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2017S-07
WORKING PAPER
WP

2017s-07

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Série Scientifique
Scientific Series

Montréal
Février/February 2017

CIRANO
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Centre interuniversitaire de recherche en analyse des organisations

ISSN 2292-0838 (en ligne)

Statistical Tests of the Demand for Insurance: An "All or Nothing" Decision

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Résumé/Abstract

Several theoretical models and empirical results stress an unexpected all-or-nothing insurance behavior. Using experimental data of Corcos et al. (2017), who developed an extended version of Mossin's traditional theoretical demand for insurance and provided non-parametric tests, this paper presents descriptive statistical analyses and econometric tests studying whether these experimental data comply with the all-or-nothing hypothesis. Our findings support this assumption for both risk averters and risk lovers. When this all-or-nothing behavior fails to meet Expected Utility predictions, it highlights a lack of responsiveness of individuals to insurance prices. When facing a more-than-actuarial insurance price, risk averters keep buying full insurance rather than partial insurance. A zero fixed cost holds risk lovers in the insurance market where they choose full instead of waive insurance. The bimodal nature of decisions might create an opportunity for the authority for driving people to enter the insurance market where they then buy full insurance.

Mots clés/key words: Demand for Insurance; Experimental Study; All or Nothing Decision Parametric Tests

Codes JEL/JEL codes: C40, C91, D81

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1 Introduction

In Corcos, Pannequin, and Montmarquette (2017), the Mossin's theoretical analysis (1968) of the demand for insurance is extended to risk loving individuals and to the study of corner solutions. The authors also test in the Lab this extended model considering several insurance price levels: actuarial and more-than-actuarial prices but also less-than-actuarial prices, as those of public health insurance.[1] Using nonparametric analyses of the data, the authors find that exit rather than coverage contraction appears to better explain the behavior of participants in the experiment.

From a theoretical point of view, except for the EU approach which highlights the optimality of partial insurance contracting when the pricing is unfair (and All-or-Nothing behavior for all other prices), a large body of theoretical frameworks tend to show that an All-or-Nothing (AoN) behavior seems to be the rule rather than the exception. For instance, applying the dual theory of Yaari (1987), Doherty and Eeckhoudt (1995) stress that when there is a single insurable source of risk, and the contract is linear, dual theory leads only to corner solutions whether the insurance price is actuarial or more-than-actuarial, people choosing to buy full insurance or not to participate in the insurance market. In the same way, applying the value function of Tversky and Kahneman (1992) to study the demand for insurance with fair pricing, Schmidt (2016) finds that for all plausible reference points, subjects either buy full insurance or waive insurance. For a rank-dependent expected-utility decision maker, Bernard et al. (2015) show that for any price at least actuarial, optimal insurance contracting would require full coverage of small losses while significant losses should be insured above a deductible. From an empirical point of view, Sydnor's (2010) study highlighting the preference of individuals for low deductibles also supports the idea that when using insurance, people crave for a full-coverage contract. Focusing on deductibles, Shapira and Venezia (2008) investigate the reasons why individuals prefer insurance contracts without deductibles. They show, in a series of experiments, that the full-insurance contract acts as an anchoring point. The subjects seem all the more to underestimate the value of a policy with a deductible as it moves away from the full-insurance contract.

All these elements suggest a behavioral heuristic leading policyholders to react to changes in insurance contractual parameters, exhibiting an All-or-Nothing behavior. Would this all-or-nothing feature be proven, insurance policies perspective should be reconsidered. As they frequently rely on partial insurance schemes – including full coverage above a deductible – insurers first should redesign their

[1] Most of the time, Public Health Insurance pricing involves a mandatory lump sum (through taxation) supplemented by a small fee-for-service whenever care is provided to the insured.

pricing accounting for this thirst for full insurance. In the same way, as full insurance and risk retention are focal points within this behavioral pattern, regulating the extent of insurance hedging is a minor issue compared to inducing insurance market participation. Therefore, rather than focusing on policy and premium to achieve a socially desirable level of coverage, public policy should instead address the issue on how to encourage individuals to participate in the insurance market, the choice for a comprehensive coverage resulting almost naturally.

In this context, and consistent with the previous results of the non-traditional expected utility models, a new reading of the extended-Mossin-Expected-Utility model (EU) pointing to corner solutions reveals that the main feature of the demand for insurance is an all-or-nothing behavior. The motivation for this research is to address this concern. Using the experimental data of Corcos et al. (2017), we examine the very nature of insurance demand by focusing on whether individuals make all-or-nothing insurance choices. However, given the proximity of the EU model to the all-or-nothing behavior, we use it as a theoretical framework to identify and characterize situations where optimal insurance requires either full coverage, waive insurance, or both of these focal solutions. It points out contractual parameters and individuals' characteristics (risk attitudes) that should theoretically motivate the choice to participate fully in the insurance market or to exit the market. This model also enables to test the robustness of the all-or-nothing assumption to insurance pricing when both the fixed cost and the unit price vary.

