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Leaving the market or reducing the coverage?

Anne Corcos[*] *François Pannequin*[†], *Claude Montmarquette*[‡]

Résumé/abstract

This study develops an experimental analysis addressing the premium sensitivity of the demand for insurance accounting for risk attitudes, including risk-loving. Our contribution disentangles the conditional demand (the non-null demand for insurance) from the propensity to buy insurance. Our research shows that the contraction of the global demand for insurance induced by the raise in unit prices and fixed cost is primarily due to policyholders exiting the insurance market rather than reducing their levels of coverage. However, contrary to the theoretical predictions, an increase in the fixed cost has effects only on the risk lovers' behavior. The stability of the conditional demand is robust to changes in insurance contracts and individuals'risk attitude. These results suggest that the decision about insurance may boil down to an "all or nothing" choice.

In line with the theory, risk lovers express a lower global demand for insurance than risk-averse subjects and are the first to leave the insurance market when the premium (unit price or fixed cost) is prohibitive.

Implications regarding public and economic policies are discussed. As a by-product, our experimental design enables to test and reject the assumption of inferiority of the risk averters' demand for insurance.

Mots clés/keywords : demand for insurance, conditional demand, propensity to buy insurance, risk attitude, two-part tariff, experimental study

Codes JEL/JEL Codes : C91, D81

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Introduction

Managing deficits in the insurance industries, as in the public health sector, raises strategic, and public policy issues. Increasing insurance premiums could be a way to cope with these deficits assuming a low elasticity of the demand. However, one could also expect that an increase in premium might result in a sharp decrease in the demand for insurance. This reduction in the global demand could spring from two different effects: a contraction effect, generated by a fall in the conditional demand for insurance (the level of insurance coverage for individuals who keep buying insurance) and an exit effect due to the propensity to leave the insurance market after a raise.

Identifying what situation will eventually occur is an important issue for political authorities. From a macroeconomic perspective, although both effects should theoretically result in a reduction of the deficits, an exit effect also generates negative externalities likely to burden the public finance. Indeed, the growing number of uninsured people will have to be supported ultimately by the whole community.

The government's responsibility is to promote the fluidity of the insurance markets to facilitate competition among insurers. If consumers are locked into their contracts (namely if price increases do not result in an exit effect promoting competition among insurers), the government's duty is to legislate to remove exit barriers and other mechanisms set up by insurers to keep their policyholders captive (e.g., deadlines and cancellation).

Insurers' policies are also "effect-dependent". When insurers decide to increase insurance premiums, they are confronted with an exit effect, resulting in higher costs to find new customers, whereas a contraction effect of the conditional demand induces insurers to differentiate their products to prevent customers from lowering their level of coverage.

Our model-based-experimental protocol studies the sensitivity of the demand for insurance on various contractual parameters of insurance. Our approach is twofold. First, we investigate how the contraction effect and the exit effect interplay after a raise in insurance premium by distinguishing the likelihood to buy insurance from the demand for insurance of those who buy insurance (the conditional demand). Second, we take account of the individuals' risk attitude, including the risk-loving participants.

Many studies on the demand for insurance have been carried out based on real or experimental data. For example, Phelps (1973) estimated the demand for health insurance, Richards (2000) studied the crop insurance, Esho *et al.* (2004) confirmed the effect of risk aversion on the demand for property insurance. However, no study distinguishes between the two components of the insurance demand.

Initial laboratory studies related to insurance had more in common with surveys than with experiments. Jaspersen (2015) in his extensive review on insurance demand distinguishes between hypothetical surveys and experimental studies of insurance demand: only 45 of the 95 articles reviewed were about experimental studies. For example, Slovic *et al.* (1977), Schoemaker and Kunreuther (1979), and Hershey and Schoemaker (1980) focused on the basics of insurance demand but relied on questionnaires. What characterizes those experiments is the simplicity of the contractual mechanisms: the unit price of insurance is actuarial, and the offered quantity of insurance is nil or full. None of these studies has focused on the interplay between the propensity to buy insurance and the conditional demand when contractual parameters vary. Nor do they address the issue of the exit effect even if it is highly relevant in this context.

A major weakness of experimental and empirical studies of insurance demand lies in the treatment of risk aversion which is deducted from observed insurance choice (Cohen and Einav, 2007) or is approximated using a correlated variable such as education or cultural indicator to risk aversion (Esho *et al.*, 2004). Very few experimental studies use a neutral measure of risk aversion, and when they do, as in Kunreuther and Michel-Kerjan (2013), the measure is implemented in the gain domain which is not insurance-domain relevant. Furthermore, risk lovers's behavior has never been given a particular attention for both theoretical and empirical reasons. Risk lovers are not expected to buy insurance unless the insurance premium is at an unrealistic less-than-actuarial rate, endangering the financial condition of insurers. Moreover, risk lovers are supposed to account for only a small proportion of the population. However, since Kahneman and Tversky (1979), we know that if individuals are risk averters in the gain domain, they are prone to be risk lovers in the loss domain, which is the insurance domain. Therefore, the insurance behavior of risk lovers deserves to be scrutinized.

Our paper fills these gaps. We develop a theoretical model of demand for insurance that we then test experimentally. Our analytical approach breaks down the global demand into the propensity to buy insurance, and the amount of coverage demanded (the conditional demand). Disentangling the exit effect from the contraction effect leads to a deeper comprehension of insurance demand. We distinguish risk-loving and risk-averse individuals from both a theoretical and an experimental point of view: we classify individuals based on their attitude toward risk (loving or averse) in the domain of losses using an adapted-Holt-and-Laury-measure.

The theoretical model and its experimental counterpart refer to a two-part premium structure that includes a fixed cost and a unit price for insurance.[1]

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[1] This mechanism appears highly relevant to the insurance industry. Insurance is conditioned by a large variety of fixed administrative expenses (marketing costs, price formation, fees for administration and audit) that need to be paid regardless of the level of

In many countries, health insurance involves a mandatory contribution that is complemented by a user fee. For the policyholders, this amounts to paying a fixed cost that is then adjusted to reflect how much of the medical services are consumed. This premium structure makes it possible to test the impact of a change in unit price as well as a change in wealth, through the effect of the cost-fixed component. This factor accounts for a tax on individuals' wealth when they buy insurance, allowing to address, as a by-product, the inferiority of the insurance issue raised by Mossin (1968).

The empirical analysis of the data comforts our theoretical predictions: if an increase in the unit price or the fixed cost induces a contraction of the global demand for insurance, this contraction is primarily due to an exit of the insurance market. The amount of coverage of those who stay remains unchanged. Besides, in compliance with our theoretical model, our risk-loving subjects express a global demand for insurance lower than those who are risk-averse, and they are the first to leave the insurance market when they feel the price (unit price or fixed cost) becomes prohibitive. However, individuals who buy insurance require the same level of coverage, regardless of their risk attitude.

Overall, the risk-loving participants buy more insurance than the theory predicts. Our experiment highlights a very specific risk-loving behavior that shows that risk lovers adopt a gambling behavior, buying insurance sporadically, without consideration for parameters such as insurance premium or previous accident occurrence.

The remaining of the paper is organized as follows. Section 2 presents the theoretical model of insurance demand with a two-part premium structure. It emphasizes the consequences of attitudes toward risk - risk-averse or risk-loving - and yields a series of predictions to be tested experimentally. Section 3 describes the two stages of the model-based-experimental design: measuring attitude toward risk and eliciting the insurance demand at the individual level. Section 4 presents the experimental results and shows in what fashion both the contractual parameters (unit price and fixed cost) and the attitude towards risk shape the insurance demand behavior. That section is mainly based on non-parametric analyses. Section 5 presents the results referring to an econometric model of the insurance demand in accordance with the theoretical model. Section 6 concludes with a discussion regarding the consequences of our experimental findings, regarding both the validity of the theoretical predictions and the contractual policies.

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coverage while this latter element is associated with a unit price that varies with the amount purchased. As a rule, insurers estimate, for each category of policyholders, a pure premium reflecting their risk exposure. A loading is applied to this actuarial premium to cover management costs, taxes and so on, but some administrative costs are charged as pure fixed costs. In real life, policyholders may not know the ins and outs of the sharing between the fixed and variable components of the insurance premium. But this pricing is common to a large number of fields, including insurance.

1. The Theory of Insurance Demand

Using a more general insurance pricing scheme that includes a fixed and a variable component, we develop explicitly, both for risk averters and risk lovers, the theoretical expectation of Mossin's (1968) canonical insurance demand model where over-insurance is forbidden to fit with our experimental setting. Likewise, in our experiment the insurance coverage is voluntarily chosen by the decision-maker, however, interior and corner solutions need to be distinguished.

1.1 Insurance demand with a two-part premium structure

Consider an expected-utility-maximizer agent with an original level of wealth W_0, subject to a risk of losing an amount x with a probability q. In exchange for an insurance premium $P = pI + C$, she receives a compensation amounting to I in the event of an accident, where p represents the unit price of insurance, I the indemnity, and C a fixed cost. We assume that $0 \leq I \leq x$, precluding over-insurance.

