(Non-)Insurance Markets, Loss Size Manipulation and Competition: Experimental Evidence

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Abstract

The common view that buyer power of insurers may effectively counteract provider market power critically rests on the idea that consumers and insurers have a joint interest in extracting price concessions. We develop theory and provide experimental evidence that the interests of insurers and consumers may be importantly misaligned. Insurers with buyer power benefit from increasing small initial loss sizes to create demand for insurance. Insurer competition eliminates profits but markets do not return to the initial non-insurance state. This constitutes a welfare loss. The results suggest that policy makers must take care in granting insurers buyer power.

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With a few exceptions, market power is considered to have a detrimental effect on consumer welfare. One suggested exception is that in markets with supplier concentration, granting buyers countervailing power enables them to extract discounts from these suppliers. Consumers benefit when these negotiated discounts are passed on to them. This argument has been used in product markets but also in insurance markets where the buyers are insurers who bargain with service suppliers about the price to redress a loss. However, in markets where the buyer is an insurer or has delegated the buying decision to an insurer, the interests of insurers and consumers to reduce input prices may be importantly misaligned. Given risk-averse consumers, the positive dependence between the insurer’s expected profits and the loss size consumers face puts natural
limits on the insurer’s incentives to pursue lower loss sizes. To the contrary, insurers may try to raise loss sizes in order to expand the market for insurance. This positive dependence of consumer demand on input prices distinguishes markets where the downstream firm is an insurer from other product markets where demand is a function of final-good prices only.

The consequences of buyer power have been studied theoretically and empirically for general retail markets where downstream buyers negotiate prices with upstream suppliers (Chae and Heidhues, 2004; Inderst and Wey, 2007, and Ellison and Snyder, 2010) and for the specific case where insurers negotiate with service suppliers (Sorensen, 2003; Lakdawalla and Yin, 2015; Trish and Herring, 2015; Ho and Lee, 2013). These studies illustrate that the relation between service supplier concentration and insurer countervailing power on negotiated prices, premiums and welfare is complex. For instance, in case of health insurance, Lakdawalla and Yin (2015) find that insurer bargaining power leads to significant price reductions but only when the upstream manufacturers face sufficient competition in their product market. Trish and Herring (2015) find that health insurance premiums are lower when insurer concentration is high in markets relevant to insurer bargaining with hospitals, but higher when concentration is high in the markets where the insurance is sold. Ho and Lee (2013) report mixed effects of the removal of one large health insurer on the premiums set by insurers with negotiated prices increasing or decreasing up to 15% across markets. An important common feature of all these studies is that they take the risk and, consequently, the demand for the insurance as given and focus on how concentration on either the supplier and/or the buyer side influences the outcome of the bargaining game that unfolds.

We instead investigate insurers’ incentives to engage in loss prevention in contexts where these activities potentially have a negative impact on insurance demand. Take the extreme case of an insurer with full buyer power who very successfully reduces the potential loss consumers face. He possibly erodes his own market because consumers may not bother to buy insurance when the downside is negligible. Because of this mechanism, the interests of insurers and consumers may be importantly misaligned. In particular, in markets with relatively small loss sizes the insurer has incentives to use his buyer power to create an insurance market by increasing the potential loss.

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1Snyder (2008) summarizes the literature on countervailing power since Galbraith (1952) and concludes “The concept of countervailing power was controversial in Galbraith’s day (…), and continues to be so today. Formalizing the concept is difficult because it is difficult to model bilateral monopoly or oligopoly, and there exists no single canonical model.”.
Attention for this dimension of insurance markets has been scant, with the exception of the theoretical contributions by Schlesinger and Venezian (1986, 1990). They explicitly examine the insurers’ incentives to engage in loss prevention and loss reduction, which they define as reducing the probability of a loss and reducing the severity of any loss that does occur, respectively. Despite the conclusion that for loss reduction “the incentive is to reduce the size of small losses while simultaneously increasing the size of large losses”\(^2\) in both papers they mostly ignore the possibility that an insurer would act to the detriment of consumers, arguing that: “...such action is likely to meet with resistance from the individual (...) as well as from insurance regulators.”\(^3\) Given the possibilities to cover up such activities, we are less sanguine about this possibility.

Central in our analysis is a categorization of markets into insurance and non-insurance markets based on what we call the initial loss size. A market’s initial loss size is the loss size that would prevail without insurer intervention. We define a market ‘an insurance market’ if the initial loss size is sufficiently large for risk-averse consumers to prefer buying insurance over staying uninsured when the insurance is priced at actuarially fair rates. On the other hand, a ‘non-insurance market’ is characterized by initial loss sizes sufficiently small such that, even if offered at actuarially fair rates, risk-averse consumers do not bother to buy coverage because the transaction cost of taking out insurance exceeds the benefits of coverage.

We make two main contributions. First, we formulate (Section 1) the distinction in insurance and non-insurance markets in a state-preference framework (Arrow, 1964). This representation allows us to build the argument that in non-insurance markets, insurers with buyer power have incentives to increase the initial loss size in order to create an insurance market. We also show that competition between insurers erodes their profits by pushing premiums to the actuarially fair rate but does not lead the market to return to the initial state where potential losses are sufficiently small for consumers not to buy insurance. This transformation into an insurance market therefore results in a irreversible welfare loss. This is markedly different in markets that are insurance markets by nature. In those markets, competition also erodes insurer profits, but in their quest for lower premiums insurers will push the prices of suppliers all the way to marginal cost, greatly benefiting insurees.

The second contribution is that we take our theoretical predictions to the lab. We report the results of a number of experiments designed to investigate under which conditions insurers

\(^2\)1990, p. 83.
\(^3\)1986, p. 232.
can tweak the risk to which the uninsured are exposed to their own benefit but possibly to
the consumers’ disadvantage. This risk manipulation can in principle take either the form of
increasing the probability of a loss or the size of a potential loss; in this paper we focus on the
latter.

For our purposes, one obvious advantage of conducting an experiment over analyzing empir-
cical data is that we can observe and control whether a market constitutes an insurance market
by setting the initial loss size. We set up markets with five consumers and one (monopoly treat-
ment) or two (duopoly treatments) insurers. Service-suppliers are only implicitly introduced: In
setting loss sizes, the insurer(s) completely determine prices in the upstream market. In other
words, insurers in our experiment (jointly) enjoy full buyer power The monopoly treatment
(MONOP-NI) is used to examine whether the extent to insurer-subjects with market power seize
the opportunity to increase the potential loss to which consumers are exposed. The duopoly
treatments aim to study the premium and loss size setting strategy of competing insurers in in-
surance (DUOP-I) and non-insurance (DUOP-NI) markets. This allows us to test our theoretical
prediction that competition will be more beneficial for consumers in insurance markets than in
non-insurance markets. A second advantage of turning to the lab is that we can use standard
risk elicitation methods to measure the risk preferences of market participants. This enables
us to rule out that any differences in outcomes between markets are the result of unobserved
differences in risk attitudes.

In each period, the consumer-subjects each receive an endowment of €20 but they may lose
part or all of this endowment with a given probability. The insurer decides on the amount at risk
(the potential loss size) and sets a premium. Consumers subsequently make the binary decision
to either taking insurance by paying the premium to the insurer or to go uninsured. In the
final step, nature decides whether a consumer experiences a loss in that period. In the duopoly
treatments with seven participants, two subjects have the role of insurer and the remaining five
subjects can select one of these insurers to buy insurance or decide to go uninsured. We sidestep
issues of adverse selection and moral hazard by assuming throughout that all agents have perfect
information.

Our main experimental findings are as follows. First, insurer-subjects in the non-insurance
monopoly treatment MONOP-NI are well able to select the loss size-premium combination that
maximizes their profits conditional on the risk-preferences of the consumer-subjects assigned to

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4One can think of this as insurers being vertically integrated with the upstream market or having otherwise
the power to block cost-saving technologies or the entry by cheaper suppliers.
their market. In spite of the seemingly difficult task of selecting profit-maximizing combinations of loss sizes and premiums in a setting with non-automated live buyers, insurer-subjects managed to do so quite adequately. The loss size is on average set at €16.44 and, with a loss probability of 60%, the accompanying premium of on average €11.59 more than compensates for any expected losses\(^5\). That insurer-subjects in this market, consumers earn an average surplus of €9.22.

Second, competition between insurers in the non-insurance duopoly market DUOP-NI wipes out insurer-profits, reduces the average loss size to €4.99 and increases average consumer surplus to €15.36. However, we do not observe a reversion to the initial non-insurance state where consumers do not face any loss: the average loss size uninsured consumers face is a still sizeable €7.71 which can be attributed to the threat to insurers that their market is eaten away if loss sizes become too small. In fact, with €3.54, the average premium faced by consumers in the duopolistic insurance market DUOP-I (where the loss size to the non-insured is by definition €20) is even somewhat lower (significant at the 10% level) than in DUOP-NI while the average consumer surplus (€16.21) is not significantly higher. In sum, if it is left to insurers, the distinction between non-insurance and insurance markets disappears and all markets become insurance markets, independent of whether the insurers face competition.

Beside these two main contributions, our study also contributes to the research on the stability of risk preferences across decision contexts (Barseghyan et al., 2011; Einav et al., 2012). Our design with non-automated live-buyers necessitates that we meticulously account for consumer risk preferences to rule out that between-treatment heterogeneity in preferences is driving our results\(^6\). To accomplish this, we split the experiment in two stages with the actual market game being preceded by a risk-elicitation stage. We elicit and estimate risk-preferences using the multiple price list methodology that has also been applied by Von Gaudecker et al. (2011). A comparison of the first (risk-elicitation) and second (market game) stage choices of consumer-subjects allows us to address the question whether individuals exhibit the same risk attitudes when they are put in a strategic market context instead as when they are submitted to an individual risk-elicitation task. We find that the elicited risk attitudes predict a consumer’s insurance choices in a market context reasonably well but that they exhibit some inclination to make less risk averse choices when the insurance market is competitive. The latter may be

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\(^5\) An average loss size of €16.44 fares well with the 28% of the initial endowment that dictator-subjects leave on the table in dictator games (Engel, 2011).

\(^6\) This is in particular an issue because our experimental markets are small, having five consumers in each market; an insurer who is randomly assigned more risk-averse consumers is able to attain higher profits.
because consumers have an expectation that in a competitive environment playing hard to get is more likely to result in receiving more favorable offers in future periods.

1 Theoretical Framework

Figure 1 presents in state-claims space the decision-problem of a monopolistic insurer facing a risk-averse consumer with a strictly concave utility function $U(\cdot)$, $U' > 0$ and $U'' < 0$.

There are two possible states of nature, a good state $W_g$ and a bad state $W_b$, distinguished by whether the consumer with initial wealth $W$ experiences a loss of size $L$ or not. Let $p$ denote the probability of a loss (“bad state”). The 45° line is the certainty line comprising the collection of contingent claims with equal consumption in both states. Indifference curves in state-claims space are defined as the set of claims for which a consumer’s expected utility $V(W_g, W_b) = pU(W_b) + (1 - p)U(W_g)$ is constant. These indifference curves are convex for risk-averse consumers.

When the initial loss size $L_0 = 0$, consumers keep their initial wealth $W$ in both states, that is, they face the initial state claim $(W, W)$ shown as point $D$ in the figure. This clearly is a non-insurance market. If the consumer faces a positive transaction cost $c$ in buying insurance, the market will continue to be a non-insurance market for all initial loss sizes $L_0 \leq L_S$ for which the certainty equivalent $CE(L_0)$ is such that $U(CE(L_0)) = U(W - pL_0 - c) \leq pU(W - L_0) + (1 - p)U(W)$. For $L_0 = L_S$, the left-hand side of this inequality corresponds to point $M_S$ in Figure 1, the right-hand side to point $B$. The market is a non-insurance market for all initial loss sizes $L_0 \leq L_S$, that is, all points on the vertical line between $D$ and $B$, because the transaction cost exceeds a monopolistic insurer’s profit margin ($\pi_{M_S} < c$).