We refer to a graphical representation of the choices predictions of our EU model and descriptive statistics of the participants' choices. A one-sample Kolmogorov-Smirnov test is used to confront a strategy of random choices by the participants with the EU model in explaining the experimental data. The graphical presentation and descriptive statistics, furthermore, illustrate from a static point of view the bimodal nature (the all-or-nothing choices) of the demand for insurance. To study the *individual* insurance demand from a dynamic perspective, we also develop an econometric model that accounts for the strong bimodality of the experimental data. Estimates from the econometric model point out that if the insurance pricing determines the decision to enter the market, it does not explain the demand for partial insurance, participants mainly entering the insurance market to purchase full coverage. The econometric model thus highlights the very dichotomous nature of individuals' insurance decisions: not participating in the insurance market or participating in the market to fully insure. Eventually, as it now seems a major concern, our findings are likely to inform policy choices for a society that maximizes the number of (fully) covered individuals.

The remainder of the paper is organized as follows. In Section 2, the Corcos at al.'s (2017) theoretical model is briefly presented. Section 3 describes the experimental settings. Accounting for risk attitudes and contractual parameters, in section 4 we examine to what extent the observed behaviors fit with the all-or-nothing hypothesis and discuss this finding. Section 5 concludes.

2 The Theory of Insurance Demand

Relying on an insurance pricing based on two components, a fixed cost and a unit price, Corcos et al. (2017) extend Mossin's (1968) canonical insurance demand model and develop the theoretical predictions for risk averters and risk lovers. A broad outline of the model is reproduced below.

2.1 The theoretical framework

The decision maker is endowed with an initial wealth W_0, and she is facing a *q*% risk of losing an amount *x*. When investing in an insurance premium equal to $P = pI + C$, where *p* represents the unit price of insurance, *I* the indemnity, and *C* a fixed cost (C≥0), the decision maker receives a compensation amounting to *I* if an accident occurs. We assume that over-insurance is prohibited so $0 \leq I \leq x$.

Final wealth is random and equal to W_1 in the no loss state, and to W_2 in the loss state:

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

Accounting for risk attitudes (Risk Aversion (RA) or Risk Loving (RL)) her preferences are represented either by a concave or a convex utility function U(W). In both cases, 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 decision maker will buy a positive insurance coverage whenever at least one insurance arrangement is improving her well-being exists. This idea is expressed by the following participation condition (PC), where $EU(0) = (1-q)\,U(W_0) + q\,U(W_0 - x)$ represents the expected utility without any insurance coverage:

$$\begin{aligned} & EU(I) \geq EU(0) \\ \Leftrightarrow\ & (1-q)U(W_0 - pI - C) + q\,U(W_0 - pI - C - x + I) \geq EU(0) \qquad (PC) \end{aligned}$$

This theoretical framework characterizes the necessary conditions for choosing a positive insurance coverage and, if appropriate, the optimal level of coverage. The first order conditions (FOC) for positive insurance coverage, and also conditions for corner solutions (market exit and full insurance), are studied in Appendix.

2.2 The EU Theoretical Predictions

According to the experimental setting, the theoretical predictions for the insurance demand I (prohibiting over-insurance) are presented in Table 1.

Two fixed costs levels – (C = 0) and (C > 0) – are crossed with three unit price values: less-than-actuarial (p < q), actuarial (p = q), and more-than-actuarial (p > q).

Table 1: Insurance demand by contract and attitude toward risk

	Less-than-actuarial unit price $p < q$		Actuarial unit price $p = q$		More-than-actuarial unit price $p > q$	
	$C = 0$	$C > 0$	$C = 0$	$C > 0$	$C = 0$	$C > 0$
RA	$I^* = x$ [a]	$I^* \in \{0,x\}$ [a]	$I^* = x$ [a]	$I^* \in \{0,x\}$ [a]	$I^* \in [0,x[$	$I^* \in [0,x[$
RN	$I^* = x$ [a]	$I^* \in \{0,x\}$ [a]	$I^* \in [0,x]$	$I^* = 0$ [a]	$I^* = 0$ [a]	$I^* = 0$ [a]
RL	$I^* \in \{0,x\}$ [a]	$I^* \in \{0,x\}$ [a]	$I^*=0$ [a]	$I^*=0$ [a]	$I^*=0$ [a]	$I^*=0$ [a]

a: Cases compatible with the AoN hypothesis.

Table 1 unambiguously underlines a key feature: the theoretical demand for insurance is strongly dichotomic, with 15 cases out of 18 where insurance demand is split between two optimal values: no insurance (0) or full insurance (x). The binary nature of individuals' behavior is consistent with the All-or-Nothing rule (AoN hypothesis). Some exceptions are for risk-averse participants facing a more-than-actuarial unit price.[2]

[2] When the unit price is actuarial and the fixed cost is zero, RNs are indifferent between all levels of coverage. They can choose to cover partially as well.

3 The Experimental Design[3]

The experiment was conducted in Montreal (Canada) with 117 participants (mainly students but also workers of various ages, both male, and female) and is outlined below.