Final wealth, where W_1 is the wealth in case of no accident and W_2 the wealth in the event of an accident, is given by:

$$\begin{cases} W_1 = W_0 - pI - C \\ W_2 = W_0 - pI - C - x + I \end{cases}$$

We examine the insurance decisions of this agent as a function of her attitude towards risk. Her preferences are represented by a concave or convex utility function U(W), and she maximizes the following expected utility:

$$\begin{aligned} EU(I) &= (1-q)U(W_1) + q\,U(W_2) \\ &= (1-q)\,U(W_0 - pI - C) + q\,U(W_0 - pI - C - x + I) \end{aligned}$$

The theoretical model provides the necessary conditions for this agent to buy insurance and, if she does, to find her optimal level of insurance coverage. The agent will opt for insurance if her welfare with an insurance contract is greater than her welfare without, as expressed by the following participation condition (PC), where $EU(0) = (1-q)\,U(W_0) + q\,U(W_0 - x)$ represents the expected utility in the absence of insurance:

$$EU(I) \geq EU(0)$$

$$\Leftrightarrow (1-q)U(W_0 - pI - C) + q\,U(W_0 - pI - C - x + I) \geq EU(0) \qquad (PC)$$

1.1.1 For a risk averter (RA), characterized by a concave utility function, if condition (PC) is satisfied, the optimal level of coverage (interior solution) is given by the following first-order condition (FOC):

$$\frac{\partial EU}{\partial I} = -p(1-q)U'(W_1) + (1-p)qU'(W_2) = 0 \qquad (1)$$

Under the assumption of risk aversion, marginal utility is decreasing, and the following second-order condition is satisfied:

$$\frac{\partial^2 EU}{\partial I^2} = p^2(1-q)U''(W_1) + (1-p)^2\, qU''(W_2) < 0 \tag{2}$$

Then, theoretical predictions are easily derived from the FOC:

- When the unit price of insurance is actuarial ($p = q$), the optimal choice for the individual is to buy a complete coverage ($I^* = x$). Individual welfare is therefore given by $EU = U(W_0 - qx - C)$.
- When the unit price of insurance is less than actuarial ($p < q$), the decision maker prefers to be over-insured.
- When the unit price of insurance is higher than actuarial ($p>q$), the decision maker opts for partial insurance coverage, and the highest level of welfare, at any given fixed cost, is lower than in the case of an actuarial price.[2]

Comparative Statics:

We focus on the effects of the contractual parameters (p and C) on *I*. By Mossin (1968), when risk aversion is decreasing in wealth W_0 (with $I > 0$ and $p>q$)[3] an increase in W_0 makes the demand for insurance of risk-averse individual fall[4] and insurance is an inferior good. Under this DARA assumption (decreasing absolute risk aversion), given a two-part tariff, a reduction in the fixed cost component causes a reduction in the demand for insurance and $\frac{dI}{dC} \geq 0$. The demonstration of this result is identical to that of Mossin, provided that the fixed cost is viewed as an element subtracted from the initial wealth.

Note that, with a less-than-actuarial unit price of insurance, the policyholder would be over-insured ($I>x$) and the inequality would be reversed: $\frac{dI}{dC} \leq 0$;.but if over-insurance is forbidden, then full insurance remains the best constrained choice even when C increases.

Besides, as shown in Eeckhoudt *et al.* (2005), if insurance is an inferior good, the price effect will be ambiguous: an increase in the unit price of insurance will have a negative substitution effect and a positive wealth effect; it results in an ambiguous final effect.[5]

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[2] Since $p > q$, the FOC implies that $U'(W_1) < U'(W_2)$. It follows that $W_1 > W_2$ and $I < x$.

[3] In this optimization problem, optimal insurance demand *I* is an implicit function of the parameters (W_0, p, C, q). Differentiating the 1st order condition, denoted $H(I) = \frac{\partial EU}{\partial I} = 0$, we get: $\frac{dI}{dC} = -\frac{\partial H}{\partial C} / \frac{\partial H}{\partial I}$. As $\frac{\partial H}{\partial I} = \frac{\partial^2 EU}{\partial I^2} < 0$, the sign of this impact is determined by the sign of $\frac{\partial H}{\partial C} = p(1-q)U''(W_1) - (1-p)qU''(W_2)$, which finally depends on the difference between the 2 coefficients of absolute risk aversion, evaluated respectively for W_1 and W_2: $-A(W_1) + A(W_2)$ where $A(W) = -U''(W)/U'(W)$.

[4] When wealth increases, aversion to any given risk decreases. The marginal benefit of insurance declines with wealth. So does the demand for insurance.

[5] Relying on the 1st order condition, the impact of a change in p is given by: $\frac{dI}{dp} = -\frac{\partial H}{\partial p} / \frac{\partial H}{\partial I}$. Again, since $\frac{\partial H}{\partial I} < 0$, we find that the sign of $\frac{dI}{dp}$ depends on the sign of $\frac{\partial H}{\partial p}$. We find

With a constant absolute risk aversion (CARA), the fixed cost has no impact on the indemnity's size and its only effect is to potentially reduce the propensity to buy insurance. In this case, the comparative statics of a price change is clear: insurance demand decreases with p. More generally, if insurance is a normal good (i.e. if the utility function is either CARA or IARA, increasing absolute risk aversion), substitution and wealth effects will reinforce each other, and an increase in the unit price, p, will reduce the demand for insurance.

Corner solutions (or the exit condition):

We focus now on the conditions under which the individual prefers not to be insured. As EU is strictly concave, the 1st order condition evaluated at I=0 ((1a) below) provides a condition for an individual to participate in the insurance market:

$$\left.\frac{\partial EU}{\partial I}\right|_{I=0} = -p(1-q)U'(W_0 - C) + (1-p)qU'(W_0 - x - C) \geq 0 \qquad \text{(1a)}$$

While condition (PC) is a sufficient condition for an optimal insurance contract to be bought, condition (1a) is a necessary condition to observe at least a positive amount of insurance.

When expression (1a) is negative, the marginal cost of the 1st unit of insurance is higher than its marginal benefit and p exceeds a certain threshold (p>t).[6] At point I=0, the strictly concave EU function is decreasing (see figure 1) and increasing insurance coverage from that point would reduce the individual's welfare so $EU(I > 0) < EU(0)$. If condition (1a) is not checked, the participation constraint is not met either.

From conditions (PC) and (1a), it results that the likelihood of insurance participation decreases with p since, in both cases, the left-hand side term of the inequality is decreasing in p.

$\frac{\partial H}{\partial p} = -EU' + I\frac{\partial H}{\partial C}$, where $EU' = (1-q)U'(W_1) + qU'(W_2)$. The 1st term corresponds to a negative substitution effect; the 2nd term is the wealth effect previously identified.

[6] Where t = q u'(W_0-x-C) / EU(0).

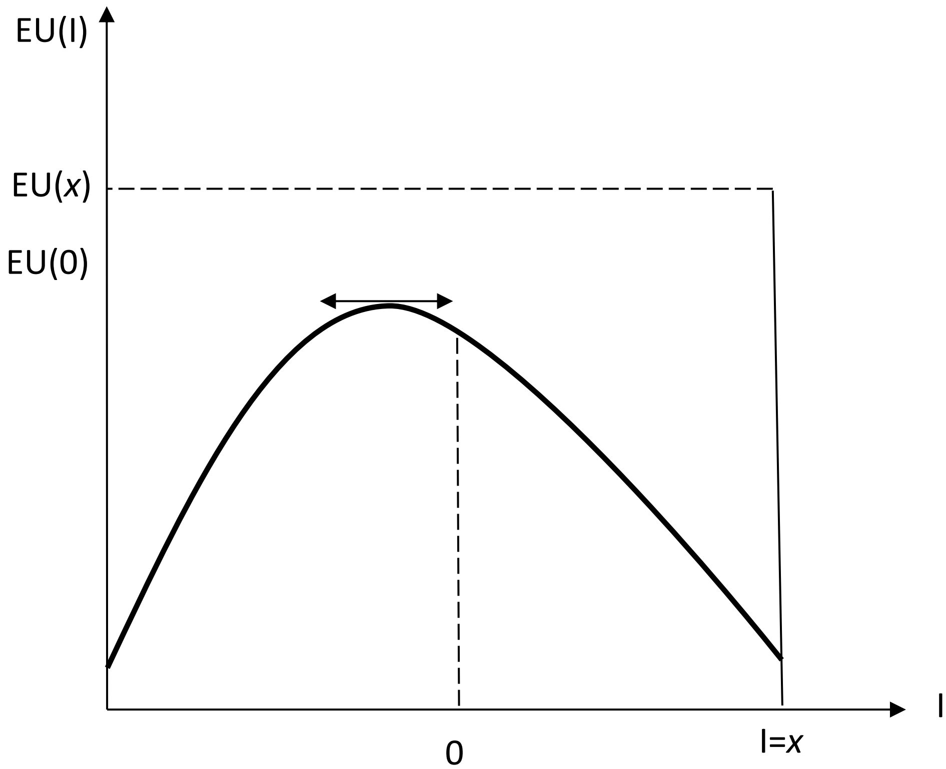


Figure 1: Expected utility of a RA as a function of her insurance demand (p > t)

The impact of a change in the fixed cost C on the propensity to buy insurance is also negative. The left-hand-side term of inequality (1a) is not necessarily decreasing in C; it depends on the nature of risk aversion (IARA, CARA or DARA). Nevertheless, for every pair (p, I), the individual's welfare EU(p, C, I) is strictly decreasing in C, and there exists a threshold $\hat{C}$ such that EU(p, $\hat{C}$, I) = EU(0). By the implicit function theorem, this threshold can be shown to decrease as p increases. Thus, the influence of C on the propensity to buy insurance is determined by condition (PC) and the likelihood of a positive insurance coverage decreases with C.