Figure 1 immediately shows that the monopolistic insurer has strong incentives to push the initial state claim towards $(W, W - L_L)$ (point $A$) with corresponding expected profits $\pi_{ML}$ by increasing the loss size to $L_L$, the exogenously defined maximum loss size. We state this as a proposition the formal proof of which is given in the appendix:

**Proposition 1** When consumers are risk-averse, the expected profits of a monopolistic insurer charging a premium $R(L) = W - CE(L)$ are increasing in $L$.

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7For ease of exposition, we assume that consumers have homogenous risk preferences. In the analysis of the experimental data we relax this assumption and explicitly allow for the possibility that the consumers the insurer faces in his experimental market may have heterogeneous risk preferences.

8This immediately follows from the marginal rate of substitution being equal to $-(1 - p)U'(W_g)/(pU'(W_b))$. 

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In this case, offering insurance at premium $R^M(L_L)$ makes the consumer indifferent between buying insurance (contingent claim $M_L$) and staying uninsured (contingent claim $A$). Without countervailing bargaining power towards suppliers, the insurer’s expected profits are $\pi_{M_L}$ on each policy sold.

With countervailing buyer power, the insurer may extract price concessions from suppliers such that his direct claims costs are less than $L_L$ in case one of his clients experiences a loss. This may further increase his profits: in the most extreme case he negotiates a price of 0 such that his per-client profits equal the premium paid $R(L_L)$. It is of key importance for the insurer that this negotiated deal is not available to the non-insured, because otherwise the contingent claim of the uninsured returns to point $D$ and the insurance market is fully eroded. In case of exclusive deals and no competition in the insurance market, the insurer has no incentive to pass more than an infinitesimally small part of the negotiated discounts to its insured consumers, such that consumers have a slight preference for buying insurance (point $M_L$) to staying uninsured (point $A$).
In sum, when the initial loss \( L_0 = L_L \), the presence of a monopolistic insurer neither benefits consumers nor wreaks havoc on their welfare. When the initial loss size \( L_0 < L_L \), consumers may experience a loss in welfare because of the attempts by insurers to increase the loss size, possibly to its maximum.

1.1 Competition in the Insurance Market

How does competition in the market for insurance affect these outcomes? Absent buyer power, insurers take the initial state claim \((W, W - L_L)\) as given and will offer insurance at competitive prices. That is, consumers can exchange one unit of wealth in good times for one unit of wealth in bad times at the actuarially fair ratio of \((1 - p)/p\). In Figure 1, these fair price lines are shown as dotted lines. In an insurance market with \( L_0 = L_L \), consumers benefit from competition because they can now reach the contingent claim \( C_L \) instead of \( A \).

What if the insurers compete for consumers but each have full buyer power towards suppliers? Is this the best of worlds that brings consumers back to point \( D \)? The answer is that this critically depends on whether negotiated discounts also become available to uninsured consumers. If not, uninsured consumers continue to face a loss \( L_L \) while insurers have strong incentives to negotiate discounts to enable them to profitably undercut the premium of their competitors. In case the supplier has zero marginal cost and the insurer does not have any variable cost, competition will push the contingent claim offered by insurers to point \( D \). All consumers will choose to buy insurance at zero premium while the insurers’ profits equal zero. We again state this association between the level of competition in the insurance industry and insurance premiums as a formal proposition:

**Proposition 2** Let \( c \) be the transaction cost a consumer experiences when buying insurance. For given \( c \) let \( L(c) \) be the potential loss for which a consumer is indifferent between buying insurance at the actuarially fair rate or remaining uninsured. When two insurers compete in premiums \((R_1, R_2)\) and loss sizes \((L_1 \text{ and } L_2)\), in equilibrium \( R_1 = R_2 = L_1 = L_2 = 0 \) and \( E[\pi_1(L_1)] = E[\pi_2(L_2)] = 0 \), for any potential loss \( L \geq L(c) \) faced by the uninsured.

However, if the negotiated deals are also available to the non-insured (i.e. \( L = \min\{L_1, L_2\} \)), competitive insurers with buyer-power will only push back the loss size to \( L_1 = L_2 = L(c) \). Lower loss sizes would erode the insurance market because consumers would no longer bother to buy insurance since the benefits do not exceed the transaction cost \( c \). In equilibrium, consumers
are indifferent between buying insurance (point $C$) or not (point $B$) while insurers’ profits again equal zero. Notably, the market in this case remains an insurance market and consumers are worse off than at point $D$. Only when the transaction cost $c = 0$, consumers will take out insurance for any small risk. In that case $L(0) = 0$ and the equilibrium will be similar to the exclusive negotiated deals case with insurers offering contingent claim $D$.

2 An Illustrative Example

As indicated, transitions of markets from non-insurance markets are hard to identify in practice because the initial loss size $L_0$ is not observed. To illustrate how this mechanism may function to insurance markets, we provide an example how efforts to counteract supplier market power with insurer market power may backfire.

2.1 Quality Differences

Consider a product market with a monopolistic firm that supplies two vertically differentiated versions of a particular product, a version of quality $q_L$ and a second version of $q_H$. The unit cost of production of each version is constant but higher for the high quality version, $c_L < c_H$. Consumers receive a surplus of $U = \theta q - x$ if they buy a product of quality $q$ at price $x$ and 0 otherwise.\(^9\) Consumers are heterogenous in their taste for quality, with a fraction $\lambda$ having taste parameter $\theta_H$ and the remaining fraction $1 - \lambda$ having taste parameter $\theta_L < \theta_H$. Up to this point, the set up is similar to the simple vertical differentiation model that can be found in Tirole (1988, p. 96-97). The profit-maximizing supplier will always find it in its interest to offer both the low quality and the high quality product to the market.

Now suppose that the consumer is risk averse with utility function $u(w) = 1 - e^{-\gamma w}$ with $w$ denoting his wealth level and $\gamma$ the parameter of risk aversion. The potential loss the consumer faces is equal to the price $x$ he paid for the product. One can show that for certain parameter values of $\gamma, \lambda, \theta_L, \theta_H, c_L, c_H, q_L, q_H$ and $p$, the insurer maximizes his expected profits when the supplier only supplies the higher quality product, giving him an incentive to eradicate the supply of the low quality product.\(^10\) Moreover, when the consumer “narrow brackets”, that is, treats the purchase and insurance decision as two separate decisions effectively ignoring the risk of loss in his purchase decision, the increase in the insurer’s expected profits may exceed the decrease

\(^9\)We use $x$ to denote price in order to prevent confusion with the loss probability $p$.

\(^10\)In Appendix B.3 we show this for the set of parameter values: $c_L = 0.10; c_H = 0.15; \theta_L = 0.3; \theta_H = 0.6; q_L = 0.6; q_H = 0.8; \lambda = 0.3; p = 0.3$ and $\gamma = 0.9$.  

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in profits of the supplier compared to the situation where the supplier provides both products.\textsuperscript{11} In that case, the insurer can offer full compensation to the supplier: The supplier and insurer maximize their joint profits by offering only the high quality product but consumer surplus would be higher in the situation where both products are available.

That said, the narrow bracketing assumption may not hold in all decision contexts. In case consumers incorporate the insurance decision when buying the product, the prospect of paying an insurance premium may reduce their willingness to pay for the product, with a higher reduction for the high quality product since the premium is increasing in loss size. This implies that the insurer may still benefit when only the high quality product is supplied but that joint profits do not increase.

2.2 The Dutch Windshield Repair Market

Contracting preferred suppliers can be a means for insurers to influence loss sizes. For instance, in The Netherlands some fifty insurers offer insurance for windshield repair (including windshield replacement). The total annual cost of windshield repair in The Netherlands is about €150 mln (Consumentenbond, 2012). Virtually all insurers have contracted preferred suppliers, either directly or through a trade association. An insured consumer has compelling incentives to use the services of a preferred supplier. A typical policy has no deductible in case of windshield repair by a preferred supplier while it is reduced by 50% if the windshield needs to be replaced. Also, using the services of a preferred supplier does not affect the no-claim discount, and it is customary for preferred suppliers to take care of all the paperwork that is involved in dealing with the insurer. Indeed, it is quite difficult for an independent windshield repair shop to attract customers.\textsuperscript{12} Usually these firms offer windshield repair as part of a more extended car repair service.

The market for windshield repair is highly concentrated with one dominant repair shop having a market share of about 50%, almost ten times as large as the second-largest shop (Hinloopen, 2010). Each insurer has its own set of preferred suppliers, but the dominant supplier is contracted by all insurers. Although windshield repair has many features of a homogeneous

\textsuperscript{11}Evidence suggest that people often do narrow bracket (Read et al., 1999; Gottlieb and Mitchell, 2015) and it is conceivable that people have different mental accounts for expenditures on consumption items and insurance.

\textsuperscript{12}For example, on March 24, 2010, the independent windshield repair shop Kenmerk Autoruitservice was informed by insurer Unive that [personal letter, translated from Dutch]: “Windshield repair jobs will only be reimbursed for repair shops that are selected by us. Your company is not in this category. Consequently, as of May 1st we will not reimburse repair jobs that have been carried out by your shop. In case a customer has his windshield replaced by your shop, we will increase his deductible by euro 500.”
Both the dominant service supplier and insurers emphasize that quality differences rule the selection of preferred suppliers. Indeed the dominant repair shop charges much higher prices than (independent) competitors. Compared to a representative set of repair shops, its prices are more than twice of what is readily available. For instance, replacing a windshield of a Toyota Auris would typically cost about €250, whereas the dominant repair shop charges €494. And repairing a crack in a windshield costs €77, compared to the average market price of €35 (Consumentenbond, 2012).

These substantial price differences in combination with the large market share of the dominant repair shop suggest that it enjoys market power. Apparently, individually or jointly the insurers do not manage to reduce the prices charged by the dominant repair shop. But do they have an incentive to actually bring prices down? The model in the preceding section suggests that insurers may have incentives to phase out ‘lower quality’ repair shops that charge lower prices for comparable services. The reason is that every cost reduction also reduces the risk to which the uninsured are exposed, which directly threatens the existence of this insurance market. In the extreme case where the insurer would successfully eliminate the probability that a loss would occur or manages to reduce the potential loss size to zero, he would be out of business.

3 Experimental Design and Research Hypotheses

Our experiment consists of two stages, a risk elicitation stage (Stage I) and a market stage (Stage II). The first stage is designed to elicit subjects’ individual level of risk-aversion of subjects. Subjects play this stage in isolation and this stage is the same in all treatments. In the second stage subjects play a market insurance game in groups of 6 (monopoly-treatment) or 7 (duopoly-treatment) subjects. Five subjects are randomly assigned the role of consumer and the other one or two group members are assigned the role of insurer. For 30 periods, the insurer chooses a combination of loss size \( L \) and premium \( R \). By paying the premium \( R \) consumers can insure themselves against the event of a loss of size \( L \). Consumers may also choose not to buy insurance.

We implement three treatments: one monopoly treatment and two duopoly treatments. All

\[13\] For instance, the web site of Interpolis, a leading Dutch insurance company, states the following [translated from Dutch]: "As of September 22, 2010 Interpolis works for repairing window damage only with recovery companies that are affiliated with the FOCWA or BOVAG. These organizations set strict demands on quality, warranty and service. They monitor connected recovery companies there regularly. Interpolis wishes for its customers the highest standard of service and has therefore opted for this change in the policy conditions." [http://nieuws.interpolis.nl/erkende-bedrijven-herstellen-ruitschade-interpolisklanten/](http://nieuws.interpolis.nl/erkende-bedrijven-herstellen-ruitschade-interpolisklanten/) (visited July 10, 2017).
treatments consist of a risk elicitation stage followed by a market stage. The two duopoly treatments differ in the potential loss size faced by uninsured subjects. These differences are explained further below where we discuss the two stages in greater detail.