The demand-for-insurance

This experiment was designed to analyze the determinants of the demand for insurance. Each subject had to participate in six rounds corresponding to six different tariffs. At the beginning of each round, participants were endowed with 1000 UME and faced a 10% risk of losing their entire wealth, which could be covered by purchasing insurance. Paying a premium P at the beginning of the round ensured the subjects received a compensation I for their loss in case an accident occurred in the round. The premium increased with the desired level of compensation according to the following two-part tariff equation, where C and p stand respectively for the fixed cost and the unit price of insurance: $P = pI + C$.

The participants had to choose whether to buy insurance and if so, how much, from a fee schedule of unit prices and fixed costs (see, as an example, Table 2 below). At the end of the round, the event (accident versus no accident) was drawn at random. In the case of an accident, if the subjects had chosen not to purchase insurance, their entire wealth was lost. They received compensation otherwise. If no accident occurred, the subjects kept their whole wealth (net of the premium if the insurance was subscribed).

Table 2: Insurance premium schedule

(1) Premium P	0	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150
(2) Indemnity I	0	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
(3) Add. indemnity	-	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

(1) Total cost of insurance with p = 0.1 C=50
(2) Demand for Insurance: Reimbursement in the event of damage
(3) Additional indemnity from an additional UME of premium

Then, the subjects were asked to play five more rounds involving different tariffs. All six contractual prices were obtained by crossing three unit prices (less-than-actuarial, $p = 0.05$; actuarial, $p = 0.10$, and more-than-actuarial, $p = 0.15$) with two levels of fixed cost ($C = 0$ and 50).

The order of the rounds was randomized to avoid potential unintended order effects. The subjects started each round with a clean slate, to evade a wealth's effect: previous subjects' earnings and losses

[3] Full details of the experimental protocol are in Corcos et al. (2017).

were not cumulative between rounds, making the rounds independent of one another. As part of the subjects' remuneration, one of the rounds was drawn at random and played with the final net UME wealth converted into Canadian dollars.

The risk attitude elicitation

Before those six demand-for-insurance rounds, the subjects' risk attitude was elicited using an adapted-Holt-and-Laury procedure. The proposed lotteries (see Table 3 below) involved losses (rather than gains) to fit the insurance context.

Table 3: Measurement of risk attitude

Decision	Option A				Option B				
	% Probability	Loss (in $)	% Probability	Loss (in $)	% Probability	Loss (in $)	% Probability	Loss (in $)	Expected Payoff Difference E(A)-E(B)
1	10	-4	90	-6	10	0	90	-10	3.2
2	20	-4	80	-6	20	0	80	-10	2.4
3	30	-4	70	-6	30	0	70	-10	1.6
4	40	-4	60	-6	40	0	60	-10	0.8
5	50	-4	50	-6	50	0	50	-10	0
6	60	-4	40	-6	60	0	40	-10	-0.8
7	70	-4	30	-6	70	0	30	-10	-1.6
8	80	-4	20	-6	80	0	20	-10	-2.4
9	90	-4	10	-6	90	0	10	-10	-3.2
10	100	-4	0	-6	100	0	0	-10	-4

For ethical reasons, subjects were provided with 10 CAD beforehand to cover their potential losses. As Etchart-Vincent and L'Haridon (2011) have shown, this provision does not substantially alter the participants' behavior despite a possible house money effect (Thaler and Johnson, 1990). As a standard feature, one decision out of ten was randomly selected, and the lottery played. The resulting losses, if so, were then further deducted from the subject's prior $10 endowment.

The incentive procedure

The remuneration was threefold: (1) a $10 endowment to cover (2) the potential losses encountered in the risk-attitude-elicitation step and (3) the potential gains from the insurance-drawn round. The subjects were fully informed in advance of the various components of their gains. The earnings were only disclosed at the end of the experiment avoiding possible wealth effects. The hourly rate of remuneration was about $15.

4 Results

The risk attitude distribution was measured as the number of times a subject chooses the least risky lottery. As RAs and RNs are not empirically distinguishable, they have been combined.[4] RAs (resp. RLs) are those who have chosen option A—the least risky one—at least five times (resp. at most four times). According to our classification of risk attitude, almost 43% of subjects are RLs. This high proportion of RLs is expected with the Holt and Laury protocol applied in the loss domain.

Overall, except for a few subjects whose risk-attitude coefficient exhibits extreme values, 85% of the participants show coefficient values between 3 and 6.

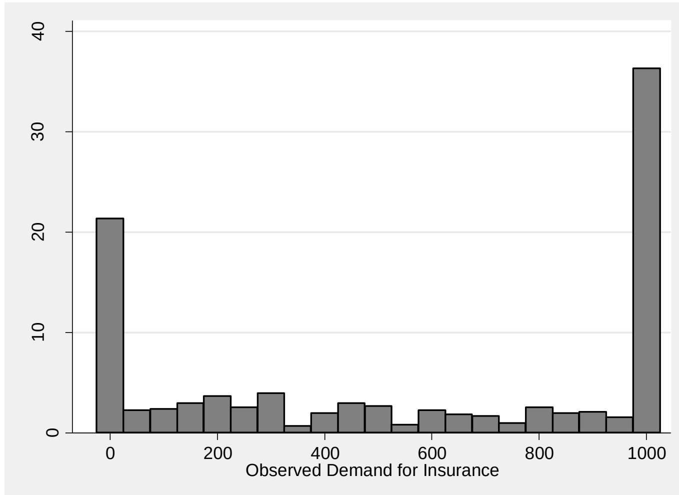
The following sections focus on the behavior of the demand for insurance. The first section examines the insurance demand from a static point of view using descriptive statistics and a K-S test. The econometric model allows us to conduct a dynamic study of insurance demand.

