How do lab data complement field data? An experimental analysis in the context of car insurance

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1. **Motivation**
2. Experimental design
3. Results
4. Main findings

General purpose

- Insurance demand depends on private / unobservable information:
  - Risk perception
  - Risk preferences

- Can lab experiments reveal any relevant information that may help predicting insurance choices? Or do standard demand model performed by insurance companies on the basis of observable variables already reflect implicitly these aspects?

- Objective of our experiment: combination of lab data with field data in order to assess the added-value of lab data in modelling car insurance demand

General purpose

- Information asymmetry and belief heterogeneity have been increasingly studied since the seminal work of RS (1976)

- On a competitive market, asymmetry information on risk preferences does not have dramatic economic impact. However, insurance markets do not necessarily feature perfect competition.

- On an oligopoly, the profitability of insurance companies depend on price elasticity which relates directly to risk preferences

General purpose

- Besides, many empirical studies could not find evidence of nonzero correlation between claims and coverage levels (adverse selection hypothesis)

- Information asymmetry may actually lead to advantageous selection:
  - De Mezza & Webb (2001): Risk preferences heterogeneity
  - Huang et al. (2010): Optimism of part of the policyholders

Research question

- Objective of the experiment
  - Assess the effect of risk perception and risk preferences as measured in a lab context on car insurance demand

- Methodology
  - Online experiment with customers of a motor insurance company
  - Combination of lab data with field data in order to study the correlation between experimental variables (risk preferences and risk perception) and real car insurance choices
  - Great advantage of having all the information of the insurance company, including the commercial premium of each coverage level

Theoretical predictions

- We refer to the standard EU-model
- Mossin's model:
  - The optimal level of coverage increases as risk aversion increases
  - Restrictions should be imposed either on the utility function or on the loss distribution in order to guarantee an unambiguous effect of risk change on insurance demand.
  - A Strict Increase in Risk raises the optimal coverage level (Some probability weight is taken from the initial density of x and sent either at its boundaries or outside the initial support)

Literature review

- University of Michigan Health and Retirement Study (HRS) and The Asset and Health Dynamics Among the Oldest Old (AHEAD)
  - Launched in 1992
  - 27 000 individuals aging more than 60 yo
  - Behavioral data collected and combined with real claims (adverse selection)
  - Risk aversion measured by hypothetical questions (without financial incentives)
  - Risk perception related to health insurance, long-term care (probability to enter a nursing home, survival probabilities, etc.)

- Petrolia et al. (2013)
  - Subjects from U.S. Gulf Coast and Florida's Atlantic Coast
  - Risk aversion, measured according to HL, is statistically correlated to flood insurance
  - Subjective probability is not a determinant of flood insurance