3.1 Stage I: Risk elicitation

The first stage of the experiment measures the individual risk preferences of all participating subjects. Our procedure closely follows the procedure used by Von Gaudecker, Van Soest and Wengström (2011) who use multiple price lists with pie-charts as a graphical tool to help describing the probabilities of the outcomes. Each subject is presented with a screen containing a $6 \times 2$ payoff matrix such as shown in Figure 2. In each row, subjects have to choose between option A or option B. This binary choice is between two lotteries but in our design, the lottery headed under ‘Option B’ is always degenerate: when selected, a sure payoff is received. This is a departure from most of the literature, including Von Gaudecker et al. (2011), with the exception of Heinemann, Nagel and Ockenfels (2009). We chose this setup to make the decision-making process for subjects as similar as possible to the one they face in Stage II. In that stage the choice is also between a non-degenerate lottery (not insure) and a certain amount (take insurance). The payoff matrices are designed such that a rational risk-neutral subject will always prefer option A in the first row, option B in the last row, and will switch from A to B in one of the intermediate rows. The procedure does however not impose monotonicity: subjects are allowed to switch from A to B in a certain row and to switch back to A in a later row. If subjects show consistent behavior, they are directed to a sub-screen with the same payoffs but a finer probability grid with steps of 5%.

Subjects face a total of 25 screens (50 including sub-screens) with each screen depicting a particular loss size-premium ($L, R$)-combinations with $L = 4, 8, 12, 16, 20$ and $R = 2, 4, \ldots, 18$ and $R > L$. In total, subjects thus make 150 (300) decisions in Stage I.

There is a rich literature on risk and risk perception that measures peoples’ risk attitudes in the laboratory. The common finding of these studies is that most people are risk-averse and tend to overestimate the value of avoiding low-probability risks (McClelland et al., 1993).

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14 The exact instructions for all treatments can be found online by clicking this link.
15 Harrison and Rutström (2008) review the different risk elicitation methods used in the laboratory including the multiple price list design. We refer the interested reader to their paper for details and the advantages and drawbacks of each method. We will only give a description of our design and indicate at which points we depart from the literature.
16 To compare, in the elicitation design of Von Gaudecker et al. (2011) subjects make 28 to 56 decisions including possible sub-screens.
Another experimental finding relevant for the current context is that individuals tend to have a disproportionate preference for certainty (Abdellaoui et al., 2011; Andreoni and Sprenger, 2012). Von Gaudecker, van Soest and Wengström (2011) and others have shown heterogeneity in risk preferences. Therefore, it is better to estimate individual specific risk preference parameters. All these studies estimate (individual) risk preferences by presenting subjects with different sets of lotteries constructed by the researcher, a procedure we follow in Stage I. The bets buyers face in Stage II are instead constructed by the subject(s) with the role of insurer. This raises two questions. First, to what extent are insurer-subjects able to learn the risk attitudes of their population of potential buyers and to offer loss size/premium combinations that maximize their expected profits? Second, are choices made by consumer-subjects in the two stages consistent, such that the revealed risk preferences in Stage I can predict a consumer-subject’s Stage II choices? The answer to the second question is also important in illuminating the issue whether risk attitudes elicited by individual-decision tasks in the lab carry over to interactive market contexts. We are not aware of any other experimental studies that have investigated these issues.

Figure 2: Example of a Stage I multiple price list decision screen.

The text [translated from Dutch] invites subjects to “Make a choice (“keuze”) between Option A and Option B for each of the choice situations below”. “met kans” means “with probability”.

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17 Risk preferences have also been estimated in the field (Beetsma and Schotman, 2001; Harrison et al., 2007; Dohmen et al., 2010) or using field data by inferring risk preferences from deductible choices (Cohen and Einav, 2007; Ericson et al., 2015). Using data on people’s deductible choices, Sydnor (2010) and Barseghyan et al. (2013) find that people overinsure in real life insurance markets.
3.2 Stage II: The market insurance game

The second stage lasts for 30 periods. Subjects are randomly matched into separate markets of six or seven subjects. In the monopoly (duopoly) treatment, in each group one (two) randomly chosen subject(s) are assigned the role of insurer; the remaining five subjects have the role of consumer. Subjects with the role of consumer are given an initial endowment of $W = €20. In each period, the insurer-subjects in the group have the task to set a premium $R_i$ and a loss size $L_i$, both in the range $[0, W]$ ($i = 1, 2$). In order not to impose a lower bound on the loss sizes set by insurers, insurers in our design can reduce the loss size without incurring any additional cost. By paying the premium to the insurer, consumers are protected against the event of a loss. Losses occur with an exogenously given probability $p = 0.60$.

Ex ante, we envisioned that insurer-subjects might have difficulties in simultaneously choosing two strategic variables, so we also ran a number of sessions with an exogenously given loss size (these are the sessions no. 1-3 and 8-10 in Table C.1). In this way, we could examine whether for given loss sizes insurer-subjects were able to find the profit maximizing premium in their market. It turned out that they were able to do so. For that reason, in what follows we focus on the sessions with endogenous loss sizes.\footnote{We also ran a number of sessions with a smaller loss probability of $p = 0.20$ (Sessions 4, 7 and 12 in Table C.1). Results of the sessions with exogenous loss sizes and $p = 0.20$ are available upon request.}

3.2.1 Monopoly treatment

The monopoly treatment MONOP-NI is designed as a non-insurance market with initial loss size $L_0 = 0$. Uninsured consumers face a potential loss of $L$, with $L$ determined as

$$L = \max(L_1, L_0),$$

where $L_1$ is set by the insurer. This resembles a non-insurance market because without the presence of the insurer, consumers would face a potential loss equal to $L = L_0 = 0$. In such a market, the presence of an insurer can only increase the potential loss of the uninsured. The loss size set by the monopolist is to be interpreted as the non-exclusive negotiated price with a service supplier in case one of the insurees experiences a loss. After having learnt the premium and the potential loss $L$, consumers decide whether or not to insure. Note that this experimental setting is akin to the extreme case where the insurer has full bargaining power vis-à-vis the supplier whereby the supplier cannot price discriminate between those that buy insurance and those that...
do not buy insurance. In practice, this may happen when the insurance company is vertically integrated with the upstream market.

3.2.2 Duopoly treatments

In the two duopoly treatments, the potential loss for the uninsured is determined as

\[ L = \max(\min\{L_1, L_2\}, L_0), \tag{2} \]

with \( L_0 \) the initial loss size and \( L_i \) the loss size set by insurer \( i \). Notice that with \( L_2 \) set to 0, this reduces to equation (1). We implement two choices of \( L_0 \): a non-insurance market (DUOP-NI) for which \( L_0 = 0 \) and an insurance market (DUOP-I) for which \( L_0 = 20 \).

Figure 3 shows an example of a decision screen consumers may face in Stage II of DUOP-NI: when uninsured, consumers face a potential loss of 1 (= 20 − 19, so the lowest loss size chosen by the two insurers has been 1); they can insure against this loss, by buying insurance from insurer 1 at a premium of 0.5 or from insurer 2 at a premium of 12.0. Most likely, insurer 2 has set a much larger loss size. It is conceivable that in this period, insurer 2 will not attract any customers. This illustrates the strong incentive embodied in (2) for competing insurers to undercut the rival’s loss size, giving the competitive outcome of Proposition 2 its best shot. Table 1 gives a summary of different Stage II treatments.
Table 1: Summary of Stage II treatments: The market insurance game

<table>
<thead>
<tr>
<th>Treatment</th>
<th># cons.</th>
<th># insurers</th>
<th>Decision variables</th>
<th>Pot. loss uninsured</th>
<th>Loss prob. ((p))</th>
<th># sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>MONOP-NI</td>
<td>5</td>
<td>1</td>
<td>R, L</td>
<td>max{L, 0}</td>
<td>0.6</td>
<td>3</td>
</tr>
<tr>
<td>DUOP-NI</td>
<td>5</td>
<td>2</td>
<td>(R, R_2, L_1, L_2)</td>
<td>max({min{L_1, L_2}, 0})</td>
<td>0.6</td>
<td>2</td>
</tr>
<tr>
<td>DUOP-I</td>
<td>5</td>
<td>2</td>
<td>(R_1, R_2, L_1, L_2)</td>
<td>max({min{L_1, L_2}, 20})</td>
<td>0.6</td>
<td>2</td>
</tr>
</tbody>
</table>

3.2.3 Payoffs

In each period, an insured consumer’s earnings equal \(W - R\) and the earnings of an uninsured consumer are \(W\) in case no loss occurs and \(W - L\) in case of a loss. Insurer \(i\)’s profits equal \(R_i\) times the number \(N_i\) of consumers that bought insurance from him minus \(L_i\) times the number of realized losses among his insurees.

The subjects’ earnings in Stage II are determined as follows. For consumer-subjects, one randomly selected Stage II period is paid out at the end of the experimental session. For insurer-subjects we decided on a different payment structure because payment based on a single period may result in losses even for insurers who systematically set their premium higher than the expected loss in case the randomly chosen period turns out to a period in which a high number of their insurees happens to experience a loss. To avoid this, insurer-subjects were paid 10% of their accumulated profits. This payoff structure may also help to induce insurer subjects to behave more as risk-neutral agents because the impact of an individual random draw on their final earnings becomes small.\(^{19}\)

3.3 Research hypotheses

We derive the theoretical equilibrium predictions for the experimental monopoly and duopoly markets under the assumption that consumer-subjects are risk-averse and insurer-subjects are risk-neutral.

3.3.1 Monop-NI \((L_0 = 0)\)

The monopolistic insurer has an incentive to set \(L_1\) higher than zero in order to create a market for his product. Proposition \([\) predicts that the insurer will set \(L_1\) to the maximal value of 20.

\(^{19}\)Of course, in principle, we could have selected those subjects who show the most risk-neutral behavior in their Phase 1 decisions. However, this would lead to certain selection-issues and, as a practical point, it would have urged us to process the Phase 1 results in the short time between the end of Phase 1 and the start of Phase 2. Since this would necessitate some estimation of individual risk-parameters, this is infeasible, even if one automates the process.
With risk-averse consumers, the profit-maximizing premium will be \( R_1 > pL = 0.6 \times 20 = 12 \), with the exact value depending on the degree of risk aversion. This prediction corresponds in Figure 1 to contingent claim \( M_L \) for the insured and \( A \) for the uninsured.

### 3.3.2 Duop-NI (\( L_0 = 0 \))

In the non-insurance duopoly market, competition will push back loss sizes to the point \( L_1 = L_2 = L(c) \), the potential loss for which a consumer is indifferent between buying insurance at the actuarially fair rate or remaining uninsured. Competition will also force insurers to charge actuarially fair premiums \( R_1 = R_2 = p \times L(c) \). We do not observe the cost of effort \( c \) experimental subjects experience in buying insurance but for \( c > 0 \), we expect to see equilibrium premiums and loss sizes strictly above zero. This prediction corresponds to contingent claim \( C_S \) in Figure 1.