1.1.3 For a risk lover (RL),[7] the expected utility is a convex function of the indemnity *I*. Since marginal utility is increasing (*U"(W)>0*) the second order condition is positive and only corner solutions (no insurance or full coverage) are likely to be observed.

[7] The demand for insurance of a risk neutral agent is trivial. Indeed, a risk neutral agent will find it profitable to get insured if the mathematical expectation of I is higher than P, so that pI+C ≤ qI. Especially for I=x, we obtain C ≤ (q-p)x. We do not detail the behavior of the risk neutral individuals since they are too few and were grouped with risk averters in our experimental analysis.

For an actuarial or a more-than-actuarial unit price of insurance ($p \geq q$), the FOC (1), evaluated at the no-insurance point ($I = 0$) is negative; this is also true when evaluated at the point of full insurance ($I = x$), as shown by the following equations:[8]

$$\left.\frac{\partial EU}{\partial I}\right|_{I=0} = -p(1-q)U'(W_0) + (1-p)qU'(W_0 - x) < 0$$
$$\left.\frac{\partial EU}{\partial I}\right|_{I=x} = (q-p)U'(W_0 - px) \leq 0 \qquad (3)$$

In other words, due to the convexity of expected utility, the decreasing segment of the function EU(I) is the geometrical locus of all insurance coverages (for $0 \leq I \leq x$). In this case, the optimal demand for insurance is zero.

For a below-actuarial unit price of insurance ($p < q$), RLs will choose to either self-insure ($I^* = 0$) or buy full insurance ($I^* = x$). In fact, in this case, the minimum of the function EU(I) is on the left of the point of full insurance (since this time, $\left.\frac{\partial EU}{\partial I}\right|_{I=x} > 0$), and we expect full insurance to be preferred to facing the risk (EU(x) > EU(0)), as shown in figure 2 below. Again condition (PC) needs to be true.

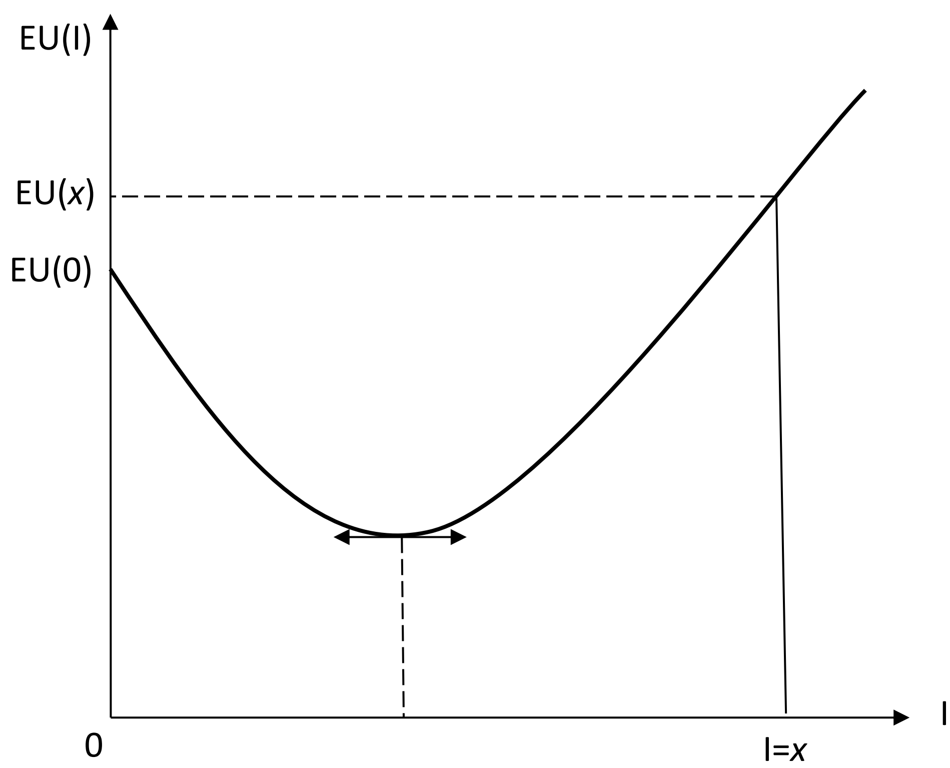


Figure 2: Expected utility of a RL as a function of their insurance demand (case of a below-actuarial price)

[8] Since $W_0 > W_0$-x, $U'(W_0) > U(W_0$-x), because marginal utility is increasing for a RL.

A RL is therefore facing a binary decision: buying full insurance only if its unit price is sufficiently lower than the actuarial unit price – not buying insurance otherwise.

1.2 The Theoretical Predictions

Table 1 below summarizes the theoretical predictions for insurance demand in compliance with both our previous theoretical model (neglecting over-insurance) and our experimental setting: we crossed two fixed costs levels – C = 0 and C > 0 – with three unit price values: below-actuarial, actuarial and above-actuarial.

Table 1: Insurance demand depending on contractual features

	Below-actuarial unit price $p < q$		Actuarial unit price $p = q$		Above-actuarial unit price $p > q$	
	$C = 0$	$C > 0$	$C = 0$	$C > 0$	$C = 0$	$C > 0$
RA	$I^* = x$	$I^* \in \{0,x\}$	$I^* = x$	$I^* \in \{0,x\}$	$I^* \in [0,x[$	$I^* \in [0,x[$
RL	$I^* \in \{0,x\}$	$I^* \in \{0,x\}$	$I^*=0$	$I^*=0$	$I^*=0$	$I^*=0$

For a risk averter:

- If $p \leq q$, the best choice is full insurance $I^* = x$ (over-insurance is not allowed in our experiment), unless the cost is prohibitive (then, $I^*=0$).
- If $p > q$, a partial insurance is optimal $I^* < x$ but, again, owing to the importance of the cost, the individual may exit the market ($I^*=0$).

For a risk lover:

- If $p \geq q$, the lack of insurance coverage is the rule.
- If $p < q$, the demand for insurance is binary and takes one of two values (0 or x) that depend on the fixed cost level.

Except for the RAs and in presence of a more-than-actuarial unit price, the insurance choice is tantamount to an "all or nothing" decision.

Given these results and the theoretical study of corner solutions, four sets of predictions will be tested at an aggregate level. Let's note the Global Demand for insurance (GD) as the average of the demand for insurance I^*. At an aggregate level, it can be viewed as the product of the Propensity to buy Insurance (PI) by the Conditional Demand (CD) and can be written as:

$$GD = PI * CD.$$

At an individual level: PI is 1 or 0 while it is between 0 and 1 at an aggregate level. At an individual level, GD is 0 if PI = 0 and GD= CD otherwise.

Corner solutions provide information about the behavior of the propensity to buy insurance (PI), namely the "exit-effect" while the study of interior solutions characterizes the determinants of the conditional demand for insurance (CI), namely the "contraction-effect".

Based on equations (1), (1a), (3) and on condition (PC) of our theoretical model, table 2 below presents the expected effects of an increase in the premium tariff for both the RAs and the RLs. The expected variation in the Global insurance Demand (the overall effect) is displayed in column (1). The theoretical variations in the proportion of insured (PI) and in the Conditional insurance Demand (CD) are reported in column (2) and (3) respectively.

Table 2: Theoretical predictions

			(1)	(2)	(3)
			ΔGD Base: N =117(I ≥ 0)	**ΔPI**	**ΔCD Base: N s.t. I > 0**
Risk attitude	Contractual parameters		**ΔGD=0 H0: GD_E–GD_S=0[1]**	**ΔPI=0 H0: PI_E–PI_S=0[1]**	**ΔCD=0 H0: CD_E–CD_S=0[1]**
RA (N=67)	Unit price	From 0.05 to 0.1	=0	=0	=0
		From 0.1 to 0.15	<0	≤0	<0
		From 0.05 to 0.15	*<0*	*≤0*	*<0*
	Fixed cost	From 0 to 50			
		p=0.05	≤0	≤0	=0
		p=0.1	≤0	≤0	=0
		p=0.15	≤0[2]	≤0	=0[2]
RL (N=50)	Unit price	From 0.05 to 0.1	<0	<0	=0
		From 0.1 to 0.15	=0	=0	=0
		From 0.05 to 0.15	*<0*	*<0*	*=0*
	Fixed cost	From 0 to 50			
		p=0.05	≤0	≤0	=0
		p=0.1	=0	=0	=0
		p=0.15	=0	=0	=0

1 : Δ(E-S) =(Endpoint-Starting point)
2: Under CARA assumption. If utility function is DARA (resp. IARA), CD increases (resp. decreases).