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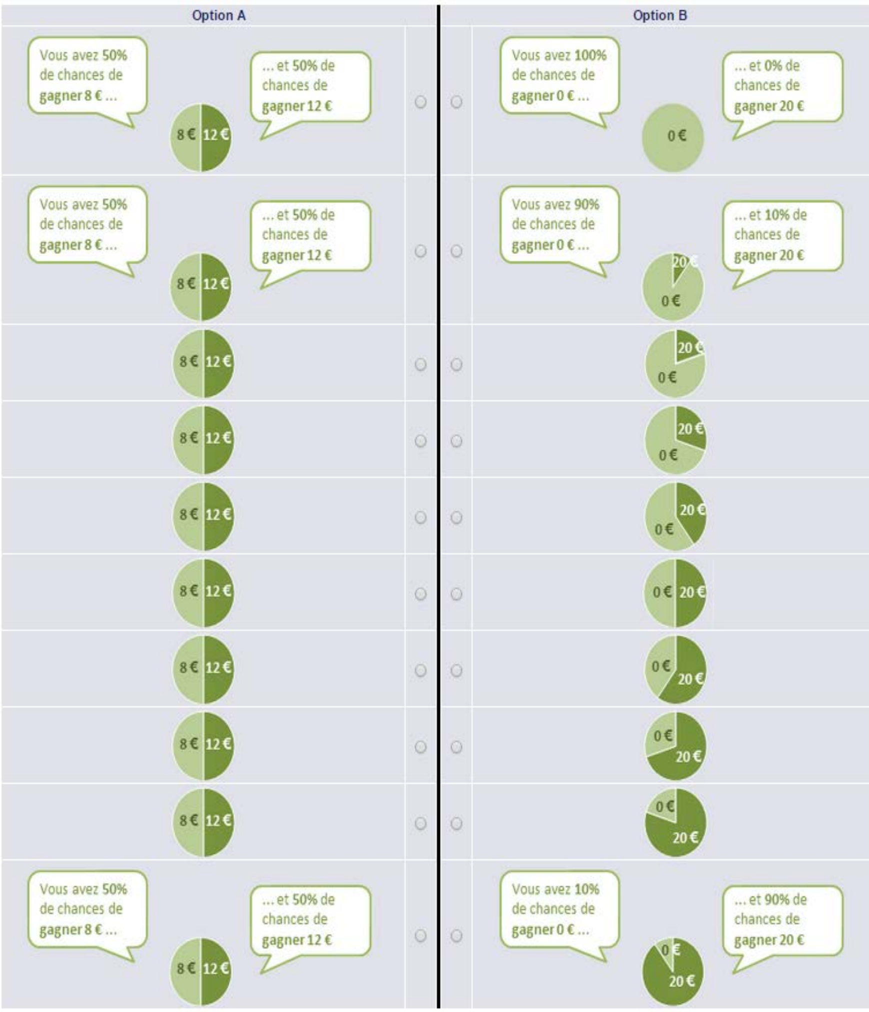
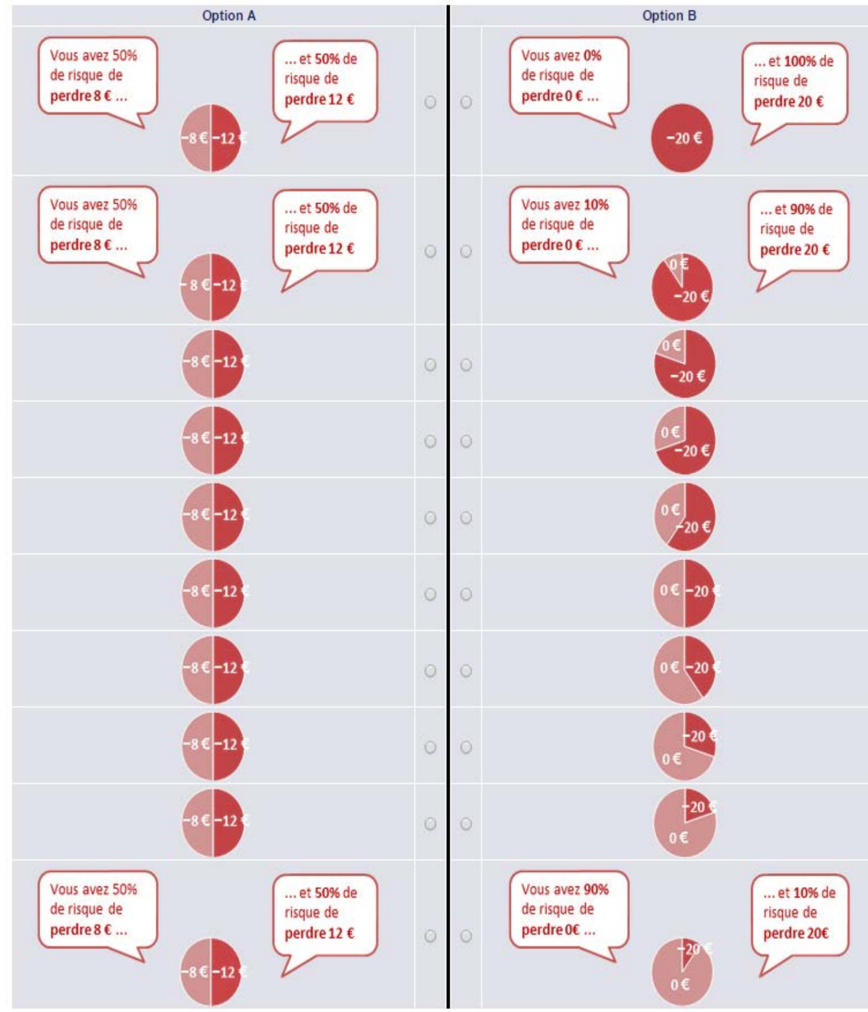
Experimental design