4.1 Descriptive statistics of the matching of the observed demand with the theoretical demand

For all contracts, the subjects chose an average coverage of 556 EMU, for a mean premium of 71 EMU. These average values should be interpreted cautiously as the experimental data in Table 4 strongly point out the bimodality of the demand for insurance: the all-or-nothing options (2 values out of 21) have been picked in 57% of the insurance decisions (full insurance has been selected in 36% of cases and no insurance in 21%), which already seems consistent with the AoN hypothesis. This is enlighted with Figure 1 below.

[4] As emphasized in Andersen et al. (2006), a multiple price list method provides the intervals for the risk-aversion coefficient (under the CRRA assumption). The H&L procedure does not allow distinguishing between RNs and RAs which are pooled.

Figure 1: Demand for insurance

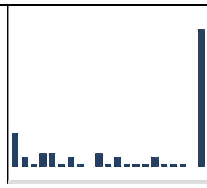
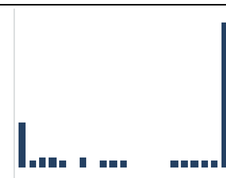
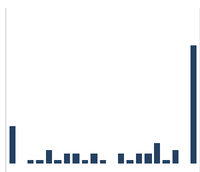
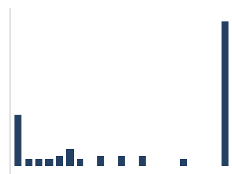
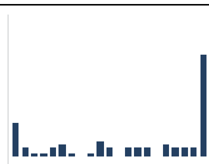
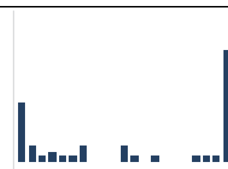
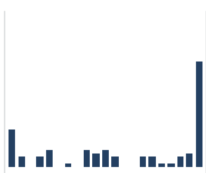
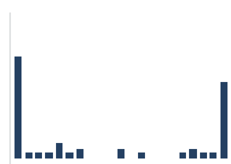
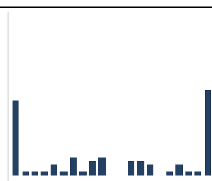
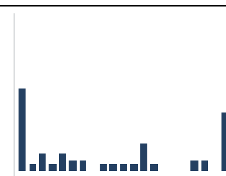
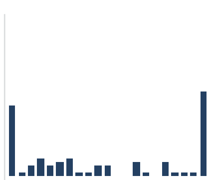
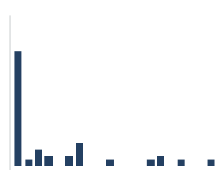


With a one-sample Kolmogorov-Smirnov test assuming a uniform distribution, we reject that, in Table 4, the decisions of the participants to buy insurance are random choices (specifically, we reject that the sample data follow a uniform distribution).[5] Table 4 suggests that the predictions of EU model are more consistent with the all-or-nothing choices than the random ones.

In Table 4, for both RAs (columns a) and RLs (columns b), and for all contractual parameters, columns 1(a,b) report the theoretical predictions of the Mossin-adapted EU model. In columns 2(a,b), the observed distributions of choices are illustrated in graphical forms. Three descriptive statistics are presented in columns 3(a,b). The first two statistics give the proportion of participants whose choices are compatible with the EU model and the proportions of participants that would have chosen the same EU predicted theoretical values if their choices were randomly drawn from a uniform distribution. The third statistics (in brackets) report the proportions of AoN choices of the participants. For example, with the contractual parameters $p<q$ and $C>0$, 55.22% of RAs chose the EU predicted values (0 and 1000) while the random choices predict that only 9.52% of the participants would have chosen the same values. With those contractual parameters, 55.22% of the observed decisions were all or nothing choices.

[5] According to a uniform distribution, any of the 21 potential choices has a 4.76% probability to be selected.