Predictions H1 and H2 are respectively devoted to the expected behavior of PI and CD when p or C vary and investigate how the exit and contraction-effects combine to generate the global effect on the demand for insurance GD. Predictions H3 deal with the role of risk aversion attitudes while prediction H4 looks at the inferiority of insurance demand.

The effects of an increase in the unit price

H1-a As the unit price rises, the RLs' GD then the RAs' decreases.
H1-b For RAs, this global reduction is explained by both an exit and a contraction-effect.
H1-c For RLs, the global contraction is due to a mere exit-effect.

The effects of an increase in the fixed cost

H2-a When it has an effect, the level of the fixed cost determines GD's level through the exclusive decision to buy insurance: the CD's level does not depend on the fixed cost.
H2-b For the RAs, under the assumption of a CARA utility function, whatever the level of the unit price, a raise in the fixed cost induces an exit-effect which results, if so, in a decrease in the GD.
H2-c For the RLs, the fixed cost raise has an impact on the RLs' behavior only when the unit price is less-than-actuarial. The observed exit-effect turns into a decrease in the GD.

The role of risk attitudes

(H3-a) We naturally infer from our theoretical study that, for any level of p or C, PI is greater for RAs than for RLs. Besides, when the unit price is less-than-actuarial, RAs' and RLs' CD are not different. The comparison is meaningless for higher levels of unit price since RLs' CD is not defined (RLs do not enter the market so their CD does not exist).

(H3-b) We expect stronger effects from RLs.

- Risk lovers should be more reactive to an increase in p and C than risk averters and should be the first to leave the market (as p and C vary respectively from $p<q$ to $p>q$ or from 0 to $C>0$).
- When p switches from $p<q$ to $p\geq q$, the contraction of CD should be higher for RLs.

Test of inferiority of insurance

As a by-product, the use of a two-part premium structure allows us to test a RAs-related proposition that is widely debated in insurance theory, the inferiority of insurance. In our experiment, an increase in the fixed cost C is comparable to a reduction in the subjects' initial wealth W_0.

(H4) For risk averters and under the DARA assumption, if p>q, the conditional demand for insurance is partial and should rise as the fixed cost increases.[9]

2. Experimental Design

2.1 The practical modalities

The experiment was conducted in Montreal with 117 participants, both male, and female. The subjects were students and workers of various ages. The subjects were seated in front of a computer and were confronted with several situations involving risk. For each risky situation, they had to decide whether to buy insurance and if so, how much. Since the subjects had to make insurance decisions to deal with the risk of loss, a first step involved the elicitation of their attitude toward risk in an insurance context. The second step addresses the demand for insurance issue.

Step 1: Measuring the attitude toward risk in the domain of losses

As in the Holt and Laury's method (2002) eliciting risk aversion from a multiple price list method, our subjects had to make ten decisions (one decision = one line), each decision consisting of the choice between two risky lotteries.

[9] If p≤q, we expect a variation in C not to have any impact on insurance demand: as long as C does not drive customers away, they will buy full insurance (as over-insurance is prohibited).

Table 3 describes the ten subsequent decisions.

We adapted the Holt and Laury's method (2002) to the insurance context in two ways. First, we implemented the measure in the loss domain, as in Chakravarty and Roy (2009): the subjects were endowed with $10 and then were facing losses as in insurance context. Second, we also set up the lotteries so that the "option A vs option B" choice is tantamount to an insurance choice in a neutral context: the option B is the uninsured option all the way down whereas the option A is the insured option where a premium of 4 provides an indemnity of 8 in the case of an accident.

In Table 3, the point at which individuals switch from option A to option B reveals their level of risk aversion. We have considered that subjects who have switched to the riskiest option B when the expected payoff of option A is greater than the expected payoff of option B, that is before question 5 in Table 3, are risk lovers (RLs) participants. They are supposed to be risk averters (RAs) otherwise. For convenient reasons, we defined risk aversion attitude by the number of times option A—the least risky one—is chosen by the subject. RAs (resp. RLs), are those who have chosen option A—the least risky one—at least five times (resp. at most four times).

Table 3: Measurement of risk attitudes

Decision	% likelihood	Loss (in $)	% likelihood	Loss (in $)	% likelihood	Loss (in $)	% likelihood	Loss (in $)	Expected Payoff Difference E(A)-E(B)	CRRA intervals[10]
	Option A				Option B					
1	10	-4	90	-6	10	0	90	-10	3.2	]-∞; -0.808]
2	20	-4	80	-6	20	0	80	-10	2.4	]-0.808; -0.62]
3	30	-4	70	-6	30	0	70	-10	1.6	]-0.62; -0.427]
4	40	-4	60	-6	40	0	60	-10	0.8	]-0.427;-0.224]
5	50	-4	50	-6	50	0	50	-10	0	]-0.224; 0]
6	60	-4	40	-6	60	0	40	-10	-0.8	]0; 0.257]
7	70	-4	30	-6	70	0	30	-10	-1.6	]0.257; 0.573]
8	80	-4	20	-6	80	0	20	-10	-2.4	]0.573; 1]
9	90	-4	10	-6	90	0	10	-10	-3.2	]1; 1.712]
10	100	-4	0	-6	100	0	0	-10	-4	]1.712; +∞[

Risk attitude is a major issue in the demand for insurance. Although our adapted Holt-Laury-measure of risk attitude is better suited for an experiment on insurance decisions, some limits need to be discussed. A recurrent point concerns the "house money" problem (Thaler and Johnson (1990)). The difficulty to run an experiment with real losses, for both practical and ethical considerations, has long been recognized. By providing a show-up fee, we avoid the ethical problem, but we run into the possibility of translating the game, in the eyes of the participants, into gains instead of losses (the "prospect-theory-with-memory effect", according to Etchart-Vincent and l'Haridon (2011)). It would result in a less risk-seeking attitude than when losses are real.

However, it can also be argued that with the house-money effect (Thaler and Johnson (1990)), participants might be willing to take more risk, and therefore could be classified as risk lovers, whereas they would have behaved as risk averters with their own money.

While recognizing those issues, the overall effect remains a difficult task. In a thoughtful experiment, close to our setting, Etchart-Vincent and l'Haridon (2011) have compared subjects' risk attitude in three payment conditions: a real loss condition based on a random lottery (incentive-compatible) system, which serves as a benchmark, a "losses-from-an-initial-endowment" procedure and a hypothetical-losses condition. Their results suggest that no significant difference arises between the three payment conditions in the loss domain, comforting our procedure.

[10] Following Chakravarty and Roy (2009), we assume that the subjects' utility functions are CRRA (Constant Relative Risk Aversion) i.e. such that $u(w) = -(-w)^k$ with $w < 0$. By observing when a given subject switches from option A to option B, it is possible to identify into which interval her relative risk aversion falls.

Step 2: Eliciting the demand for insurance

The second step of the experiment consists of a series of six rounds of insurance decisions. At the beginning of each period, an endowment W_0 = 1000 EMU (Experimental Monetary Units) was granted to each subject and they ran a 10% chance of having an accident that would cost them the entire 1000 EMU. They had the option to buy insurance against that risk of loss: subject to the payment of a premium P, which was due at the beginning of the period, subjects received an indemnity *I* if an accident occurred during the period. The premium increases with the desired level of the indemnity.

The various premiums and indemnities were determined according to a two-part insurance premium: $P = pI + C$ where *P* = insurance premium, *p* = unit price of insurance; *I* = indemnity, *C* = fixed cost. A unit price *p* = 0.1 corresponded to the actuarial unit price.

After the decision of whether to buy insurance and how much coverage to buy had been made, an individual random draw determined whether an accident had occurred during the period. The computer then calculated the subject's final wealth and posted it on the screen. Her wealth amounted to W_1 or W_2 depending on whether she suffered a loss.

$$\begin{cases} W_1 = W_0 - P = W_0 - pI - C \\ W_2 = W_0 - P - x + I = W_0 - pI - C - x + I \end{cases}$$

This decision period was then replayed five more rounds, with each of the five other premium schedules crossing three unit price levels (the actuarial unit price *p* = 0.1, a below-actuarial unit price *p* = 0.05, and an above-actuarial unit price *p* = 0.15) and two levels of fixed cost (*C* = 0 or *C* = 50 EMU). Subjects were confronted with these schedules in a random sequence so as to control for any potential order effect. Each round (or period) was independent: the subjects received a new endowment of 1000 EMU regardless of their gains or losses in the previous round.