- Online experiment administered by Harris-Interactive
- Two samples:
  - Insurance company (chosen among 25 000 Opt-In customers)
  - Polling-institute
- Quotas: gender, age, region
- Main steps in random order:
  - Risk preferences elicitation
  - Risk perception elicitation
  - Lab Insurance choices
  - Last step: general information (age, income, previous claims, etc.)

Risk aversion measure





Insurance product

		Coverage level			
		1	2	3	4
	Third Party Liability	✓	✓	✓	✓
Claims not involving the liability of the policyholder	Glass		✓	✓	✓
	Natural Catastrophes & Climatic Events		✓	✓	✓
	Fire			✓	✓
	Theft			✓	✓
	Collision & comprehensive				✓

Risk perception

Cette phase concerne **le véhicule que vous avez déclaré** (ALEKO - 2141) et qui représente le véhicule que vous utilisez à titre principal.

Pour chaque type de sinistre, quelles sont vos chances sur 100 que ce sinistre vous arrive à vous personnellement au cours de l'année prochaine ?

Par exemple,

si vous mettez un pourcentage égal à 50%, cela représente en moyenne un accident tous les 2 ans
si vous mettez un pourcentage égal à 10%, cela représente en moyenne un accident tous les 10 ans
si vous mettez un pourcentage égal à 5%, cela représente en moyenne un accident tous les 20 ans.

Type de sinistre		**Quelles sont vos chances sur 100 d'avoir ce sinistre au cours de l'année prochaine ?** (mettez un nombre compris entre 0 et 100)	**Montant moyen des dégâts occasionnés en cas de survenance**
Accidents n'engageant pas votre responsabilité	Bris de glace Pare-brise, lunette arrière, glaces latérales	%	
	Incendie Y compris en cas d'émeutes	%	
	Vol	%	
	Tempêtes, catastrophes naturelles et attentats	%	
Accidents engageant pleinement ou partiellement votre responsabilité et/ou sans tiers identifié ■ accident avec un autre véhicule identifié ou non ■ accident dans lequel seule votre voiture est impliquée ■ acte de vandalisme ■ chute d'un objet	dont le coût des dégâts subis par votre véhicule est inférieur à 400 €	%	
	dont le coût des dégâts subis par votre véhicule est compris entre 400 et 3000 €	%	
	dont le coût des dégâts subis par votre véhicule est supérieur à 3000 €	%	

Lab insurance choices

- Subjects are endowed with 10 000 ECU and incur a 20% risk of losing this amount
- They have to chose an insurance policy

Choix d'assurance

Vous avez donc **20% de risque de perdre** vos **10 000 UME**.

Le tableau suivant vous indique les différents niveaux de couverture possibles.

Niveau de couverture	1	2	3	4	
Plafond de remboursement	4 000	6 000	8 000	10 000	Coverage limit
Cotisation d'assurance	800	1200	1600	2000	Insurance premium
Choix d'assurance	○	○	○	○	

Exemple

Si vous choisissez le premier niveau de couverture, vous devrez payer une cotisation de 800 UME, ce qui vous donne droit, en cas d'accident, à un remboursement de 4000 UME.

Un sinistre sera tiré au sort aléatoirement avec **20% de risque** de survenir.