Table 4: Observed and theoretical distributions of the demand for insurance

Contractual parameters		RA (+neutrality)			RL		
p	C	Theoretical predictions (1a)	Observed Distribution (2a)	%EU vs RC[a] (%AoN) (3a)	Theoretical predictions (1b)	Observed Distribution (2b)	%EU vs RC[a] (%AoN) (3b)
Less-than-actuarial price *p<q*	*C=0*	I*=1000		**47.76 vs 4.76 (59.70)**	I*∈ {0,1000}		**68 vs 9.52 (68)**
	C>0	I*∈ {0,1000}		**55.22 vs 9.52 (55.22)**	I*∈ {0,1000}		**68 vs 9.52 (68)**
Actuarial price *p=q*	*C=0*	I* ∈ [0,1000]		**100 [b] vs 100 (52.24)**	I*=0		**22 vs 4.76 (62)**
	C>0	I*∈ {0,1000}		**50.75 vs 9.52 (50.75)**	I*=0		**38 vs 4.76 (66)**
More-than-actuarial price *p>q*	*C=0*	I* ∈ [0,1000[		**71.64 vs 95.24 (53.73)**	I*=0		**28 vs 4.76 (48)**
	C>0	I* ∈ [0,1000[		**71.64 vs 95.24 (52.24)**	I*=0		**42 vs 4.76 (64)**

a:RC: random choice
b: trivial case.

For RAs, whenever the unit price is actuarial or less-than-actuarial, the extended Mossin's model predicts better (or as good as for the trivial case) than the random choice model. However, when the price is more than actuarial, the random choice model fits better the data. For these two cases, more than 28% of RAs participants buy full insurance when they are not expected to do so. This situation indicates a lack of sensitivity to unit prices as the price is more-than-actuarial.

Regarding RLs, the extended Mossin's model always provides a better fit to the data than the random choice alternative. However, for the 4 cases with actuarial or more than actuarial unit price of insurance, this observation must be qualified as all RLs should have left the market with those contractual parameters. Instead, in one case ($p=q$ and $C=0$), 40% of RLs participants bought full insurance.[6] Risk lovers seem reactive to the windfall effect of a zero fixed cost.

Overall, participants' decisions fit fairly well with the EU model and do not appear to be random choices. Nevertheless, cases where the random choice model beats the EU model reveal a lack of responsiveness to insurance pricing (whether unit price or fixed cost), disclosing the participants' preference for full coverage. Indeed, they keep buying full coverage when they should have left the market (RLs) or switched to partial coverage (RAs).

Moreover, all but one cases exhibit a proportion of all-or-nothing choices over 50%, which makes it a very striking statistic meaning that 2 levels of coverage out of 21 bring together more than 50% of the choices. This observation underlines, if needed, the participants' attractiveness for AoN choices.

4.2 The econometric model

Providing a static comparative analysis of the data, the econometric model brings further insight at the individual level. It yields an understanding of how the unit price of insurance, fixed cost, and risk attitude intertwine to explain the demand for insurance. According to risk attitudes, the model estimates the effects on the individual demand for insurance of a variation in contractual parameters. For RLs, to account for the dichotomous features of the insured's choices following the theoretical predictions, the insurance decision has been broken down into the Propensity of No Insurance or Full Insurance (PNIFI). For the RA participants, the decisions have been partitioned into three mutually exclusive elements: whether not to insure (the Probability Not to buy Insurance PNI), whether to get Fully Insured (PFI) and how much Coverage to choose for Partial insurance (PD). The last component is the coverage of insurance of those who decided to buy some, excluding full insurance. For RAs, the distinction between PNI and PFI is justified by the fact that when prices are more-than-actuarial,

[6] For the other cases, the proportions of RLs fully insured are 28% with $p=q$ and $C>0$, 20% with $p>q$ and $C=0$, and 22% with $p>q$ and $C>0$.

individuals can choose only partially to insure. This situation makes the insurance decision theoretically no longer dichotomous.

The following econometric sequence links with our theoretical model.[7]

For the RA participants, the first type of decision is to estimate the determinants of choosing not to insure with a Random effect Probit model (the PNI model). The second kind of decision also refers to a Random effect Probit regression to estimate the determinants of buying full insurance. The third one estimates the demand for partial coverage that is superior to zero but inferior to 1000 UME. A robust Random-effects GLS regression will be used to obtain the determinants of partial insurance coverage.

For RL participants, confronted with an unbalanced data set, a linear probability model using a robust Random-effects GLS regression will be used to obtain the determinants of no insurance relative to the decision to fully insure (PNIFI).

The explanatory variables covering all the dimensions of the demand to buy insurance are *DCOST50, DLACT*, and *DMACT*. All are 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, therefore, the actuarial unit price and the zero fixed cost.

Table 5 summarizes the variables and their expected effects for the econometric models derived from the theoretical predictions of Table 1.

For RAs

According to column (1) of Table 5, relative to an actuarial unit price, a less-than-actuarial price could decrease the probability of RAs not to buy insurance (DLACT $\leq$ 0).[8] On the other hand, a more-than-actuarial unit price (DMACT) and a positive fixed cost (DCOST50) could contribute to increasing the probability of RAs not to buy insurance.

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[7] In the spirit of the double-hurdle model of Engel and Moffat (2012), we first considered running a Probit model to account for the observability rule. However, as more than 95% of the individuals who participated in our experiment bought at least one insurance contract, we were unable to converge to a solution with the double hurdle Engle-Moffat Stata procedure. In the econometric model, we have therefore discarded the five individuals who never bought insurance.

[8] All the inequality signs refer to the sign of the coefficient associated with the variable considered.