### 3.3.3 Monop-I and Duop-I (\( L_0 = 20 \))

In insurance markets, negotiated discounts are not available to uninsured consumers; they continue to face a potential loss of \( L_0 = 20 \). The presence of one or more insurance companies can therefore only benefit consumers by offering protection against a large potential loss. The monopolistic insurer does not have to worry that lowering \( L_1 \) will reduce the demand for his product because of the exclusivity of any negotiated discount. For this reason, and because \( L_1 \) is the price the insurer has to pay to the service supplier in case one of his customers experiences a loss, he has an incentive to set \( L_1 \) as low as possible, that is: equal to 0. As in the \( L_0 = 0 \) case, the profit-maximizing premium will be \( R_1 > pL = 0.6 \times 20 = 12 \), with the exact value again depending on the degree of risk aversion. This prediction corresponds in Figure 1 to contingent claim \( M_L \) for the insured. The uninsured face contingent claim \( A \) but other than in Monop-NI this is independent of the potential loss size selected by the insurer. For this reason, we do not implement treatment Monop-I because the only predicted difference with Monop-NI is higher profits for the insurer-subjects.

For the duopoly market, the fact that uninsured consumers continue to face a potential loss of \( L_0 = 20 \) ensures that the insurance market will not erode. The exclusivity of negotiated discounts thereby lifts the constraint that prevents insurer-competition in Duop-NI to push loss sizes to 0. The unique equilibrium for this case is when \( R_1 = R_2 = L_1 = L_2 = 0 \). This prediction corresponds to contingent claim \( D \) in Figure 1.
3.3.4 Predictions

The theoretical predictions regarding the choices made by the insurer-subjects in the experiment are summarized in Table 2. These predictions are the research hypotheses of our experimental investigation. The table shows that compared to the initial claim size \( L_0 \), consumers in non-insurance markets are worse off when one or more insurance companies with buyer power enter, unless the transaction cost of taking out insurance is 0. In the latter case, they are equally well off in the duopoly, but not in the monopoly case. Consumers in insurance markets are equally well off when a monopolistic insurer with buyer power enters and strictly better off when two competing insurers with buyer power enter. In sum, granting insurers countervailing buyer power only is in the interest of consumers if the market is an insurance market and the insurers face competition from other insurers.

Table 2: Research hypotheses on the predicted outcomes in the experimental markets (risk-averse consumers, loss probability \( p = 0.6 \)).

<table>
<thead>
<tr>
<th>Cont. Loss size</th>
<th>Expected Premium</th>
<th>Consumer preference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-insurance market ((L_0 = 0))</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MONOP-NI ( M_L )</td>
<td>20</td>
<td>( \pi_{M_L} &gt; 0 )</td>
</tr>
<tr>
<td>DUOP-NI ( C_S )</td>
<td>( L(c) )</td>
<td>0</td>
</tr>
</tbody>
</table>

| **Insurance market \((L_0 = 20)\)** | | |
| MONOP-I \( M_L \) | 20 | > 12 | > 12 | \( I \sim NI \) |
| DUOP-I \( D \) | 20 | 0 | 0 | \( I \succ NI \) |

4 Experimental Procedure and Data

The experiment was conducted at the CREED experimental laboratory of the University of Amsterdam. Sessions lasted between 1h25m and 1h50m. We ran a total of 20 sessions in which a total of 377 subjects participated in 60 separate markets. Of these subjects, 245 participated in one of four treatments described in the previous section: 60 (66) in the monopoly market with exogenous (endogenous) loss size and 56 (63) in the duopoly market with initial loss size \( L_0 = 0 \) (\( L_0 = 20 \)).

Students who showed up at the CREED-lab but could not participate (because multiples of 6...
or 7 students were needed) were sent away after payment of a €7 show-up fee. The other subjects were paid one randomly chosen decision in Stage I and Stage II if they had the role of consumer in Stage II; subjects with the role of insurer in Stage II were paid out one randomly chosen decision in Stage I plus 10% of the accumulated profits in Stage II. We used a 1:1 conversion rate of euro’s in the experiment to euro’s paid.

Table 3 summarizes per treatment the most important background characteristics plus some of the outcomes, splitting the sample based on the subject’s role in the market stage. The average age of 21/22 years reflects the fact that our sample consists of students of the University of Amsterdam. In all treatments, about half of the subjects is female. For age and gender, no significant differences between treatments are found. The risk elicitation stage is the same for all treatments so earnings are also very similar. There is however large between-treatment variation in the market stage earnings. Insurer-subjects earn on average €13.74 in the market stage of the monopoly treatment but are not able to attain positive earnings in the competitive non-insurance market Duop-NI. However, in the competitive insurance market Duop-I, insurers earn on average €21.83, which is significantly more than in the monopolistic non-insurance market. As we will see, the reason for this is that insurer-subjects in these markets manage to set the losses that they have to payout to their clients at very low levels while only partly passing these benefits to their clients in the form of low premiums.

For consumer-subjects, the actual earnings have not been recorded for the two stages separately, but because we can assume that earnings in the risk elicitation stage are very similar across treatments, differences in total earnings are likely to reflect differences in earnings in the market stage. We observe that in both Duop-NI and Duop-I, consumer-subjects leave the lab with more money than in Monop-NI with no significant differences between the two duopoly treatments. In the next section, we will study in greater detail the underlying behaviors that have caused these outcomes.

5 Experimental results

We split the discussion of our results in three parts. First, in Section 5.1 we analyze the results of the risk elicitation stage. The high number of subject-decisions in this stage allows us to estimate risk attitudes at the individual level. We evaluate the consistency of subjects’ stage I choices and compare our risk preference estimates with those found elsewhere in the literature. As an extra check on the success of our randomization, we also compare the distribution of risk
Table 3: Summary statistics subjects (standard deviations in parentheses) \((p = 0.6)\).

<table>
<thead>
<tr>
<th>Role:</th>
<th>Monop-NI (L_0 = 0)</th>
<th>Duop-NI (L_0 = 0)</th>
<th>Duop-I (L_0 = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Insurers (1)</td>
<td>Consumers (2)</td>
<td>Insurers (3)</td>
</tr>
<tr>
<td>Fraction females</td>
<td>0.182 (0.405)</td>
<td>0.472 (0.504)</td>
<td>0.467 (0.516)</td>
</tr>
<tr>
<td>Age</td>
<td>21.73 (1.79)</td>
<td>22.30 (3.28)</td>
<td>22.00 (3.82)</td>
</tr>
</tbody>
</table>

**Risk elicitation stage**

\(\hat{\gamma}_i\) median | 0.029 | 0.081 | 0.089 | 0.083 | 0.082 | 0.095 |
\(\hat{\gamma}_i\) mean | 0.029 | 0.091 | 0.2003\* | 0.110 | 0.072 | 0.101 |
\(\hat{\tau}_{s(i)}\) median | 1.274 | 1.136 | 1.202 |
\(\hat{\tau}_{s(i)}\) mean | 1.284 | 1.169 | 1.231 |

**Final earnings (in €)**

Total earnings\(^1\) | 29.74 (10.69) | 25.70 (7.89) | 12.87** (7.00) | 29.02** (6.09) | 36.50††† (18.87) | 28.52* (8.13) |
Risk elicitation stage | 16.00 (4.20) | - | 14.12 (6.30) | - | 14.67 (6.17) | - |
Market stage | 13.74 (8.21) | - | -1.26** (4.43) | - | 21.83††† (17.25) | - |
obs. | 11 | 55 | 16 | 40 | 18 | 45 |

\(^1\) For consumer-subjects, it was not separately recorded which of the stage I and II decisions were paid out (subjects were only informed about their earnings after the experiment had ended).

\(* \ast \ast \ast \) indicate statistically significant differences with Monop-NI at the 1%-level (5%-level, 10%-level);

\(\dagger \dagger \dagger \) indicate statistically significant differences with Duop-NI at the 1%-level (5%-level, 10%-level). Significance based on two-sided pairwise nonparametric Mann-Whitney rank-sum tests.

preferences across treatments, distinguishing between subjects assigned the role of consumer in the market stage and those assigned the role of insurer. Section 5.2 returns to the main topic of this paper by presenting the outcomes of the market insurance game. We relate the results regarding the premiums and loss sizes observed, the consumers’ insurance choices and the insurers’ profits to the research hypotheses as summarized in Table 2.

Of particular interest for our purposes is to analyze between-stage decision-consistency by subjects assigned the role of consumer in the market stage. To which extent do the decisions in the risk elicitation stage correctly predict the decisions these subjects make in the market stage? The type of decisions they face in both stages is very much comparable, but whereas they are in an individual decision-making game in Stage I with the options offered by a computer, they are in a strategic market context in Stage II when the options are offered by another subject in their market. Any observed difference in behavior would be indicative that subjects have a different
attitude towards choosing between risky prospects and insurance choices. Section 6 presents an elaborate analysis of these issues.

5.1 Individual risk preferences

First, we use the decisions from the risk elicitation stage to estimate the individual-specific risk parameter for the subjects with the role of consumer in the market stage of the experiment. To this end, we apply a structural econometric model related to the one introduced by Von Gaudecker et al. (2011) and estimate this model by maximum likelihood. For ease of comparison, we borrow their notation. We assume that subjects’ risk preferences can be represented by an expected utility framework with the standard CARA exponential utility function

\[ u(z, \gamma) = -\frac{1}{\gamma} e^{-\gamma z}. \]  

with \( z \in \mathbb{R} \) denoting a lottery and \( \gamma \in \mathbb{R} \) the Arrow-Pratt coefficient of absolute risk aversion.

In the risk elicitation stage, subjects \( i \in \{1, \ldots, N\} \) repeatedly choose between two lotteries \( \pi^A_j \) and \( \pi^B_j \) (\( j \in \{1, \ldots, J_i\} \)). Lottery \( A \) is a binary lottery with a high outcome \( A^{\text{high}} \) that happens with probability \( p^{\text{high}} \) and a low outcome \( A^{\text{low}} \) that happens with probability \( 1 - p^{\text{high}} \); lottery \( B \) is a degenerated lottery:

\[ \pi^A_j = (A^{\text{low}}_j, A^{\text{high}}_j, p^{\text{high}}_j); \quad \pi^B_j = B^{\text{cert}} \]  

Let the outcome variable \( Y_{ij} \) be such that:

\[ Y_{ij} = \begin{cases} 1 & \text{if the individual chooses } B \\ 0 & \text{otherwise.} \end{cases} \]

The corresponding certainty equivalents are:

\[ CE(\pi^A_j, \gamma_i) = -\ln\{-\gamma_i u(\pi^A_j)\}/\gamma_i \text{ and } CE(\pi^B_j, \gamma_i) = B^{\text{cert}}_j. \]

with

\[ u(\pi^A_j) = p^{\text{high}}_j u(A^{\text{high}}_j) + (1 - p^{\text{high}}_j) u(A^{\text{low}}_j) \]

\[ = -\left( \frac{p^{\text{high}}_j e^{-\gamma_i A^{\text{high}}_j}}{\gamma_i} + \frac{(1 - p^{\text{high}}_j) e^{-\gamma_i A^{\text{low}}_j}}{\gamma_i} \right) \]

\[ = -\frac{1}{\gamma_i} \left[ p^{\text{high}}_j e^{-\gamma_i A^{\text{high}}_j} + (1 - p^{\text{high}}_j) e^{-\gamma_i A^{\text{low}}_j} \right]. \]

Motivated by their research objectives, the model in Von Gaudecker et al. (2011) also incorporates loss aversion and time preferences for uncertainty resolution in the utility specification. In our study, none of the lotteries \( A \) and \( B \) involves a loss and subjects receive immediate feedback on whether or not a loss has occurred and in all cases get paid out immediately after the end of the experiment.

