \left(c + \sqrt{\frac{tf}{\frac{1}{m}\delta_i + \frac{m-1}{m}\delta_{-i}}} \right) \right) - \frac{1}{4}\sqrt{\left(\frac{1}{m}\delta_i + \frac{m-1}{m}\delta_{-i}\right) tf} \right\}
\end{aligned} \tag{20}$$

The first order condition for an interior solution is given by

$$\frac{(1-\pi)\left(c+\sqrt{\frac{tf}{\left(\frac{1}{m}\delta_i^*+\frac{m-1}{m}\delta_{-i}^*\right)}}\right)+\frac{1}{8u'(w_l)}\sqrt{\frac{tf}{\left(\frac{1}{m}\delta_i^*+\frac{m-1}{m}\delta_{-i}^*\right)}}-\frac{1}{2m}\left(\pi(1-\delta_i^*)+\delta_i^*\right)\sqrt{\frac{tf}{\left(\frac{1}{m}\delta_i^*+\frac{m-1}{m}\delta_{-i}^*\right)^3}}}{(1-\pi)\left(c+\sqrt{\frac{tf}{\left(\frac{1}{m}\delta_i^*+\frac{m-1}{m}\delta_{-i}^*\right)}}\right)+\frac{1}{2m}(1-\pi)(1-\delta_i^*)\sqrt{\frac{tf}{\left(\frac{1}{m}\delta_i^*+\frac{m-1}{m}\delta_{-i}^*\right)^3}}}=\frac{u'(w_n)}{u'(w_l)} \quad (21)$$

As a feature of the symmetric equilibrium with $\delta_i^*=\delta_{-i}^*$, we derive

$$\frac{(1-\pi)\left(c+\sqrt{\frac{tf}{\delta_i^*}}\right)+\frac{1}{8u'(w_l)}\sqrt{\frac{tf}{\delta_i^*}}-\frac{1}{2m}\left(\pi(1-\delta_i^*)+\delta_i^*\right)\sqrt{\frac{tf}{(\delta_i^*)^3}}}{(1-\pi)\left(c+\sqrt{\frac{tf}{\delta_i^*}}\right)+\frac{1}{2m}(1-\pi)(1-\delta_i^*)\sqrt{\frac{tf}{(\delta_i^*)^3}}}=\frac{u'(w_n)}{u'(w_l)}. \quad (22)$$

The case $m=1$ (22) corresponds to (13). Obviously, the right hand side of (22) increases in m for a given level of coinsurance. q.e.d.

Insurance and Product choice

In the following we will analyze suppliers' differentiation decisions. We consider, in the spirit of *Hotelling* (1929) and *D'Aspremont et al.* (1979), a linear city model. Consumers are uniformly distributed along the interval of the length of 1.

We want to concentrate on the impact of the insurance framework on suppliers' product choice. Therefore, in this section we abstain from any market entry decisions of the suppliers and a detailed analysis of the insurance market. Hence, it is assumed that all consumers purchase an insurance contract with the same coinsurance rate $\delta_i = \delta \; \forall i$. For the sake of simplicity, we consider the linear city model of *Hotelling* (1929) with only two suppliers $(n = 2)$ and quadratic transportation costs of t per unit of length.[14] The suppliers play a two stage game in which they at first simultaneously choose their locations (a, b) and afterwards their prices p_j. Firm 1 is located at the point $a \geq 0$ and firm 2 at $(1-b)$, where we set $b \geq 0$ and, without loss of generality, $1-a-b \geq 0$. The demand functions of the suppliers are

$$D_1(p_1, p_2) = a + \frac{1-a-b}{2} + \frac{\delta(p_2 - p_1)}{2t(1-a-b)}, \tag{23}$$

$$D_2(p_1, p_2) = b + \frac{1-a-b}{2} + \frac{\delta(p_1 - p_2)}{2t(1-a-b)}. \tag{24}$$

[14] This assumption is only used throughout this section of the paper because, since *D'Aspremont et al.* (1979) have shown, the assumption of linear transportation costs within the linear city model under certain circumstances can lead to the non-existence of a market equilibrium.