Table 4 shows the premium grid—the correspondence between the proposed premiums and benefits—computed for the actuarial unit price *p* = 0.1 and a fixed cost *C* = 0. For example, it would cost the subject a premium *P* = 70 EMU at the beginning of the period to receive a compensation *I* = 700 EMU in case an accident occurred during the period. At the end of the period, her wealth would be $W_1 = 1000 - 70 = 930$ if no accident occurred and $W_2 = 1000 - 70 - 1000 + 700 = 630$ if an accident occured.

Clearly, if the subject chooses not to buy insurance, her premiums and indemnities would be nil (see 1st row of Table 4). At the end of the period, her wealth would be 1000 if no accident occurred and 0 if some accident occurred.[11]

Table 4: Insurance premium grid

Premium = Total cost of insurance	**Indemnity**	**Wealth at end of period**	
p = 0.1	Reimbursement in case of accident	If no accident	If accident
C = 0		1000 - premium	1000 - premium - 1000 + indemnity
0	0	1000	0
5	50	995	45
10	100	990	90
15	150	985	135
20	200	980	180
25	250	975	225
30	300	970	270
35	350	965	315
40	400	960	360
45	450	955	405
50	500	950	450
55	550	945	495
60	600	940	540
65	650	935	585
70	700	930	630
75	750	925	675
80	800	920	720
85	850	915	765
90	900	910	810
95	950	905	855
100	1000	900	900

2.2 Monetary Incentives

Subjects' gains had a threefold component. On the one hand, a flat $10 bonus for participating to compensate for the average loss in the risk attitude measurement of step 1. On the other hand, the computer randomly drew one of the subject's ten decisions, as well as a number between 1 and 10, to determine the loss associated with the chosen option.

[11] The instructions are available upon request.

Besides, one of the six insurance decision periods was drawn at random. The gain from that period was converted into dollars at the rate 1 EMU = 0.5 cents.

These draws, as well as the resulting losses, were only communicated at the end of the experimental session to prevent intermediate wealth effects from influencing subjects' later decisions. All these rules were fully known to the subjects before the beginning of the experiment.

On average, the amount earned represents $15 on an hourly basis.

3. Results

Figure 3 shows the distribution of risk attitude coefficients, measured as the number of times the subject chooses the least risky lottery. One hundred and one subjects (86%) have switched only once. Of the remaining participants, five have alternatively chosen option A and B which can be considered as a hedging strategy (following a diversification pattern) and four others seem to have switched erroneously.[12] Seven participants have had erratic choices but since they represent less than 6% we have chosen to keep them in the full sample. On the whole, except for a few subjects whose risk attitude coefficient exhibit extreme values, 85% of the participants show coefficient values between 3 and 6.

Figure 3: Risk attitude distribution

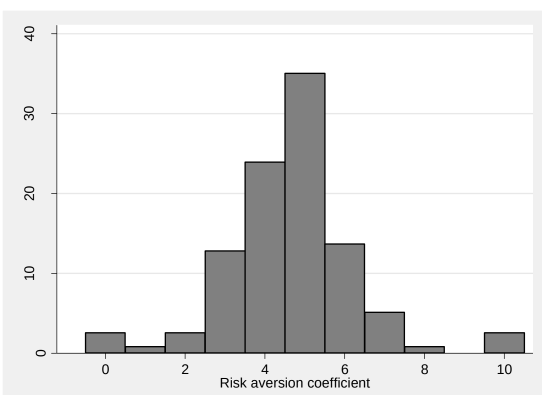
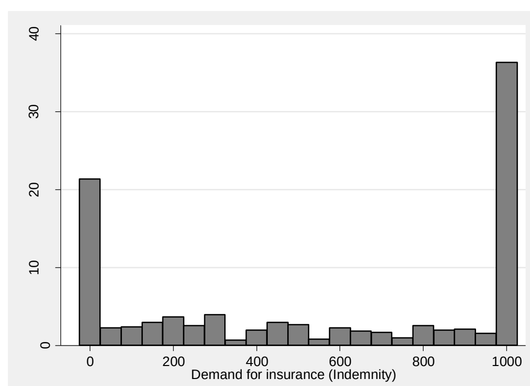


Figure 4: Breakdown of indemnities selected



Our subjects are classified as risk averters (RAs) or risk lovers (RLs) depending on whether their risk aversion indicator is lower than or strictly greater than 4. According to our classification of risk attitude, almost 43% of the subjects are RLs, probably due to our Laury and Hold measure in the loss domain.

[12] We refer to situations where, for example, one choice A appears within long series of choices B (and inversely).

Figure 4 shows, for all contracts, the number of times (as a percentage) each level of coverage was chosen. The insurance decision appears to be highly structured (57% of decisions) around the choice of full insurance (36% of insurance decisions) or no insurance (21%). The flat distribution between no insurance and full insurance is noticeable. For all contracts, the subjects chose an average coverage amounting to 556 EMU, for a mean premium of 71 EMU.[13]

3.1 The Structure of the Global Demand

Relying on our RA-RL dichotomy, we analyze the effects of the contractual parameters (unit price and fixed cost) on the demand for insurance and its components. Table 5 and Figure 5 provide, for each insurance contract, an overview of GD broken down into PI and CD. The average proportion of individuals who buy insurance (PI) is reported Table 5 column (2); the conditional demand (CD) for insurance of those who buy some insurance (I > 0) is indicated in column (3). Values are presented by contract and risk attitude.

Figure 5: Structural Analysis of the Global Demand

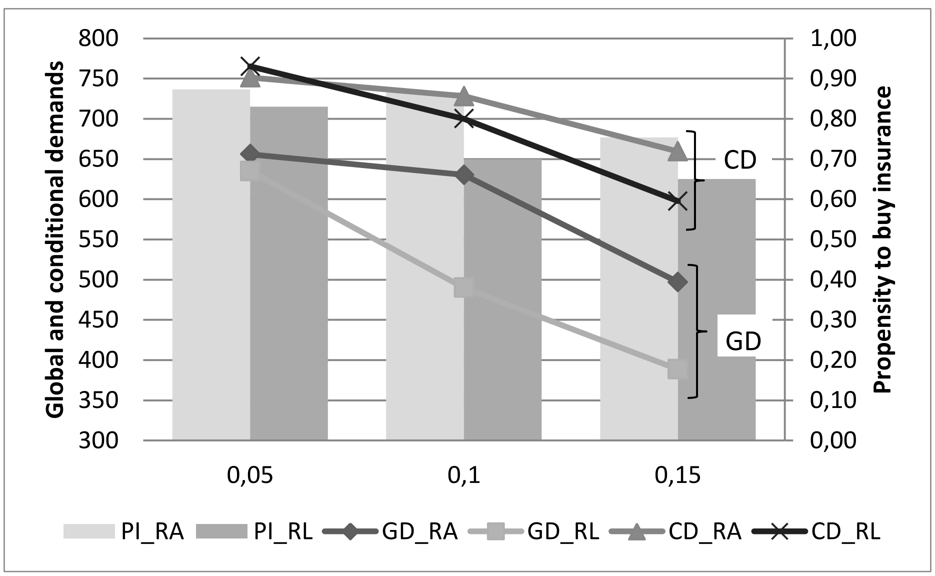


Figure 5 and Table 5 highlight a gap between GD and CD suggesting that not all subjects buy an insurance policy. Depending on the contractual parameters, between 62% and 85% of the subjects buy insurance. However, those who do so choose quite high levels of coverage (between 600 and 750 UME for an initial endowment of 1000).

[13] The demand for insurance, by contract, is given in Table 5.

Table 5: The Global demand for insurance and its components CD and PI

	Unit price	Fixed cost	(1) Global demand GD N (I ≥ 0)	(2) Propensity to buy insurance PI N	(3) Conditional demand CD N s.t. I > 0
Risk averters RAs (N=67)	0.05	0	647.76	0.88	735.6 (59)
		50	664.18	0.86	767.24 (58)
	0.1	0	637.31	0.865	736.20 (58)
		50	623.13	0.865	719.82 (58)
	0.15	0	507.46	0.746	680 (50)
		50	486.57	0.761	639.21 (51)
Risk lovers RLs (N=50)	0.05	0	659	0.84	784.52 (42)
		50	611	0.82	745.12 (41)
	0.1	0	546	0.78	700 (39)
		50	434	0.62	700 (31)
	0.15	0	425	0.72	590.27 (36)
		50	352	0.58	606.89 (29)

(N): Number of observations

Surprisingly, our data show that the RLs' coverage (either PI or CI) has abnormally high levels, even when the unit price is, at least, actuarial. Those structural considerations need to be further analyzed. In the next sections, we examine the effect of contractual parameters variation as well as risk attitude on the components of the global demand for insurance.