In column (2), we observe that the shift from an actuarial unit price to a less-than-actuarial unit price could increase the likelihood of RAs to cover (DLACT ≥0) fully. An expected negative sign is associated with a positive fixed cost (DCOST50 ≤ 0).

The last column of Table 5 related to RAs deals with the demand for partial insurance (Iϵ]0;1000[). The RA participants should partially cover only when the unit price is more-than-actuarial.[9] Therefore, we cannot predict the coefficients related to the unit prices of the regression: the partial demand does not exist for a less than or equal to actuarial unit price, and thus the comparison with the situation of a more-than-actuarial unit price is not feasible.

For RLs

As for RLs, the insurance unit price plays a leading role in their decision to buy no insurance rather than full insurance. A less-than-actuarial unit price should encourage RLs to take full insurance instead of no insurance (DLACT < 0). Conversely, regardless of the fixed cost level, when the unit price is actuarial or more-than-actuarial, RLs are expected not to participate in the market (DMACT = 0).

The fixed cost is relegated to a more distant role, and when the unit price is less-than-actuarial, a positive fixed cost should encourage RLs not to participate in the market (DCOST50*DLACT > 0) rather than to buy full insurance. However, due to the small number of observations, we only consider DCOST50 > 0.

[9] For the RNs, when the price is actuarial and the fixed cost zero, see footnote 2.

Table 5: Expected effects of the independent variables

	RA			RL
Explanatory variables	Likelihood not to buy insurance (PNI) (1)	Decision to buy a full-insurance coverage (PFI) (2)	Partial Demand for insurance RA participants 0 < PD < 1000 (3)	Likelihood not to buy insurance relative to full-insurance coverage (PNIFI) (4)
DLACT	≤ 0	≥ 0	nd	< 0
DMACT	≥ 0	< 0	nd	= 0
DCOST50	≥ 0	≤ 0	= 0, > 0 or < 0 *	>0

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

In Table 6, we report the estimates of the insurance demand models.

RAs

The probability not to buy insurance or to buy full insurance

In column (1) of Table 6, we report the determinants of not buying insurance using a Random effect Probit regression with 1 if individual *i,* facing contractual parameters *s,* does not buy insurance and 0 otherwise. Likewise in column 2, for the demand for full insurance, with 1 if individual *i,* facing contractual parameters *s,* buys full insurance and 0 otherwise.

All the RAs' theoretical predictions are borne out by the econometric estimations. The threefold estimated model underlines RAs' behavioral key feature: only a more-than-actuarial unit price determines their insurance decision. It deters RAs from buying full coverage and increases their likelihood to exit the insurance market. By contrast, neither the fixed cost nor a less-than-actuarial unit price seems to have a significant impact on any of those components of the insurance demand (PNI and PFI).

The demand for partial insurance

With a random effect unbalanced GLS regression, column (3) in Table 6 reports the determinants of buying partial insurance for p = 0.15 (excluding 0 and 1000 UME). Only the constant term (at the 1% level of significance) is statistically significant with a value of 488.40, contradicting the theoretical expectations related to the more than actuarial unit price.

RLs

Referring to a linear probability model (with 1 if individual *i,* facing contractual parameters *s,* does not buy insurance and 0 if buying full coverage), and with a random effect unbalanced GLS parameter estimates, we report in column (4) of Table 6 that all the parameters are significant (at least at a two-tail 10% level). As the unit price increases, RLs leave the market and simultaneously forgo full insurance. The extent (and the significance) of the crowding out effect decreases with the unit price. If the eviction observed when the price shifts from less-than-actuarial to actuarial complies with the theoretical predictions, the decision observed when switching to a more-than-actuarial price may be surprising since all RLs should theoretically have left the market as soon as the price was actuarial. A positive and statistically significant DMACT does not support the theoretical predictions. The descriptive statistics and the econometric model) show their complementarity and allow for a deeper understanding of RLs' insurance choices. As pointed out in the previous section, RLs'-attractiveness-to-a-zero-fixed-cost maintains RLs in a market where they fully insure, canceling out the deterrent effect of high unit prices and making the DMACT coefficient significant. It is of no surprise that accordingly the fixed cost does deter RLs from participating in the insurance market at the 3.8% level of significance (one tail test).

Table 6: Estimates of the insurance demand models for the participants

Explanatory variable	RAs: Likelihood not to buy insurance (PNI) (1)	RAs: Decision to buy a full-insurance coverage (PFI) (2)	RAs: Partial Demand for insurance 0 < PD < 1000 (3)	RLs: Likelihood not to buy insurance relative to full-insurance coverage (PNIFI) (4)
DLACT: 1 if the unit price is less than actuarial (0.05); 0 otherwise	- 0.092 (0.739)	0.326 (0.113)		-0.226*** (0.002)
DMACT: 1 if the unit price is more than actuarial (0.15); 0 otherwise	0.747*** (0.003)	-0.515** (0.017)		0.154* (0.059)
DCOST50: 1 if fixed cost = 50; 0 otherwise	- 0.008 (0.969)	-0.127 (0.457)	-71.257 (0.191)	0.119* (0.076)
Constant	- 1.956*** (0.000)	-0.346 (0.183)	488.40** (0.000)	0.368*** (0.000)
Observations	384	384	63	176
Number of subjects	64	64	38	39
Wald chi2	13.54 (0.004)	15.04 (0.002)	1.71 (0.191)	29.29 (0.000)
Rho	34.12*** (0.000)	118.27*** (0.000)	$R^2 = 0.013$	$R^2=0.122$

p-values in parentheses (two-tail tests): *** p < 0.01, ** p < 0.05, *p<0.1

The findings further suggest that RLs leave the market first (DLACT coefficient only significant for RLs) followed by RAs (DMACT coefficient significant for both RAs and RLs)