22

21
Combining equations (6) and (7), the difference in the certainty equivalents of lottery $A$ and $B$ can be written as:

$$\Delta CE_{ij} = CE(\pi_j^B, \gamma_i) - CE(\pi_j^A, \gamma_i) = B_{j}^{cert} + \frac{1}{\gamma_i} \ln\{p_{j}^{high}e^{-\gamma_i A_{j}^{high}} + (1 - p_{j}^{high})e^{-\gamma_i A_{j}^{low}}\}$$

(8)

We follow Von Gaudecker et al. (2011) in our further econometric implementation. Whereas a perfectly rational decision-maker selects $\pi_j^B$ if and only if $\Delta CE_{ij} > 0$, we allow for uncertainty by adding Fechner errors $\epsilon_{ij}$ to the deterministic economic model (see e.g. Graham Loomes, 2005). The decision problem of the individual now reads:

$$Y_{ij} = I(\Delta CE_{ij} + \tau \epsilon_{ij} > 0) \text{ with } \tau \in \mathbb{R}_+$$

(9)

with $I$ denoting an indicator function. If $Y_{ij} = 1$, individual $i$ chooses to buy insurance when faced with choice situation $j$. The behavioral interpretation of this specification is that individuals may be prone to some degree of inattention when evaluating the options, with the likelihood of choosing the less-preferred option increasing as $\Delta CE$ becomes small. The individual’s probability to make this type of ‘mistakes’ increases with the parameter $\tau \in \mathbb{R}_+$. As pointed out by Von Gaudecker et al. (2011), using certainty equivalents instead of utility differences facilitates comparisons across subjects. Other than Von Gaudecker et al. (2011), our main interest is in using the estimation procedure to back out the risk-preferences of individual subjects in the different experimental estimates. To this end, we estimate the individual-specific risk-preference parameter $\gamma_i$, whereas Von Gaudecker et al. (2011) try to retrieve the distribution of this parameter in the population. This higher flexibility in estimating individual risk-preferences implies that we have to be more parsimonious in other dimensions. For this reason, and because this is outside the scope of the current paper, we do not allow for “trembling hand” type of errors that allows individuals to choose randomly with a given fixed probability (Harless and Camerer, 1994).

The probability of the observed choice $Y_{ij}$ of individual $i$ in choice situation $j$, given all the individual specific parameters, is given by:

$$l_{ij}(\pi_j^A, \pi_j^B, Y_{ij}, \tau_{s(i)}, \gamma_i) = \Lambda \left((2Y_{ij} - 1)\frac{1}{\tau} \Delta CE_{ij}(\pi_j^A, \pi_j^B, \gamma_i)\right).$$

(10)

As Von Gaudecker et al. (2011), we estimate $\tau$ together with the preference parameters but whereas all individuals have the same $\tau$ in their specification, we can allow for session-specific $\tau$’s ($\tau_s$, with $s \in \{1, \ldots, S\}$ and $S$ the total number of sessions) because we do not include a ‘trembling hand’ parameter. As they notice, it proves difficult in practice to estimate heterogeneity in $\tau$ and the ‘trembling hand’ parameter separately.
where \( s(i) \) denotes the session in which subject \( i \) participates and \( \Lambda(t) = (1 + e^{-t})^{-1} \) the cumulative standard logistic distribution function. We estimate for each session separately the parameters \( \tau \) and the individual \( \gamma_i \)'s by maximum likelihood. The log likelihood function maximized is the sum of the log likelihood contributions of each subject.

Figure 4 shows the histogram of the estimated individual risk preference parameters of the subjects in our sample. It is reassuring that with a median value of 0.082 and a mean value of 0.1033, the resulting distribution is very similar the population distribution estimated by Von Gaudecker et al. (2011, Figure 4a). Reassuringly for the success of our randomization, Table 3 shows that for consumers, the estimated risk-preference parameters are very similar across treatments; for subjects acting as insurer, we find that those in Duop-NI are slightly more risk averse \( (p = 0.068) \) than those in Monop-NI. For Duop-NI, a regression however does not indicate a relation between insurer risk attitudes and the minimum premium available to consumers in the market stage.

Figure 5 shows for subjects in Monop-NI and Duop-NI with different risk preference estimates (one risk loving, one ‘risk neutral’ and one risk averse) the risk-elicitation stage choices that involved a loss probability of \( p = 0.6 \). In the map, the solid line indicates the choice-situations that make a risk-neutral agent indifferent between taking insurance or staying uninsured. To the left of this line, she would choose to insure, to the right to stay uninsured. The dots are filled (hollow) when the subject actually decided (not) to insure in the risk-elicitation stage when

\[\text{Von Gaudecker et al. (2011) impose more structure and do not estimate individual } \gamma_i \text{’s. For these reasons their distribution is smoother than ours.}\]

\[\text{We regressed the average minimum market premium on the insurer’s estimated } \gamma \text{’s while clustering at the market level.}\]
Figure 5: Choices by selected subjects in treatments MONOP-NI (left panels) and MONOP-NI (right panels). Loss probability $p = 0.6$.

The solid line is the risk neutral line: a risk-neutral agent should choose (not) to insure for choice-combinations to the left (right) of this line. The dots show the subject’s actual decisions in the risk-elicitation game (Stage I): they are filled and green when Option B (‘insure’) has been chosen and hollow and red if Option A (‘not insure’) has been chosen. The squares shows the offers made by the insurers in the market stage (Stage II): these are filled and blue if the consumer-subject took the offer. The size of the squares in increasing with the period in which the offer was made. Estimates of $\gamma$ based on all Stage I choices.
faced this situation by choosing Option B (A). Since each of the 25 screens only contained one such decision, each dot in Figure 5 relates to a different screen (ignore the squares for the moment, these relate to Stage II decisions). In this light, it is remarkable how consistent subject choices in this stage are: the areas of filled and hollow dots are almost completely separated. A vertical comparison of the panels reveals that the differences in $\gamma$’s indeed reflect the differences in individual risk-preferences in choices that involve $p = 0.6$, this despite the fact that the $\gamma$’s are estimated also including the choices that involve loss probabilities $p \neq 0.6$.

5.2 The Market Insurance Game

In this section, we will present the treatment effects on the key outcome variables of the market stage of the experiment: premiums, loss sizes, expected consumer earnings and insurer profits. However, our design with non-automated live-buyers necessitates that we first consider which $(R, L)$-combinations are most profitable in our experimental markets and ascertain whether these combinations are roughly the same across treatments. To this end, we construct per treatment for each $(R, L)$-combination with $p = 0.6$ the aggregate demand for insurance by considering the Stage I decisions of the subjects who are assigned the role of consumer in the market stage. This procedure provides us with a map for the aggregate demand for insurance at the treatment level. These maps are shown in Figure 6. The squares in the grid indicate the actual decisions of subjects in the risk elicitation stage. The numbers next to the squares indicate how many chose to take insurance (the more subjects take insurance the greener the square is). The maps also show the iso-expected-profit curves of a monopolistic insurer who would serve such a (hypothetical) market. For example, in MONOP-NI, 49 subjects (out of the 55) decided to buy insurance (i.e. they chose Option B) when options A and B corresponded to $(R, L) = (4, 8)$.

There are a number of important points to take away from these maps. First, in line with the individual estimates of risk preferences, in all treatments a majority of consumer-subjects shows risk-averse behavior. For example, in all treatments, most subjects decide to buy insurance at a premium of 8 to be safeguarded against a 60% probability to lose 12. Second, the iso-profit curves are very similar across treatments, reinforcing our earlier observation that any difference

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26 For example, the combination $(R, L) = (2, 12)$ appeared in screen #3, the combination $(R, L) = (6, 12)$ in screen #21.

27 The per-market aggregate demand functions may look slightly different because each market only contains a sub-sample of five consumer-subjects. In the online Appendix we provide plots for each separate market.

28 This particular combination corresponds to the fourth choice situation in Figure 2.
Figure 6: Stage I aggregate decisions by consumer-subjects (squares) for choice combinations involving a loss probability \( p = 0.6 \) and the corresponding iso-expected-profit curves for a monopolistic insurer.

The number to the right of each \((L,R)\)-combination denotes the total number of consumer subjects in the treatment that chose Option B (‘insure’) in the risk-elicitation stage. Based on these choices, we calculate the profits an insurer earns in expectation when offering \((L,R)\) in all 30 periods. Iso-profit lines are shown for the levels \([-200, -100, 1, 20, 40, 60, 80]\). The plots were created in Matlab using the \texttt{interp2} function for interpolation of the gridded data. The solid line is the risk neutral line.

In outcomes cannot be explained by treatment heterogeneity in consumer risk preferences. Third, in each of these markets, a profit-maximizing monopolistic insurer would do best if he sets the loss size close at 20 and offers insurance at a premium of about 14 to 16.\(^{29}\)

In sum, if the decisions of consumer-subjects in the market stage of this experiment are consistent with their first stage elicited risk-preferences (which is investigated in Section 6.1),

\(^{29}\)We provide a numerical example for \textsc{Monop-NI}: at a premium of 14 and a loss size of 20, 37 subjects out of the 55 consumer-subjects would take insurance and the insurer’s per consumer expected profits would equal \((37/55) \times (14 - 0.6 \times 20) = 1.35\); setting a loss size of 16 and a premium of 10 would lead to expected per consumer profit of \((48/55) \times (12 - 0.6 \times 16) = 0.35\).
monopolistic insurer-subjects indeed maximize expected profits by setting the loss size \( L \) at the maximal value, in line with the theoretical argument posed in Proposition [1]. We next turn to the question whether insurer-subjects in MONOP-NI are able to uncover the particular iso-profit map of their market and set the loss size and premium to the profit-maximizing level.

Table 4: Main experimental outcomes (market level standard deviations in parentheses).

<table>
<thead>
<tr>
<th>Periods</th>
<th>1-15</th>
<th>16-30</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MONOP-NI</td>
<td>DUOP-NI</td>
</tr>
<tr>
<td>Min. Premium ((R))</td>
<td>10.68</td>
<td>5.29***</td>
</tr>
<tr>
<td>Loss Size ((L))</td>
<td>(1.89)</td>
<td>(1.41)</td>
</tr>
<tr>
<td>Loss Size ((L))</td>
<td>15.16</td>
<td>9.02***</td>
</tr>
<tr>
<td>Loss Size ((L))</td>
<td>(1.41)</td>
<td>(2.5)</td>
</tr>
<tr>
<td>Fraction Insured</td>
<td>0.44</td>
<td>0.59</td>
</tr>
<tr>
<td>Fraction Insured</td>
<td>(0.10)</td>
<td>(0.23)</td>
</tr>
<tr>
<td>Expected Profits</td>
<td>2.87</td>
<td>-1.25***</td>
</tr>
<tr>
<td>Insurers</td>
<td>(2.50)</td>
<td>(1.47)</td>
</tr>
<tr>
<td>Expected Earnings</td>
<td>10.33</td>
<td>14.94***</td>
</tr>
<tr>
<td>Consumers</td>
<td>(1.83)</td>
<td>(1.43)</td>
</tr>
<tr>
<td>Obs.</td>
<td>11</td>
<td>16</td>
</tr>
</tbody>
</table>

***(*,* *) indicate statistically significant differences with MONOP-NI at the 1%-level (5%-level, 10%-level); †††(††,†) indicate statistically significant differences with DUOP-NI at the 1%-level (5%-level, 10%-level). Significance based on two-sided pairwise nonparametric Mann-Whitney rank-sum tests.