3.2 Comparative Statics Analysis of the Global Demand

Table 6 provides the results of Wilcoxon Signed Rank Tests carried out on paired data. These tests show whether changes in the contractual parameters impact GD, and how the effect breaks down into its two dimensions. For each increase in the unit price (from 0.05 to 0.1, 0.1 to 0.15 and also from 0.05 to 0.15) or in the fixed cost (from 0 to 50), the rows of Table 6 provide the values of the test and the changes in GD (col. (1)), PI (col. (2)) and CD (col. (3)).

The conditional demand is narrowly understood: only the demand for insurance of people who bought insurance in *both* situations under comparison has been taken into account.[14] The null hypothesis assumes that no change occurs between the values before and after an increase in the contractual parameters (e.g., H0: $GD_{endpoint}$- $GD_{starting\ point}$ = 0).

All the tests were carried out controlling for the individuals' risk attitude.

Table 6: Wilcoxon signed rank tests

Risk attitude	Contractual parameters		(1) **ΔGD Base: N =117(I ≥ 0)** **H0: GD_E– GD_S=0¹** z-tests (*p*-value)	(2) **ΔPI Base: N =117** **H0: PI_E– PI_S=0¹** z-tests (*p*-value)	(3) **ΔCD Base: N s.t. I > 0** **H0: CD_E– CD_S=0¹** z-tests (*p*-value)
RA (N=67)	Unit price	From 0.05 to 0.1	-0.721 (0.4711)	-0.258 (0.7963)	-0.476 (0.6342)
		From 0.1 to 0.15	-3.252 (0.0011)**	-3.128 (0.0018)**	-1.419 (0.1559)
		From 0.05 to 0.15	*-4.516 (0.000)***	*-3.266 (0.0011)***	*-2.847 (0.0044)***
	Fixed cost	From 0 to 50	-0.290 (0.7720)	-0.000 (1.000)	-0.277 (0.7817)
RL (N=50)	Unit price	From 0.05 to 0.1	-3.076 (0.0021)**	-2.837 (0.0046)**	-1.444 (0.1489)
		From 0.1 to 0.15	-1.466 (0.1426)	-1.000 (0.3173)	-1.056 (0.2910)
		From 0.05 to 0.15	*-4.459 (0.000)***	*-3.402 (0.0007)***	*-2.913 (0.0036)***
	Fixed cost	From 0 to 50	-1.472 (0.1411)	-2.596 (0.0094)**	0.436 (0.6629)

1 : Δ(E-S) =(Endpoint-Starting point)

The contractual parameters

Based on matched samples, *Wilcoxon Signed Ranks Tests* reported in Table 6 exhibit several salient points. According to our theoretical predictions related to an increase in the unit price, RLs should adjust their global demand for insurance (GD) at the first increase in price while the RAs should do so only when the unit price becomes more-than-actuarial, that is after the second raise. When relevant, RAs' adjustments should be made by

[14] However, the same Wilcoxon signed rank tests were also carried out accounting for these intermittent coverage situations. They lead to similar results. Furthermore, these results are very stable and do not depend on the test used: they also hold when using parametric tests such as the Student's test or the Pearson correlation coefficient.

leaving the market and by reducing their coverage. RLs should only leave the market.

In compliance with those theoretical predictions, the two types of subjects leave sequentially the insurance market as the unit price rises. However, in both cases, the decrease in the GD is only explained by an exit-effect although the RAs' CD should also contract.[15] Those findings partly support H3b.

In the case of a raise in the fixed cost and whatever the risk attitude, the CD is not expected to vary. The GD should decrease following the sole exit-effect. Our data show[16] that only the RLs are fixed-cost-sensitive when the price is, at least, actuarial. However, if the raise in the fixed cost leads subjects to leave the market (exit effect), its overall effect on the GD is not significant.

Therefore, our data support H1-(a and c) and H2-(a and b) whereas H1-b and H2-c are only partially validated.

The risk attitude effect

Our measure of the risk aversion coefficient has been designed in a strong analogy with insurance decisions: we expect the risk attitude estimation elicited in step 1 to be related to the insurance decisions expressed in step 2 of the experiment. The *Wilcoxon Signed Ranks Tests* reported in Table 7 address the risk attitude issue. Table 7 gives the p-value of the comparison tests between RAs and RLs: column (1) compares their GDs, columns (2) and (3) their PIs and CDs respectively.

Our findings suggest that the risk attitude modulates the way people react to unit price and fixed cost. The tests show that the difference between RAs' and RLs' PI is significant when $p \geq q$ and $C=50$. In these cases, RAs also exhibit a significantly higher GD than RLs. Besides, the difference between RAs and RLs' CD is never significant, whatever the contractual parameters. These results only partly support our H3-a hypothesis since the RLs' behavior is never significantly different than RAs' when the fixed cost is zero, even for high levels of unit price.

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[15] However, and whatever the risk attitude, a massive increase in the unit price (from 0.05 to 0.15) significantly reduced GD through each of its dimensions: some subjects choose to exit the insurance market (PI decreases) and those who keep buying insurance reduce their level of coverage (CDI shrinks).

[16] A detailed test of the fixed cost effect is presented in the next section.

Table 7: Influence of risk preferences on demand for insurance

		Risk preferences comparisons $(GD_{RA}-GD_{RL})>0$	Risk preferences comparisons $(PI_{RA}-PI_{RL})>0$	Risk preferences comparisons $(CD_{RA}-CD_{RL})>0$
Unit price	Fixed cost	**(1)** (*p*-value)	**(2)** (*p*-value)	**(3)** (*p*-value)
0.05	0	(0.558)	(0.263)	(0.762)
	50	(0.239)	(0.249)	(0.366)
	Tot.	(0.347)	(0.177)	(0.615)
0.1	0	(0.118)	(0.112)	(0.304)
	50	(0.008)**	(0.001)**	(0.395)
	Tot.	(0.005)**	(0.001)**	(0.291)
0.15	0	(0.136)	(0.375)	(0.108)
	50	(0.042)*	(0.018)*	(0.351)
	Tot.	(0.022)*	(0.040)*	(0.130)
Combined	0	(0.112)	(0.110)	(0.290)
	50	(0.003)**	(0.000)***	(0.319)
	Tot.	(0.002)**	(0.000)***	(0.236)

p-values in parentheses:***p<0.001, ** p < 0.01, * p < 0.05

We were expecting more significant differences between RAs and RLs with RLs buying less insurance. When the unit price is more-than-actuarial, the RLs are highly likely to use insurance (between 62% and 78% of RLs, depending on the fixed cost level), and when buying insurance, they choose a relatively high coverage (CI=700 UME on average).

It begs the question of the nature of the classification obtained by our Holt and Laury adapted measure. As highlighted in the recent survey of Jasperen (2016), several studies (Hershey and Schoemaker (1980), Lypny (1993), Kusev et al. (2009)) show that the nature of individual decisions under risk depends on the framing. Decision makers exhibit more risk aversion for the same choices if they are framed as insurance rather than neutral games. Therefore, our decontextualized measure of risk aversion coefficient could not correctly predict the behavior of individuals in an insurance context. It is possible that individuals identified as RLs by our measure, become RAs when it comes to insurance issues.

Our results show that a neutrally framed measure of risk aversion, conducted in the loss domain, significantly categorizes insurance behaviors but in a different way. The RLs could be RLs in a sense somewhat different from that understood in the insurance theory. Numerous facts, reported in Table 8, suggest that RLs' behavior deviates from both the RAs' observed behavior and the RLs' theoretical behavior. In both cases, the key factor lies in the excess volatility observed in the RLs' decisions which suggest that risk-loving could refer to behavior that goes beyond the mere risk retention.

Table 8: Additional tests concerning risk attitude on the demands for insurance

Risk-loving characterization		RAs (N[a])	RLs (N[a])	Comparison tests stat (p-value)
% extreme values (0 and 1000)		0.54	0.63	-2.39* (0.017)
Variance of demand for insurance across contracts		399.19 (402)	434.88 (300)	0.8424* (0.055)
Number of times subjects successively enter and exit the insurance market		1.04 (67)[c]	1.44 (50)[c]	-4.24* (0.044)[b]
PI of the period if, in the previous period:	no accident occurs	0.82 (307)	0.73 (223)	
	an accident occurs	0.79 (28)	0.66 (27)	

[a]N=number of observations
[b] One tail student test
[c] Number of RA and RL subjects

Comparing their respective percentages of extreme choices (no insurance or full coverage) and also the variance of their insurance options make the difference between RLs' and RAs' behavior apparent: by the theoretical predictions, RLs appear to choose significantly more often extreme values than RAs do.[17]

Likewise, the RLs' number of market "entry and exit" is significantly greater than the RAs', suggesting a more erratic buying behavior.[18] This point is reinforced by two factors. On the one hand, RLs' likelihood to buy insurance seems to be accident-dependent: RLs are less likely to buy insurance when they suffered an accident in the previous period than when they did not.[19] On the other hand, the proportion of RAs buying insurance does not depend on the occurrence of an accident in the prior period. This situation highlights the fact that RL participants, and only them, could suffer from the gamblers' fallacy.