Each company maximizes the profit function Π_j

$$\Pi_1(p_1, p_2) = (p_1 - c)\left(a + \frac{1-a-b}{2} + \frac{\delta(p_2 - p_1)}{2t(1-a-b)}\right) \tag{25}$$

and

$$\Pi_2(p_1, p_2) = (p_2 - c)\left(b + \frac{1-a-b}{2} + \frac{\delta(p_1 - p_2)}{2t(1-a-b)}\right). \tag{26}$$

We can solve the two stage decision problem by means of backward induction. At stage 2 the suppliers choose the Nash equilibrium prices p_j^* for given locations (a,b), which result from the intersection of the following reaction functions

$$\frac{\partial \Pi_1}{\partial p_1} = a + \frac{1-a-b}{2} + \frac{\delta(p_2 - 2p_1 + c)}{2t(1-a-b)} = 0$$

$$\Leftrightarrow \frac{1}{2}\left(c + \frac{t(1-a-b)(1+a-b)}{\delta} + p_2\right) = p_1^* \tag{27}$$

and

$$\frac{\partial \Pi_2}{\partial p_2} = b + \frac{1-a-b}{2} + \frac{\delta(p_1 - 2p_2 + c)}{2t(1-a-b)} = 0$$

$$\Leftrightarrow \frac{1}{2}\left(c + \frac{t(1-a-b)(1-a+b)}{\delta} + p_1\right) = p_2^*. \tag{28}$$

The symmetric equilibrium prices are:

$$p_1^* = c + \frac{t}{\delta}(1-a-b)\left(1 + \frac{a-b}{3}\right) \tag{29}$$

and

$$p_2^* = c + \frac{t}{\delta}(1-a-b)\left(1+\frac{b-a}{3}\right) \tag{30}$$

respectively.

The equilibrium price level in the repair market increases with a declining coinsurance rate δ, and the insurance design has a decisive impact on the price level in the repair market. Henceforth, we deal with the optimal product choice of the suppliers at stage 1. For that reason suppliers maximize their profit function for given prices $p_1^* = p_2^*$

$$\Pi_1(a,b) = \left(p_1^* - c\right)\left(a + \frac{1-a-b}{2} + \frac{p_2^* - p_1^*}{2t(1-a-b)}\right) \tag{31}$$

and

$$\Pi_2(a,b) = \left(p_2^* - c\right)\left(b + \frac{1-a-b}{2} + \frac{p_1^* - p_2^*}{2t(1-a-b)}\right). \tag{32}$$

The optimal product choice of supplier 1 is given by

$$\frac{d\,\Pi_1}{d\,a} = \left(p_1^* - c\right)\left(\frac{\partial D_1}{\partial a} + \frac{\partial D_1}{\partial p_2}\frac{d\,p_2^*}{d\,a}\right), \tag{33}$$

where we can distinguish the demand and the strategic price effect of a variation of the product choice. Using (23), (29) and (30), the demand effect is

$$\frac{\partial D_1}{\partial a} = \frac{1}{2} + \frac{\delta\left(p_2^* - p_1^*\right)}{2t(1-a-b)^2} = \frac{3-5a-b}{6(1-a-b)}. \tag{34}$$

Since we deal with a symmetric problem, the insurance design has no impact on the demand effect for both suppliers. Finally, using (23) and (30), we have to verify the leverage of insurance coverage on the strategic effect

$$\frac{\partial D_1}{\partial p_2}\frac{d\,p_2^*}{d\,a}=\left(\frac{\delta}{2t(1-a-b)}\right)\left[\frac{t}{\delta}\left(-\frac{4}{3}+\frac{2}{3}a\right)\right]=\left(\frac{-2+a}{3(1-a-b)}\right). \tag{35}$$

Apparently, we obtain the same result that the insurance arrangement has no impact on the strategic effect, and therefore on the suppliers product choice. Since the mark-up (p_1^*-c) is positive, $d\Pi_1/da<0$ holds, which leads to the maximal differentiation result of *D'Aspremont et al.* (1979). q.e.d.

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