Three key results concern the all and nothing decisions: 1) For RAs, the non-significance of the model of partial demand emphasizes how RAs' demand for insurance translates into the full insurance/no insurance choices 2) As the unit price increases, participants RLs first, then RAs exit the insurance market and forgo full insurance, as highlighted in columns 1 and 4 of Table 6. This again underlines the all-of-nothing feature of the insurance decisions; 3) The only significant effect of a zero fixed cost is to drive RLs into the insurance market where they fully insure.

5 Discussion and conclusion

Using the theoretical assumptions of the extended-Mossin model, this paper addresses the issue of the all-or-nothing hypothesis of insurance demand for risk-loving and risk-averse individuals. A graphical representation provides a static analysis and a global fit between the EU theory and the data, controlling for contractual parameters and risk attitudes. The econometric model provides static comparative analysis of the individual demand for insurance. Both approaches confirmed the strong attraction to the corner solutions predicted by the theory: full insurance coverage or no insurance. According to Table 4, whenever EU predictions are supported, they are compliant with the AoN behavioral pattern; whenever these predictions are not supported, the AoN assumption provides a strong fit to data. The econometric model strengthens the evidence for the AoN behavior since the extended EU model of partial demand is insignificant while contractual parameters – unit price and fixed cost – are found to be decisive in motivating full insurance or exit from the market.

Both approaches examine the role played by the key contractual factors on the individual propensities to buy no insurance or to fully insure. A fall in the unit price of insurance has an incentive effect on both risk-lovers' and risk-averters' demand for insurance: as the unit price decreases, risk-averse participants are the first to enter the market to purchase a full contract followed by risk lovers (who do the same). However, a zero fixed cost has an incentive effect on risk lovers only who are prone to enter the market (and buy full insurance) when the fixed cost is nil.

If the extended EU model describes fairly well the behavior of participants, however, the AoN assumption provides a strong fit to data that cannot be explained entirely by our theory and other studies discussed in the introduction.

How to elucidate this attraction to extreme choices? Shapira and Venezia (2008) show that in a series of experiments the full-insurance contract acts as an anchoring point. Also although the 0 or 1000 cannot be considered as focal points as in coordinating game theory, an article by Sugden and Zamarrón (2006) discussing Schelling's the strategy of conflict (1960) offers interesting clues on this question. The AoN choice can be seen as a pragmatic rule favoring strategies with certain properties of "salience."[10] However, from a normative point of view, our extended EU theory suggests that some money is left on the table, even though, very little.

This article is an additional piece of the insurance behavior characterization. By uncovering an all-or-nothing insurance behavior, it provides tangible elements to understand what prompts individuals to enter the market and to buy full insurance. Focusing on the differences between RAs and RLs, the risk attitude analysis is extremely promising. It provides the authorities with evident and functional public policy keys. Above all, bear in mind that the all-or-nothing behavior property reverses the way in which insurance policy should be thought. Public authorities are now questioning the ways to increase the individuals' amount of coverage. They set up a fine-tuning of policies to offer a coverage amount seen as optimal. Our results show that, rather than focusing on the amount, governments should instead consider how to push individuals into the insurance market, the latter then naturally choosing a full coverage. Also, the all-or-nothing situation and the in particular "nothing" case provides a theoretical foundation for a minimum compulsory coverage to make sure that the whole population is covered.

Acknowledgments

This work is partially supported by a grant overseen by the French National Research Agency (ANR) in the context of the "Investissement d'Avenir" program, through the "iCODE Institute project" funded by the IDEX Paris-Saclay, ANR-11-IDEX-0003-02.

[10] In our case, saliency points could consist of the two extreme values (0 and 1000) but also the value in the middle of the insurance choice grid. This last point was not the choice of the participants.

Appendix

The decision maker, whether risk-loving, risk-neutral, or risk-averse, takes into account the participation condition (PC): $(1-q)U(W_0 - pI - C) + qU(W_0 - pI - C - x + I) \geq EU(0)$, and solves the following problem:

$$\max_{I} EU = (1-q)U(W_0 - pI - C) + qU(W_0 - pI - C - x + I)$$

A.1 For a risk averter (RA), the utility function is strictly concave, and if condition (PC) is satisfied, the following first-order condition (FOC) characterizes the optimal level of coverage for an interior solution:

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

The second-order condition is trivial.[11] Then, the FOC and the condition (PC) give rise to the main features of interior solutions.