On the whole, our investigation suggests that RLs' insurance decision could have much more in common with gambling and strategic decision than with risk retention. RLs appear to adopt a behavior associating insurance with a gamble: rather than avoiding insurance, risk-loving could refer to a risk-taking behavior consisting of alternating hedging decisions with no insurance.

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17 Especially when the unit price is more than actuarial, RAs may have to only partially cover, while the RLs' theoretical insurance choices are binary and can only be 0 or 1000.
18 The subjects faced with different contracts.
19 The difference, though important (73% vs 66%), is not significant (p-value= 0.4804) due to the small number of periods an accident occurs.

3.3 Testing the insurance-inferiority proposition in insurance theory

Given our two-part premium structure, we can test the insurance-inferiority proposition debated in insurance theory in the only case of risk aversion. Under the assumption of decreasing absolute risk aversion, an increase of initial wealth (W_0 in our presentation) results in a decline in the RA's demand for insurance (Mossin, 1968).[20] In our experiment, an increase in the fixed cost is equivalent to a reduction of the subjects' initial wealth W_0. If it does not drive the policyholder away, it increases the marginal benefit of insurance, which translates into a raise in the insurance benefit.

Table 9: Wilcoxon signed rank tests of the inferiority proposition

			(1)	(2)	(3)
			Overall effect: Variation in the global insurance demand **Base: N =117 (I ≥ 0)**	Variation in the proportion of insured	Variation in the conditional insurance demand **Base: N s.t. I > 0**
Risk preferences	Contractual parameters From 0 to 50		**ΔGD=0 H0: GD_E– GD_S=0**[1] z-tests (*p*-value)	**ΔPI=0 H0: PI_E– PI_S=0**[1] z-tests (*p*-value)	**ΔCD=0 H0: CD_E– CD_S=0**[1] z-tests (*p*-value)
RA (N=67)	Fixed cost variation From 0 to 50	For 0.05	0.784 (0.433)	-0.378 (0.705)	1.198 (0.231)
		For 0.1	-0.287 (0.774)	0.000 (1.000)	-0.385 (0.700)
		For 0.15	-0.852 (0.394)	0.277 (0.781)	-1.269 (0.204)
		Combined	*-0.290 (0.7720)*	*-.000 (1.000)*	*-0.277 (0.7817)*
RL (N=50)	Fixed cost variation From 0 to 50	For 0.05	-0.407 (0.684)	-0.378 (0.705)	-0.254 (0.799)
		For 0.1	-0.899 (0.369)	-1.886 (0.059)*	1.491 (0.136)
		For 0.15	-1.283 (0.199)	-1.941 (0.052)*	0.243 (0.808)
		Combined	*-1.472 (0.1411)*	*-2.596 (0.0094)***	*0.436 (0.6629)*

1 : Δ(E-S) =(Endpoint-Starting point)

[20] When the wealth increases, the aversion to any given risk decreases. Consequently, the marginal indemnity of insurance declines with wealth and so does the demand for insurance.

Therefore, according to Mossin (1968), if insurance is an inferior good, then $\frac{dI}{dC} \geq 0$ when risk aversion is decreasing in wealth (with $I > 0$).[21] This result only applies to the particular case of a risk-averse individual facing an above-actuarial unit price motivating partial coverage. In the case of an actuarial price, we expect a variation in C to have no impact on the insurance demand: As long as the fixed cost, C, does not drive customers away, they will buy full insurance. For a below-actuarial price ($p < q$), the inequality is reversed: Given that opportunity, the individual would prefer to over-insure and, therefore, an increase in C would yield a decrease in insurance coverage I: $\frac{dI}{dC} \leq 0$. If over-insuring is not an option (our assumption), variations in C will have no impact as far as they are below the threshold at which the individual is not interested in buying insurance.

In our study, the theoretical prediction of the inferiority of the demand for insurance has no empirical basis (see the Wilcoxon test in Table 9). For risk-averse subjects who pay an above-actuarial unit price ($p = 0.15$), the demand for insurance should increase with the fixed cost, but this is not the case as shown in table 9. Instead, as predicted by the theory, the fixed cost translates into the eviction from the insurance market.

As far as RAs are not fixed-cost sensitive, the assumption H4 of the inferiority of insurance is rejected. Using an entirely controlled risk-exposure degree, our experiment contributes to a clarification since with real data a positive correlation between risk and level of wealth can be suspected.

4. The econometric models

This section is complementary to the non-parametric analysis of the experimental results discussed earlier. The econometric models enable to differentiate, according to risk attitude, the effects of contractual parameters on the demand for insurance.

The following econometric sequence links with our theoretical model. Disregarding the five individuals who never buy insurance,[22] the first step is

[21] The demonstration of this result is identical to that of Mossin, provided that the fixed cost is considered as an element subtracted from initial wealth.

[22] Some individuals, for a variety of reasons, will never buy insurance. They derived no utility to participate in the insurance market, whatsoever. This situation is a real corner solution failing to pass the first hurdle of the observability rule as discussed by Humphreys (2013). Other individuals are interested in buying insurance but under specific conditions. Thus, for example, if the premium is too high, some participants who have a preference for insurance might in that situation leave the market for insurance temporarily. In this last case, the zero observed is a genuine zero. This situation is the second hurdle (see Engle and Moffat, 2012).

In our experiments, we are dealing with individuals making multiple decisions under different insurance contracts. We are likely to find individuals buying different amounts of insurance, including no insurance in some cases and also full insurance. We are also likely to to run a random effect Probit model to estimate the determinants of choosing a positive level of coverage, the PI model. The second phase concerns the conditional demand (CD) for insurance that includes in our theoretical model participants buying full or partial insurance. Depending on how we explain the decision of participants to buy full insurance or to subscribe to a partial insurance, the theoretical model implies that the parameters estimates will be different. A Tobit type 2 model (generalized Tobit) with an upper censure at 1000 (full insurance) is required. The first part of the Tobit 2 model is a Probit regression to estimate the determinants of buying full insurance.[23] The last step is to estimate the demand for partial coverage that is superior to zero but inferior to 1000 UME. Those restrictions need adding two inverses of Mill ratio into the linear demand for partial insurance. The inverses are obtained from the previous Probit regressions. Also, from our theoretical predictions, this last estimation concerns the RA participants only. A robust random-effects GLS regression will be used to obtain the determinants of buying partial insurance.

Table 9 summarizes the variables and their expected effects for the three econometric models, derived from the predictions of Table 2.

The explanatory variables covering all the dimension of the demand to buy insurance are *RL, DCOST50, DLACT*, and *DMACT*. *RL* stands for risk-lovers participants. It is an auxiliary variable with *RL* =1 if the participants have chosen less than five times the smallest loss option during the Holt and Laury's process. *DLACT, DMACT*, and *DCOST50* are also auxiliary variables that describe the pricing of the insurance contract: *DLACT* = 1 if the unit price is less than actuarial; *DMACT* = 1 if the unit price is more than actuarial, and *DCOST50* = 1 if the fixed cost of the contract is *DCOST50* = 50. The reference variables are thus the risk-adverse participants, the actuarial unit price, and the zero unit cost.

In line with the predominant role played by risk aversion in the theoretical insurance model, we have crossed all contractual variables with the risk lover dummy variable to account for a differential behavior of risk lover participants: *RL.DLACT, RL.DMACT, RL.DCOST*. For lack of a sufficient number of observations the interactions among three explanatory variables are not discussed.

Table 10: Variables and their expected effects

Explanatory	Likelihood to	Conditional demand

observe individuals never buying insurance whatever the contract. In the spirit of the double-hurdle model of Engle and Moffat, we first considered running a Probit model testing the observability rule. However, as more than 95% of our 117 individuals who participate in our experiment had bought at least one insurance contract, we were unable to converge to a solution with the double hurdle Engle-Moffat Stata procedure. We had nothing to say specifically on who are those individuals from a theoretical point of view.

[23] Note that this Probit regression in not conditional on a positive level of insurance.

variables	buy insurance (PI)	(CD)	
	Decision to buy insurance PI=1 (1)	Decision to buy a full insurance coverage CD=1000 (2)	Demand for partial insurance RA participants 0<CD<1000 (3)
DLACT	> 0	> 0	nd
DMACT	< 0	< 0	nd
DCOST50	< 0	< 0	= 0, >0 or < 0 *
RL	< 0	< 0	nd
RL.DLACT	> 0	> 0	
RL.DMACT	= 0	= 0	
RL.DCOST50	< 0	< 0	

* Depending on the nature of risk aversion: CARA, DARA or IARA.
nd: not defined

For the determinants of the propensity to buy insurance (PI), the situation is clear (first column of Table 10): this propensity is lower for *RL* participants than for *RA* participants, and even more so when for the latter they face a unit cost of 50 (*RL.DCOST*). For *RA* participants, their reaction to a 50 unit is also negative. A more than actuarial unit cost, *DMLACT,* will decrease the likelihood to buy insurance for all (*RL+RA*) participants. For a lower-than-actuarial unit price, *DLACT*, this will increase the probability for all participants to buy insurance and in particular for *RL*. Thus, the expected positive sign on the crossed variable *RL. DLACT*.
The expected signs of the variables for the decision to buy full insurance are presented in the second column of Table 10. They are straightforward and intuitive and follow essentially from the discussion concerning the decision to buy insurance. In particular, the probability to buy full insurance for *RL* participants facing a unit price less than actuarial derived directly from our theoretical model.