5.2.1 The Monopolistic Non-Insurance Market

In Table 2 we hypothesize that monopolistic insurers in the non-insurance markets MONOP-NI will design a contingent claim \( M_L \) such that the premium exceeds 12, the uninsured face a loss size of 20 and expected profits \( \pi_{M_L} \) are strictly positive. The results in Table 4 provide empirical support. When we focus on the final 15 periods, both the uninsured loss size and the premium are far above zero, although the loss size for the uninsured is strictly below the upper bound of 20 \((p < 0.001)^{30}\) and, correspondingly, the average premium is with 11.59 not significantly different from 12 \((p = 0.545, \text{two-sided } t\text{-test})\) but sufficiently high to generate profits that are strictly positive in expectation \((p < 0.001)\). Consumers on average take out insurance in 52.7% of the cases, a number that is not significantly different from 50% \((p = 0.205, \text{two-sided } t\text{-test})\).

Insurers’ average expected profits are 4.59 and clearly positive whereas consumers expected earnings are on average 9.22. This is still somewhat better \((p < 0.001)\) than the expected earnings of 8 \((= (1 - 0.6) \times 20)\) consumers can expect to earn in case no insurance would be offered to protect against a potential loss of 20 that materializes with probability \( p = 0.6 \) but

\(^{30}\)p-values in this section are based on one-sided t-tests, unless stated otherwise.
the point of course is that the potential loss does not come down.

Figure 7 shows for all treatments the average market loss sizes and premiums over time and the average percentage of consumers that buys insurance in a given period. Panels (a) and (b) show that in MONOP-NI, average potential loss sizes and premiums settle fairly quickly around the values of 16 and 12, respectively. The average percentage of consumers buying insurance (panel (c)) continues to show considerable variation, which is indicative of insurer-subjects efforts to tweak the loss size/premium-combination such that they extract the maximal surplus from the consumers in their market. Figure 8 shows for each treatment the average per period profits and earnings insurers respectively consumers can expect given their choices and the objective loss probability $p = 0.6^{31}$ Panel 8a clearly shows that as the experiment progresses, insurer-subjects in MONOP-NI learn how to attain higher profits. Panel 8b shows that as a result, consumer earnings decrease over time.

For the example subjects in Figure 5, the squares denote the premium-loss size combinations that were actually offered to them by the insurer(s) in their market. Squares are solid (hollow) if the subject decided (not) to accept the offer. Larger squares correspond to later periods in the market stage. For the markets shown, the $(L, R)$-choices of the insurer in market #502 (panel e) clearly converge to the theoretical prediction of $(20, 14)$. This is less true for the choices of the insurers in markets #512 and #1212. The iso-profit curves for those markets show that this is because the consumer risk-preferences in those markets generate a rather flat profit function in $(L, R)$-space without a clear maximum $^{32}$ In general, insurer-subjects seem well able to find the profit maximizing combination of their two choice variables given the risk-preferences of the consumers in their market. This is a remarkable achievement, especially since they do not know the consumer-subjects with whom they form a group nor their risk-profile $^{33}$

5.2.2 Competitive Insurance and Non-Insurance Markets

For the duopoly markets, the hypotheses (see Table 2), state that independent of the initial loss size, the introduction of competition should reduce both the expected profits to zero; in the insurance market DUOP-I, premiums should also be zero in equilibrium (with all consumer-subjects preferring coverage over staying uninsured; in DUOP-NI we expect that insurers, in an attempt not to erode the market for insurance, will continue to set the loss size (and thereby

---

31 By considering ex ante expected outcomes instead of ex post realizations, the plots ignore the noise caused by the idiosyncratic draws of nature that influence the actual outcomes subjects experience.

32 See the online Appendix.

33 Levitt (2006) shows that real-life firms have problems in selecting the profit-maximizing price.
(a) The average potential loss size uninsured consumers face.

(b) Average premium set by insurers.

(c) Average percentage of all consumers that decide to buy insurance.

Figure 7: Per period average market stage outcomes for MONOP-NI (triangles) and DUOP-NI (circles) and DUOP-I (squares).

The dashed lines depict the mean ± two standard error confidence intervals. The loss size for the uninsured is always 20 in DUOP-I and therefore not shown in panel (a).
Figure 8: Per period average expected insurer profits and consumer earnings for MONOP-NI (triangles) and DUOP-NI (circles) and DUOP-I (squares).

The expected profits and earnings are calculated assuming that consumers (insured and uninsured) experience a loss with probability $p = 0.6$. 
the premium) strictly above zero. That is, they will primarily compete in premiums but less in loss sizes.

**Duop-NI** Figure 7 shows that when compared to Monop-NI, the introduction of competition leads to significantly lower loss sizes and premiums (see also Table 4). Table 4 and Figure 8 also show that, in line with our hypothesis, insurers are not able to make positive profits in this market ($p = 0.681$ for the final 15 periods). Figure 8 shows that in time, insurer-subjects learn how to break-even in these markets. Compared to the non-insurance monopoly market, consumers significantly benefit from insurer competition with average expected earnings increasing from about 9 to more than 15.

However, despite competition, the market remains an insurance market: the loss size the uninsured face does not drop to 0 but remains at a significantly higher value of 7.71 ($p < 0.001$). That is, as predicted, competition moves the contingent claim for the insured in Figure 1 from point $M_L$ to $C_S$ while the uninsured face contingent claim $B$. Importantly, both insured and uninsured consumers are worse off than when they faced the initial state claim $D$.

**Duop-I** In the competitive insurance market Duop-I, uninsured consumers continue to face a loss size of 20 (contingent claim $A$ in Figure 1). Our hypotheses state that insurer-competition will lead insurers to transfer all advantages of negotiated discounts to their consumers by lowering the premiums up to the point where both premiums and the losses to be recouped by insurers are 0 (point $D$); in equilibrium, all consumers will prefer to buy insurance.

Table 4 and Figure 7c show that throughout, over 95% of all consumer-subjects chooses to buy insurance. This insurance market is a real boon to the insurer-subjects because they quickly learn to set the value of the loss that they have to recoup to zero while, despite competition, they are still able to charge significantly positive premiums of on average 3.54 in the final fifteen periods ($p < 0.001$). Although the premiums do not converge to zero, at the 10%-level they are significantly lower than in the non-insurance markets Duop-NI ($p = 0.083$). This difference can be attributed to the threat the insurers face in the non-insurance markets Duop-NI that pushing the loss sizes too low will erode their market. For this reason, they refrain from ‘negotiating’ as fiercely as in treatment Duop-I. Figure 8b suggests that expected consumer earnings are on

---

34 As one insurer-subject explained in the post-experiment survey [translated from Dutch]: “Because I determined the loss size, I tried to lower this in exchange for a higher premium (such that both I and the consumers would be better off as long as they continued to pay the premium). However, this did not succeed. The temptation for the others not to insure proved too great.”
average even a bit higher in the competitive insurance market with initial loss size \( L_0 = 20 \) but this difference is statistically insignificant.

In sum, in case the potential loss to the uninsured is 20, consumers are clearly better off when there is a competitive market for insurance: the insurers (who have all the bargaining power) negotiate great deals with the service supplier and transfer part of this advantage to their insurees in the form of lower insurance premiums. Our results thus show that for high risks (expensive services), having a competitive insurance market with the insurers having bargaining power increases consumer welfare. On the other hand, our evidence shows that in markets that are non-insurance markets by nature, the introduction of competition between insurers does not push premiums and loss sizes back to the initial state: consumer earnings are similar in the competitive non-insurance and insurance markets; in the non-insurance markets, they end up paying even slightly higher premiums to receive coverage.\(^{35}\) Figure 8a contains an important policy implication: from the observation that insurers in a market do not make profits, one should not conclude that competition forces insurers to do all they can to offer insurance at the lowest possible prices.

6 Further checks

In this section, we report some additional analysis on the data that serves as a further check on our results. First, in Section 6.1 we address whether the choices made by consumer-subjects in the risk-elicitation stage are indicative of their behavior in the subsequent market stage. Then, as a check on the external validity of our findings, we investigate in Section 6.2 how the consumer-subjects’ elicited risk attitudes relate to insurance purchases they make in every-day life. We collected information on this in an ex post survey. Finally, Section 6.3 considers for insurer-subjects whether there is a relation between their risk-attitudes and the offers made in the market stage.

6.1 Consistency Risk Elicitation and Market Stage

Do risk-preferences elicited in the laboratory adequately capture the behavior of an individual in choices under uncertainty outside the lab? The stability of risk preferences across decision

\(^{35}\)In our design, insurers do not incur any additional cost when removing supplier loss size. Given that insurers do not make profits in the competitive non-insurance markets, it is conceivable that introduction of a cost that is monotonically increasing in the reduction of the loss size would only exacerbate the differences between insurance and non-insurance markets.
contexts is an important and mostly open research question\textsuperscript{36} We zoom in on one particular element of this question: Do subjects exhibit the same attitude towards risk when they are put in a strategic market context instead of an individual risk elicitation task? We answer this question by consider the consistency between the stage I and II choices of consumer-subjects.

The first part of Table 5 contains the results for risk elicitation stage. This stage is identical for all treatments such that it is only natural that the average value of the individual risk preference estimates $\hat{\gamma}_i$ is very similar. We use these estimated $\hat{\gamma}_i$’s to back out for each consumer-subject $i$ the average difference in the certainty equivalent ($\Delta CE$) between option A and B that he or she is confronted with in Stage I. The mean of these values is reported in Table 5, as is the number of choices between option A and B that is correctly predicted when individual $i$’s risk preferences are represented by utility function (3) with $\gamma = \hat{\gamma}_i$. Given that the estimated $\gamma_i$’s are similar across treatments and that subjects face the same choice problems, it is not surprising to find that the mean $\Delta CE$ value and the success rate of the (in-sample) predictions is very similar across treatments with the estimated utility model predicting on average 84% of all choices correctly.

In the market stage, the options A and B are endogenously set by the insurer-subjects. This results in the options consumer-subjects face being less extreme than in the risk elicitation stage. For example, an insurer-subject has no interest offering insurance against a potential loss of 20 at a premium of 2. This is also manifest in Figure 5: the offers of insurers tend to be centered along the risk-neutral line. This implies that one cannot simply do a between-treatment comparison of the success rate of the realized (out-of-sample) predictions for the market stage. For this variable, Table 5 indeed reveals large differences: from 65.2% in MONOP-NI to 95.3% in DUOP-I. The high number in DUOP-I is caused by the presence of the clearly unattractive option of staying uninsured (and facing a potential loss of 20) in the latter treatment. This leads to a large $\Delta CE$ in evaluating the options and a correspondingly low chance that a subject makes a ‘mistake’. As $\Delta CE$ becomes smaller, the likelihood of the ‘mistake’ of choosing the less preferred option grows. The small market stage $\Delta CE$’s in MONOP-NI and DUOP-NI are indicative of insurer-subjects manoeuvring the premium-loss size combination into a region where consumer-subjects become close to indifferent between whether or not to buy insurance.