When the unit price of insurance is actuarial ($p = q$), the optimal choice for the RA is to buy a complete coverage ($I^* = \mathrm{x}$) or no insurance if $C > \hat{C}^*$.

When the unit price of insurance is less than actuarial ($p < q$), an RA prefers to be over-insured (so $I^* = \mathrm{x}$ since over-insurance is not allowed), except if C is too high.

When the unit price of insurance is higher than actuarial ($p>q$), an RA individual opts for a partial insurance coverage $(I^* < \mathrm{x})$ or no insurance if C is a deterrent.

To consider the corner solutions (the exit and full insurance conditions), we need to evaluate the FOC at I = 0 and I = x:

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

$$\left.\frac{\partial \mathrm{EU}}{\partial \mathrm{I}}\right|_{\mathrm{I=x}} = (\mathrm{q} - \mathrm{p})\mathrm{U}'(\mathrm{W}_0 - \mathrm{px} - \mathrm{C}) \geq 0 \qquad \text{(FOCb)}$$

The decision maker (DM) will leave the market under two circumstances:

[11] For a risk averter, the marginal utility is decreasing and we get: $\frac{\partial^2 EU}{\partial I^2} = p^2(1-q)U''(W_1) + (1-p)^2\, qU''(W_2) < 0$.

- If (FOCa) is satisfied (which needs p>q since marginal utility is decreasing and implies condition $(\overline{PC}): (1-q)U(W_0 - pI - C) + qU(W_0 - pI - C - x + I) < EU(0); \forall I \in [0; x]$);
- If (FOCa) is not satisfied but $(\overline{PC})$ is;

Condition $(\overline{PC})$ is more likely to occur with high values of p and C since the left-hand side of this inequality is decreasing with p and C. Condition (FOCa) is decreasing with p but has an ambiguous behavior when C varies. If (FOCa) is true, then the left-hand side term of this inequality is decreasing with C if the utility is CARA or DARA; if (FOCa) is wrong, the effect of a rise in C would be ambiguous under the same requirements for the utility function, but it would boost the chances to satisfy $(\overline{PC})$.
Thus, *the likelihood of a market exit increases with p (for p>q) and with C.*
The DM will choose a full-insurance coverage if conditions (FOCb) and (PC) are simultaneously satisfied. This scenario requires p≤q and C to be relatively low.

A.2 For a risk-neutral (RN), the solution is trivial. An RN agent will find it profitable to get insured if the mathematical expectation of I is higher than P, so that qI ≥ pI + C.
For an actuarial unit price ($p = q$), a RN is indifferent to the level of coverage ($I^* \in [0,x]$) *if* $C = 0$ and chooses no insurance $(I^* = 0)$ if $C > 0$;
For a more-than-actuarial unit price ($p > q$), no insurance is purchased ($I^*=0$) at any fixed cost ($C \geq 0$);
For a less-than-actuarial unit price ($p < q$), the RN agents' demand for insurance is dichotomous: full insurance ($I^* = x$) is optimal when the fixed cost is nil; if $C > 0$, it is optimal to buy a full-insurance coverage ($I^* = x$) or no insurance at all ($I^* = 0$) if the fixed cost is dissuasive.
Again, *the likelihood of a market exit (resp. full insurance) increases (resp. decreases) with p and C. To summarize, for an RN individual, if* $px + C \geq qx$*, the market exit is optimal while full insurance is optimal if* $px + C \leq qx$.

A.3 For a risk lover (RL), 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.

For an actuarial or a more-than-actuarial unit price of insurance ($p \geq q$), (FOCa), the FOC evaluated at the no-insurance point (I = 0), is negative;[12] this is also true at the full insurance point (I = x).[13] In other words, due to the convexity of expected utility, the geometrical locus of all insurance coverages (for $0 \leq I \leq x$) belongs to the decreasing segment of the function EU(I). In this case, the optimal demand for insurance is zero.

For a less-than-actuarial unit price of insurance ($p < q$), an RL chooses to either self-insure ($I^* = 0$) or buy full insurance ($I^* = x$).[14] 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 (i.e., EU(x) > EU(0)). Again, condition (PC) needs to be true, and the presence of a fixed cost may cause market exit.

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

Once more, the likelihood of a market exit (resp. full insurance) increases (resp. decreases) with p and C. For an RL decision maker, the market exit is optimal as soon as $px + C \geq qx$, while full insurance requires that $px + C$ is sufficiently below qx ($px + C < qx$ is necessary but not sufficient).

[12] Since $W_0 > W_0 - x$, $U'(W_0) > U(W_0 - x)$, since the RL's marginal utility is increasing with wealth, and $\left.\frac{\partial EU}{\partial I}\right|_{I=0} = -p(1-q)U'(W_0) + (1-p)qU'(W_0 - x) < 0$.

[13] $\left.\frac{\partial EU}{\partial I}\right|_{I=x} = (q-p)U'(W_0 - px) \leq 0$

[14] Again, full insurance is preferred since over-insurance is precluded.

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