The last column of Table 10, concerning the demand for partial insurance between 0 and 1000, is restricted to *RA* participants. Following our model, no *RL* participants should be in that category. Under the assumption of decreasing absolute risk aversion, DARA, the model tests the inferiority hypothesis predicting an increase in the conditional demand with an increase in fixed cost (equivalent to a reduction of the subjects' initial wealth).
In Table 11, we report the estimates of the demand insurance models.

Table 11: Estimates of the demand insurance models

Variable	Likelihood to buy insurance (PI)	Conditional demand (CD)	
	Decision to buy insurance PI=1 (1)	Decision to buy a full insurance coverage CD=1000 (2)	Demand for partial insurance RA participants 0<CD<1000 (3)
DLACT: 1 if the unit price is less than actuarial (0.05); 0 otherwise	0.091 (0.740)	0.306 (0.126)	
DMACT: 1 if the unit price is more than actuarial (0.15); 0 otherwise	-0.742*** (0.007)	-0.483*** (0.021)	
DCOST50: 1 if fixed cost = 50; 0 otherwise	0.008 (0.970)	-0.119 (0.474)	6.208 (0.857)
RL 1 if AP[a] < 5; 0 otherwise	-0.745** (0.045)	-0.157 (0.651)	
L&DLACT	0.642* (0.089)	0.367 (0.215)	
RL&DMACT	0.531 (0.114)	-0.087 (0.781)	
RL&DCOST50	-0.525* (0.066)	-0.0461 (0.846)	
LAMBDA1			-513.364 (0.405)
LAMBDA2			80.917 (0.686)
Constant	1.940*** (0.000)	-0.325 (0.160)	464.710 (0.003)
Observations	672	672	185
Number of subjects	112	112	48
ll_c	-260.27	-355.67	
chi2	36.28	41.93	4.00
R-sq			0.009
Rho	0.540*** (0.000)	0.615*** (0.000)	0.512

P-values in parentheses: *** p < 0.01, ** p < 0.05, * p < 0.1. Two-tail tests are reported.
a) AP: the number of time the smallest loss was chosen by the participants. The reference interval is coherent with a Constant Relative Risk Aversion utility function. See Table 3. The results are unchanged when restricting AP to < 4.
LAMDA1 and *LAMDA2* are inverses of Mills ratio.

In column 1 of Table 11, we report the determinants of buying a positive amount of insurance using a random effect Probit regression with 1 if individual *i* facing contractual parameters *s* buy insurance and 0 otherwise. The results strongly support the theoretical predictions of Table 10. We observe that an above-actuarial unit price decreases the probability of buying insurance. The likelihood of buying insurance also decreases for risk-lovers participants. At the 10% level of significance (two-tail test), our estimates show that when risk-lover participants face a unit price less than actuarial, their probability to buy insurance increases. Also at the 10% level of significance, the probability of buying insurance decreases for risk-lover participants confronted with a positive fixed cost.

Empirical results for the decision (propensity) to buy full insurance are presented in column 2 of Table 11 using a random effect Probit regression: with 1 if individual *i* in situation *s* buys full insurance and 0 otherwise. The results show that an above-actuarial unit price decreases this probability. However, nor the risk attitude, not the fixed cost variable and the crossed variable *RL.DLACT* present statistically significant coefficient estimates although all are with the correct expected sign.

Column 3 in Table 11 investigates the determinants of buying partial insurance (more than 0 and less than 1000 UME), restricted to *RA* participants, with a random unbalanced effect GLS regression corrected with the two inverses of the Mills ratio. With the coefficient estimate of *DCOST50* statistically not different from zero, we reject the inferiority of insurance hypothesis. The constant term (at the 1% level of significance) is statistically significant with a value of 464.71.

The fact that in 37% of all their decisions, risk lovers opt for a partial insurance coverage (excluding full insurance), contradicts our theoretical predictions. More in line with the theory, the risk averters opt for a partial insurance coverage in 46% of their choices.

In short, as shown with the non-parametric section, the insurance decisions are polarized between no insurance (the exit effect) and full insurance.

5. Discussion and conclusion

In this study, we develop an experimental analysis addressing the issue of premium sensitivities on the demand for insurance. We argue for a better measurement of risk aversion by adapting the Holt and Laury (2002)'s protocol in the loss domain. Accounting for risk lovers, we characterize both risk averters and risk lovers insurance-related behavior when facing two fundamental pricing tools of the insurance premium: a fixed cost and a unit insurance price.

For a better understanding of the demand for insurance, our contribution demonstrates the interest, in disentangling the conditional demand (the non-null demand for insurance) from the propensity to buy insurance. First, as theoretically expected, both our non-parametric tests and econometric models show how highly structured around the choice of full insurance or no insurance, the observed insurance decision is. Second, in line with the foregoing, a statistically robust result is that an increase in the contractual parameters only reduces the subjects' propensity to buy insurance, inducing a sole exit-effect. Indeed, our study reveals a somewhat strong result: the elasticity of the conditional demand relative to the unit price or the fixed cost is small or even zero, and this stability is robust to changes in insurance contracts and in subjects' risk attitude. Therefore, it is quite clear that if the raise in the unit price or the fixed cost induces a contraction of the global demand for insurance, this contraction is primarily due to an exit of the insurance market, the amount of coverage of those who stay remaining unchanged. Those results are compliant with our theoretical predictions except for the change from the actuarial to the more-than-actuarial unit price where we were expecting a significant contraction effect for risk averters.

One may wonder whether the insurance decision is tantamount to an "all or nothing" choice.

Another element studied in this experiment is the role played by the risk attitude of participants on the demand for insurance. Here, the results are intuitive and coherent with the theory. The risk-loving subjects express a global demand for insurance lower than those who are risk-averse, and they are also the first to leave the insurance market when they feel the premium (unit price or fixed cost) becomes prohibitive. However, the experimental results temper the effect attributed to the participant's risk attitude. Risk lovers' and risk averters' conditional demands are never significantly different: regardless of their risk attitude, subjects who buy insurance require the same level of coverage.

Therefore, the effect of risk aversion on the global demand for insurance must be qualified. We are aware of the difficulty of measuring the participants' attitude toward risk even in a neutral context as we did, and the fact that in a contextual insurance decision, some participants identified as risk-loving might turn into risk-averse participants. However, the fact that we cannot directly translate risky decontextualized choices into insurance decisions does not mean that there is no bridge between a decontextualized behavioral measure of risk aversion and those insurance decisions. Our contribution investigates this topic and shows that it makes sense to dichotomize the population into two groups – risk lovers and risk averters – based on a decontextualized measure. There are numerous elements in the behavior of risk-lover participants, such as increasing variability in their decisions, addressing insurance decision in the form of a gambling decision, that balance the outcome that they buy more insurance than the theory of insurance predicts.

Insofar as those results could be reliably extrapolated to the insurance industry, they could have significant implications for public policy. With an increase in insurance premium leading people to exit the market or not to insure rather than reducing their coverage, the community faces a significant risk involved by those who turn away from insurance. From an ethical point of view, we cannot endorse a policy that would have the primary effect of lifting people out of the insurance market. Moreover, the resulting negative externality generates financial cost, which indeed strain earnings expected from the premium increase.

Regarding public policy, the consequence of such a result is immediate: it calls for compulsory insurance clauses to prevent such a situation. Thus, our study could provide justification for the existence of such insurance terms, in health insurance, car insurance, home and flood insurance, for examples.

The consequences for private insurers could also be important since our results show that people are likely to give up insurance if they feel the premium is too high. Therefore, insurers have an incentive not to treat the policyholders as captive but rather as likely to turn to the competitors, providing that switching costs are low. Depending on the degree of competition, insurers could be induced to provide fair insurance premiums.

Furthermore, the specific role played by the fixed cost through the exit-effect sheds new light on the linearity observed in practice in the form of insurance premium. One can ask to what extent the observed linearity is not already the outcome of the insurers' anticipation of the fixed cost exit-effect. Finally, as a by-product, the use of a two-part premium structure enables us to test a key prediction of Insurance Theory: the inferiority of insurance demand. According to this prediction, the demand for insurance of a risk averter paying an above-actuarial price should increase in the presence of a fixed cost (equivalent to a wealth reduction). Our experiment does not bring any empirical support to this prediction. The fixed cost plays its eviction role, as predicted, but does not induce any significant change in the conditional demand, which favors CARA assumption.

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