For this reason, we correct as follows for between-treatment differences in the $\Delta CE$ values of the options available to consumers. Conditional on the estimated $\gamma_i$’s and $\tau$’s and given the

\textsuperscript{36}See the recent survey by Barseghyan et al. (2015) and the references therein.
Table 5: Choices by consumer subjects in the risk elicitation and market stage ($p = 0.6$).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>MONOP-NI</th>
<th>DUOP-NI</th>
<th>DUOP-I</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Risk Elicitation Stage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean $\Delta CE$</td>
<td>3.837</td>
<td>3.878</td>
<td>3.879</td>
</tr>
<tr>
<td>mean $\hat{\gamma}$</td>
<td>0.081</td>
<td>0.083</td>
<td>0.095</td>
</tr>
<tr>
<td>correct decisions</td>
<td>84.1%</td>
<td>83.9%</td>
<td>84.7%</td>
</tr>
<tr>
<td>II. Market Stage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean $\Delta CE$</td>
<td>1.550</td>
<td>1.165</td>
<td>11.296</td>
</tr>
<tr>
<td>correct decisions (predicted)</td>
<td>73.4%</td>
<td>69.1%</td>
<td>99.1%</td>
</tr>
<tr>
<td>correct decisions (realized)</td>
<td>65.2%</td>
<td>72.3%</td>
<td>95.3%</td>
</tr>
<tr>
<td>Difference (in perc. points)</td>
<td>-8.2</td>
<td>3.2</td>
<td>-3.8</td>
</tr>
</tbody>
</table>

Incorrect predictions

<table>
<thead>
<tr>
<th></th>
<th>insured</th>
<th></th>
<th>uninsured</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>45.53%</td>
<td>28.16%</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>54.47%</td>
<td>71.84%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

| | # incorrect predictions | 574 | 309 | 64 |
| | fraction incorrect predictions | 0.348 | 0.258 | 0.047 |
| | obs. | 55 | 40 | 45 |

value $\Delta CE_{ij}$ of each offer $j$ posed to subject $i$, we use (9) to calculate the probability that the subject does not make a mistake. We then take for each consumer-subject the average of these probabilities. Averaging over all consumers in a given treatment then gives us the predicted number of correct decisions that takes into account between-treatment differences in the offers consumers face. Table 5 shows that the predicted and actual percentage of correct decisions are relatively close in the duopoly treatments. For MONOP-NI, the table reveals an overprediction of correct decisions. That is, given their choices in the first stage and the offers they face in the market stage, consumer-subjects seem to make more inconsistent choices than can be accounted for by random mistakes only.

While the difference between the predicted and realized number of correct decisions tells us how well the risk preferences in the first stage predict the actual behavior of consumer-subjects in the market stage, it is not informative about the direction of any bias. To investigate whether people behave more or less risk-averse when put in a market context, we next consider whether the estimated $\gamma_i$’s over- or under-predict the demand for insurance in the market stage. To this end, we plot in Figure 9 for each treatment separately the market stage decisions that are inconsistent with the individual risk preferences estimated in Stage I. Panel 9c, for example shows that for DUOP-I the total number of incorrect predictions is very small, they are all in the same
direction: consumer-subjects do not buy insurance in choice-situations where they should have given their estimated risk preferences. In other words, they sometimes behave less risk-averse in this particular market context. Also for the other competitive treatment DUOP-NI, 71.8% of all incorrect predictions predict that subjects should have bought insurance whereas in practice they decided to go insured. Figure [9b] reveals that in many of these cases, consumer-subject rejected offers that were actuarially more than fair. In MONOP-NI, the incorrect predictions are rather evenly split between predicting buying insurance when the subject did not and vice versa. Figure [9a] also does not reveal a bias in a particular direction.

The main take away is that the elicited risk attitudes predict a consumer’s insurance choices in a market context reasonably well but that they exhibit some inclination to make less averse choices when the insurance market is competitive. Possibly this is caused by the expectation that in a competitive environment playing hard to get is more likely to pay off in the form of receiving more favorable offers in future periods.

6.2 Consumer-subjects: Insurance purchases outside the lab

In the short survey administered at the end of the experiment we asked participants whether they were insured against a number of common risks. Our list included comprehensive travel insurance, cancelation insurance, prolonged warranty insurance, dental insurance and personal possessions insurance. Table 6 shows the prevalence of these insurances in our sample. About two-thirds of all subjects indicate to own a Permanent Travel Insurance and Dental Insurance, which makes these the most commonly owned insurance policies in our sample.

To see whether the estimated risk preferences reflect an individual’s subject’s propensity to buy any of the insurances listed in Table 6, Table 7 reports the estimates of a regression of the $\hat{\gamma}_i$’s on dummy variables for owning any of these. The results show that the insurance dummies are jointly insignificant. At first sight, the absence of a risk-coverage correlation may be surprising but it isn’t once one realizes that equilibrium insurance premiums are influenced by a myriad of other factors including adverse selection (Chiappori and Salanié, 2014).

A final issue to consider is whether the insurance policies participants buy outside the lab have, next to the $\gamma_i$’s estimated in the first stage, any predictive value in predicting subject’s insurance choices in the market stage of the experiment. To this end, Table 8 reports for each

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37 The answer categories are “YES”, “NO” and (for the cancellation and prolonged warranty insurance) “SOMETIMES”. We coded “YES” as 1, “NO” as 0 and “SOMETIMES” as 0.5.

38 Cohen and Siegelmann (2010, p. 62) notice that “A risk-coverage correlation appears to be a feature of some insurance markets or pools of insurance policies but not of others.” See also Ericson et al. (2015).
Figure 9: Stage II insurance choices inconsistent with estimated Stage I risk preferences.
Table 6: Insurances owned by subjects (standard deviations within parentheses).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>MONOP-NI</th>
<th>DUOP-NI</th>
<th>DUOP-I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent Travel Insurance</td>
<td>0.677</td>
<td>0.679</td>
<td>0.769</td>
</tr>
<tr>
<td></td>
<td>(0.471)</td>
<td>(0.471)</td>
<td>(0.425)</td>
</tr>
<tr>
<td>obs.</td>
<td>62</td>
<td>53</td>
<td>52</td>
</tr>
<tr>
<td>Cancellation Insurance</td>
<td>0.274</td>
<td>0.208</td>
<td>0.365</td>
</tr>
<tr>
<td></td>
<td>(0.370)</td>
<td>(0.285)</td>
<td>(0.455)</td>
</tr>
<tr>
<td>obs.</td>
<td>62</td>
<td>53</td>
<td>52</td>
</tr>
<tr>
<td>Prolonged Warranty Insurance</td>
<td>0.153</td>
<td>0.123</td>
<td>0.115</td>
</tr>
<tr>
<td></td>
<td>(0.308)</td>
<td>(0.276)</td>
<td>(0.291)</td>
</tr>
<tr>
<td>obs.</td>
<td>62</td>
<td>53</td>
<td>52</td>
</tr>
<tr>
<td>Dental Insurance</td>
<td>0.774</td>
<td>0.630</td>
<td>0.667</td>
</tr>
<tr>
<td></td>
<td>(0.422)</td>
<td>(0.487)</td>
<td>(0.476)</td>
</tr>
<tr>
<td>obs.</td>
<td>62</td>
<td>54</td>
<td>51</td>
</tr>
<tr>
<td>Personal Possessions Insurance</td>
<td>0.071</td>
<td>0.106</td>
<td>0.133</td>
</tr>
<tr>
<td></td>
<td>(0.260)</td>
<td>(0.312)</td>
<td>(0.344)</td>
</tr>
<tr>
<td>obs.</td>
<td>56</td>
<td>47</td>
<td>45</td>
</tr>
</tbody>
</table>

treatment the results of a probit regression of a dummy variable indicating whether insurance was bought in the market stage on a number of explanatory variables. As expected, the probability of buying insurance is positively correlated with an individual’s degree of risk aversion, negatively correlated with the premium one needs to pay for the insurance and positively dependent on the potential loss faced when uninsured. In Duop-I, the dummy variables on insurances owned are statistically significant at the 5% level. However, from the sign of the individual coefficients, no clear picture emerges about how, next to knowing a person’s risk attitudes as represented by $\hat{\gamma}_i$, a consideration of an individual’s actual purchases informs the experimenter about the subject’s choices in the market stage.

6.3 Insurer-subjects: Risk attitudes and offers

One motivation for our introduction of the payoff structure where we pay insurer-subjects in the market stage 10% of their accumulated profits is that this may induce them to behave more risk-neutral because it reduces the impact of individual random draws (determining the loss of an insured consumer) on their final earnings. To see whether this approach has been successful, Figure 10 plots for each experimental market the average minimum premium at which insurance was offered against the estimated individual risk-preference parameter of the insurer-subjects in that market. In DUOP-I, the minimum market premium however seems to be negatively related

[Footnote: In Duop-I the estimated relations are less clear-cut due to the high overall (> 95%) take-up rate.]
Table 7: Relation Stage I risk preferences and outside lab insurance choices.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>$\hat{\gamma}_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent Travel Insurance</td>
<td>0.043* (0.025)</td>
</tr>
<tr>
<td>Dental Insurance</td>
<td>0.01 (0.024)</td>
</tr>
<tr>
<td>Cancellation Insurance</td>
<td>-0.044 (0.032)</td>
</tr>
<tr>
<td>Prolonged Warranty Insurance</td>
<td>-0.02 (0.045)</td>
</tr>
<tr>
<td>Personal Possessions Insurance</td>
<td>0.017 (0.041)</td>
</tr>
<tr>
<td>constant</td>
<td>0.082***</td>
</tr>
</tbody>
</table>

$Probability F test$

| insurance dummies                | 0.439             |  
| $R^2$                            | 0.033             |  
| obs.                             | 148               |  

to the private risk preferences of the insurers offering the premium. A simple regression confirms this ($\beta = -12.96; p = 0.011; n = 18$). A somewhat similar tendency is observed in MONOP-NI ($\beta = -12.31; p = 0.237; n = 11$) but not in DUOP-NI ($\beta = -0.42; p = 0.679; n = 16$).

We established (Figure 8a) that selling insurance in MONOP-NI and DUOP-I is far more profitable than in DUOP-NI. For this reason, one possible reading of the relation between market premiums and insurer risk preferences shown in Figure 10 is that a higher degree of risk aversion is correlated with a higher eagerness/impatience to make a sale. So insurers in these treatments may not act fully independent of their private risk-preferences. For our experimental findings, this means that the minimum premiums reported in Table 4 may underestimate the equilibrium values that would obtain in a setting with risk-neutral insurers selecting the offers (as we expect actual insurance firms to do).

7 Summary and conclusions

The question how concentration in downstream markets enables buyers to effectively improve their bargaining position in price negotiations with service suppliers continues to be complex. This paper argues that this is especially true in markets where the buyers consist of insurance companies who negotiate on behalf of their customers. Existing empirical studies focus on the...
Table 8: Relation Stage II and outside lab insurance choices.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Monop-NI</th>
<th>DUOP-NI</th>
<th>DUOP-I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated risk preferences</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\hat{\gamma}_i$</td>
<td>1.611***</td>
<td>0.668**</td>
<td>0.019</td>
</tr>
<tr>
<td></td>
<td>(0.518)</td>
<td>(0.278)</td>
<td>(0.043)</td>
</tr>
<tr>
<td>Participant characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>female</td>
<td>0.246***</td>
<td>-0.088</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>(0.078)</td>
<td>(0.067)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>age</td>
<td>-0.075</td>
<td>-0.031</td>
<td>-0.052</td>
</tr>
<tr>
<td></td>
<td>(0.101)</td>
<td>(0.223)</td>
<td>(0.037)</td>
</tr>
<tr>
<td>age$^2$</td>
<td>0.002</td>
<td>0</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.005)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>minimum market premium</td>
<td>-0.102***</td>
<td>-0.309***</td>
<td>-0.005***</td>
</tr>
<tr>
<td></td>
<td>(0.031)</td>
<td>(0.035)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>potential loss uninsured</td>
<td>0.094***</td>
<td>0.209***</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.023)</td>
<td>(--)</td>
</tr>
<tr>
<td>Insurances owned</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel Risk Insurance</td>
<td>0.198*</td>
<td>0.168**</td>
<td>-0.008</td>
</tr>
<tr>
<td></td>
<td>(0.100)</td>
<td>(0.081)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>Dental Insurance</td>
<td>0.095</td>
<td>0.130*</td>
<td>-0.019***</td>
</tr>
<tr>
<td></td>
<td>(0.081)</td>
<td>(0.068)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>Cancellation Insurance</td>
<td>-0.065</td>
<td>-0.311**</td>
<td>0.019</td>
</tr>
<tr>
<td></td>
<td>(0.111)</td>
<td>(0.129)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>Extended Health Insurance</td>
<td>0.200</td>
<td>-0.166</td>
<td>-0.013</td>
</tr>
<tr>
<td></td>
<td>(0.132)</td>
<td>(0.142)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>Personal Possessions Insurance</td>
<td>0.077</td>
<td>-0.008</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>(0.116)</td>
<td>(0.116)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Probability F tests</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>insurance dummies</td>
<td>0.1681</td>
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Marginal effects reported; errors clustered at the subject level; standard errors in parentheses; ***(**/*) denotes significance at the 1% (5%/10%) level.

A relation between competition intensity in the up- and downstream market and the negotiated prices but mostly take the costs of the upstream firms as given. We emphasize that when insurers can use their bargaining power not only to arrive at better prices but also to influence the cost structure in upstream markets, this not necessarily leads to lower costs when lower costs imply that the uninsured face lower potential losses. Indeed, decreases in the potential loss reduces the demand for insurance by risk-averse consumers, posing a direct threat to the raison d’être of the insurer.

We use theory and empirical illustrations to convey how insurers might successfully apply
this mechanism in practice and we present experimental evidence showing that insurer-subjects in the lab routinely move away from the non-insurance outcome because they recognize the threat of potential losses that are too low for consumers to buy insurance. The introduction of insurer competition does not change this outcome although it does annihilate the insurers’ profits.

We believe that this research contains an important policy implication and an illustration of a common misconception. It is beyond doubt that insurances increase welfare by their risk-sharing properties in markets that we characterize as insurance markets. However, in granting insurers buyer-power as a counterweight to supplier market power, regulators should pay attention that insurers do not abuse this power to protect insurance markets or to create them in those realms of life that are non-insurance markets by nature. This may for example happen when their market power enables insurers to block the introduction of cost-saving technologies, the entry of cheaper suppliers or by stimulating service suppliers to bundle different services into a more expensive product.

In our experimental markets, insurer competition drives their profits to zero. However, our results also show that based on this statistic alone, one should not conclude that competition guarantees consumers the lowest possible prices because loss sizes are still far above the zero lower bound and even somewhat higher than in markets that are insurance markets by nature. Our findings suggest that competitive forces primarily induce insurers to decrease premiums to the actuarially fair rate for a given loss size but that they are wary to curb the loss sizes.
References


Ho, Kate and Robin S. Lee, “Insurer competition in health care markets,” NBER working paper no. 19401 September 2013.


A Appendix [FOR PUBLICATION]

B Proofs

B.1 Proof of Proposition 1

\[ \frac{dE[\pi(L)]}{dL} = d\left\{ W - U^{-1}[pU(W - L) + (1 - p)U(W)] - pL \right\} /dL \]

\[ = -d \left\{ U^{-1}[pU(W - L) + (1 - p)U(W)] \right\} /dL - p \]

\[ > -d \left\{ U^{-1}[U(p(W - L) + (1 - p)W)] \right\} /dL - p \]

\[ = -d \left\{ pW - pL + (1 - p)W \right\} /dL - p \]

\[ = 0. \quad \square \]

B.2 Proof of Proposition 2

In what follows, we assume risk-averse consumers have homogenous risk preferences such that we can normalize the number of consumers without loss of generality to \( n = 1 \). Besides the premium, consumers have to incur a transaction cost \( c \) when buying insurance such that they only buy insurance if the potential loss \( L \geq L(c) \).

\( L(0) = 0 \). We assume that the uninsured face a potential loss \( L \in [L(c), +\infty) \). The proof is in three steps.

a First, in equilibrium \( R_1 = R_2 \leq W - CE(L) \), i.e. both insurers must charge an identical premium. For suppose that, say, \( R_1 > R_2 > pL_2 \), then \( E[\pi_2] > 0 \) and \( E[\pi_1] = 0 \) because insurer 1 would not have any clients. Insurer 1 could strictly improve by setting \( R_1 = R_2 \) (and \( L_1 = L_2 \)) which would render insurer 1 half of market demand and expected profits \( E[\pi_1] = E[\pi_2]/2 > 0 \).

b Second, in equilibrium, the premium by both insurers has to satisfy \( R_i = pL_i \) for \( i = 1,2 \). That is, the expected profits \( E[\pi_i] \) equal zero for both insurers. For suppose that \( R_2 = R_1 > pL_1 \). Then, insurer 1 can strictly increase its expected profits by reducing the premium by an amount \( \epsilon \), with \( 0 < \epsilon < (R_1 - pL_1)/2 \). By undercutting his competitor, he no longer has to share the market and expected profits \( E[\pi_1] = E[\pi_2]/2 = (R_1 - \epsilon) - pL_1 > (R_1 - pL_1)/2 = E[\pi_1] \).

c Finally, we prove that in equilibrium \( L_1 = L_2 = 0 \), that is: independent of the loss \( L > L(c) \) faced by the uninsured, the insurers will reduce the cost they have to pay when one of their customers faces a loss to 0. From b), we know that \( L_1 = L_2 \). Now suppose that \( L_1 = L_2 = \tilde{L} > 0 \). Then there exists a value \( L^{new} \) with \( 0 < L^{new} < \tilde{L} \) such that if, say
insurer 1, sets \( L_1 = L^{\text{New}} \) and \( R(L^{\text{New}}) = W - CE(L^{\text{New}}) \), he will reap positive profits. Because \( R(L) \) is increasing in \( L \) and \( R(0) = 0 \), for \( L^{\text{New}} \) sufficiently small, \( R(L^{\text{New}}) < p\hat{L} \): all consumers prefer insurance by firm 1 to insurance by firm 2 or staying uninsured. □

### B.3 Numerical Example

#### B.3.1 Separate Evaluation Purchase and Insurance Decision

Consider the market described in Section 2. A monopolistic firm can supply two versions of a particular product, one with quality \( q_L \) and the other with quality \( q_H > q_L \). The constant marginal cost of supplying version \( i \in \{L, H\} \) is \( c_i \). Consumers differ in their taste for quality \( \theta \) with a fraction \( \lambda \) (the ‘high types’) having taste parameter \( \theta_H \) and the remaining fraction \( 1 - \lambda \) (the low types), \( \theta_L < \theta_H \). Consumers receive a surplus \( U = \theta q - x \) if they buy a product of quality \( q \) at price \( x \).

In what follows, we take the parameter values \( c_L = 0.10; c_H = 0.15; \theta_L = 0.3; \theta_H = 0.6; q_L = 0.6; q_H = 0.8; \lambda = 0.3; p = 0.3 \) and \( \gamma = 0.9 \). We consider three cases: 

a. **Only quality \( q_L \) is supplied** The supplier can decide to sell to both types of consumers, in which case he sets a price \( p^*_L = \theta_L q_L = 0.3 \cdot 0.6 = 0.18 \) and his profits equal \( \pi = \theta_L q_L - c_L = 0.18 - 0.08 = 0.10 \), or only to the high types at price \( p^*_L = \theta_H q_L = 0.36 \) giving profits \( \tilde{\pi} = (\theta_H q_L - c_H)\lambda = (0.36 - 0.15)0.3 = 0.078 \).

b. **Only quality \( q_H \) is supplied** If the supplier sells the high quality good to both consumers, he cannot charge more than \( p^*_H = \theta_L q_H = 0.24 \), leading to profits \( \pi = 0.09 \). In this case, it is more profitable to sell only to the high types at price \( p^*_H = \theta_H q_H = 0.48 \), giving profits \( \tilde{\pi} = 0.099 \).

c. **Both qualities are supplied** If both qualities are supplied, one needs to ensure that both types buy the good that is designed for them. The low quality product is priced at \( p^*_L = \theta_L q_L = 0.18 \). To induce the high types to buy the high quality product, the incentive compatibility constraint \( \theta_H q_H - p_H \geq \theta_H q_L - p_L \) needs to be satisfied. This holds for \( p^*_H = p^*_L + (q_H - q_L)\theta_H \), see Tirole (1988, p. 153), for the given parameter values \( p^*_H = 0.30 \) and \( \pi^*_LH = 0.7(0.18 - 0.10) + 0.3(0.30 - 0.15) = 0.101 \). This is highest profit that can be obtained such that in isolation, a
profit-maximizing supplier would decide to supply both goods.

**The insurance decision** Once the consumer has bought the good at price $x$, he faces a potential loss of $x$. Suppose that he is risk averse with CARA exponential utility function $u(w) = 1 - e^{-\gamma w}$ with $w$ denoting his wealth level and $\gamma$ the parameter of risk aversion. The inverse of this function is $u^{-1}(y) = -\ln (1 - y)/\gamma$. The insurance premium $R(x)$ for which

$$u(w - R(x)) = pu(w - x) + (1 - p)u(w).$$

is by definition the premium that makes this consumer indifferent between buying insurance and staying uninsured. For our utility specification, we can solve for $R(x)$:

$$R(x) = \ln 1 - p + pe^{\gamma x}/\gamma. \quad (B.1)$$

The insurer’s expected profits from selling one insurance policy to recoup the loss of $x$ at a premium $R(x)$ are

$$E[\pi_{INS}] = R(x) - px.$$

For the given parameters, the insurer’s total expected profits when both products are supplied are: $E[\pi_H^{INS}] = (1 - \lambda)(R(p_L) - p\cdot p_L) + \lambda(R(p_H) - p\cdot p_H) = 0.7(0.057 - 0.3\cdot 0.18) + 0.3(0.099 - 0.3\cdot 0.3) \approx 0.0048$. However, the insurer attains higher expected profits when only the high quality is supplied to the high types. Then, $E[\pi_H^{INS}] = \lambda(R(p_H) - p\cdot p_H) = 0.3(0.167 - 0.3\cdot 0.48) \approx 0.0069$.

In order words, the insurer has an incentive to press the supplier to stop offering the low quality product. Moreover, in the case at hand, with 0.10588 the joint profits of the supplier and insurer when only the high quality product is offered are higher than the combined profits of 0.10583 when both products are supplied. This implies that the insurer can reimburse the supplier for any profits lost from not supplying the low quality version and still benefit.

**B.3.2 Simultaneous Evaluation Purchase and Insurance Decision**

Now consider the case where the consumer does not separate the purchase and insurance decision. That is, at the time of purchase he is aware that buying the product involves a risk which entails that now or at some future moment he will buy insurance against this risk. This implies that his willingness to pay for the product reduces to $x$ defined by the implicit function $x = \theta q - R(x)$. An approximate solution for $x$ can be obtained by using (B.1), take exponentials of the left- and right-hand side and use a second-order Taylor approximation for the exponential functions in
the resulting equation. The approximate solution $x^* = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$, with $a = \gamma^2(1 - p)$; $b = -\gamma(1 + p + 2\gamma q)$, and $c = \gamma q(1 + \gamma q)$.

In this case and for the given parameter values, the insurer’s expected profits are still higher when only the high quality product is supplied but offering both products maximizes the combined profits of the insurer and supplier.
## C Additional Tables and Figures

### Table C.1: Sessions summary

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Total # of markets: | 60 | 12 | 10 | 10 | 11 | 9 | 8 |
Total # of subjects: | 377 | 72 | 60 | 60 | 66 | 63 | 56 |

In the sessions with fixed loss sizes, the following orders were implemented in the periods [1 − 15]/[16 − 30]:
Session 1: 16/4, 4/16, 8/20; Session 2: 12/20, 20/12, 12/4; Session 3: 12/20, 20/12, 12/4;
Session 8: 4/16, 8/20; Session 9: 4/16, 4/12, 12/4, 12/20, 20/12;
Session 10: 8/20, 12/4, 12/20, 4/12.
Figure C.1: Distribution of estimated risk aversion parameters $\gamma$ (All sessions).