Si ce sinistre se réalise effectivement, l'assurance vous remboursera 4 000 UME. Votre gain impliqué par cette étape sera égal à :

10 000 (votre richesse initiale) - 800 (cotisation d'assurance) - 10 000 (coût du sinistre) + 4 000 (remboursement) = **3200 UME**.

Si le sinistre ne survient pas, votre gain impliqué par cette étape sera égal à :

10 000 (votre richesse initiale) - 800 (cotisation d'assurance) = **9200 UME**.

Results

- Period: July 2014
- Drop-out rate = 35%
- 511 subjects with full answers
- 184 subjects have been identified as customers with our partner with the same insured vehicle
- Average incentive: 23€

General information

	Customers	Panelists	p-value
Vehicle value	7434	8351	16.83%
Vehicle age**	8.7	7.6	2.27%
Full insurance coverage***	60%	72%	0.25%
Income (ordered variable, avg = 30 k€)	4.91	4.99	36.37%
Age	36	37	13.63%
Claims	22%	23%	80.21%

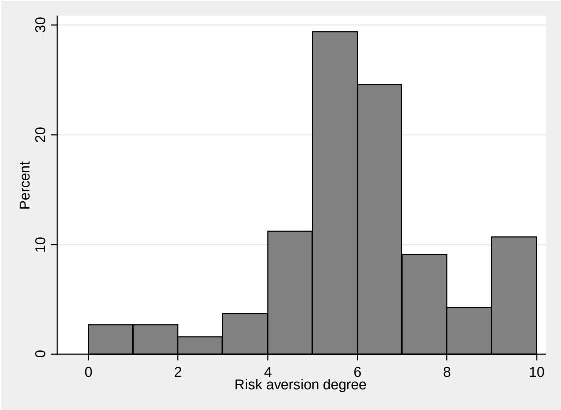
- Subjects from our insurance company partner have cheaper and older vehicles
- They are less likely to purchase a full comprehensive coverage

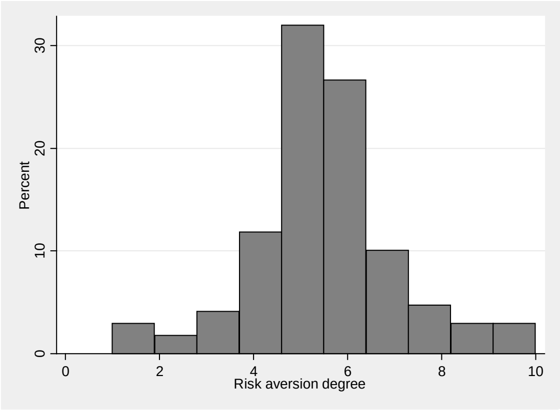
Risk aversion

	Customers	Panelists	p-value
Risk aversion in the gain domain	6.03	6.22	31.86%
Risk aversion in the loss domain **	5.6	6	3.21%
Switching back in the gain domain	12%	8%	15.92%
Switching back in the loss domain	14%	12%	60.93%

- Our partner's customers are more risk averse in the loss domain
- The percentage of subjects who switched back several times is nearly the same for both samples

Data cleaning





- Given the distribution of the risk aversion measure, we suspected that some subjects have systematically chosen option A without a real understanding of the experiment rules
- Consequently, some subjects (8%) have been excluded from the analysis. Exclusion based on answers to the other parts of the experiment, for instance 0% or 100% for all claims probability.
- Similar observation reported in Hergueux et Jacquemet (2015) – Social preferences in the online laboratory.
  - Over 180 In-lab and 202 Internet subjects, 4 (2%) have chosen option A in the last question vs. 22 (11%).
  - Similarly, 13 subjects switched back from option B to option A in the traditional experiment vs. 44 in the online experiment.

Risk aversion

	N	% of full comp.	Car age	Car value	Income	Age	Male	Driving license age	BM coefficient	Subj. probability	Insurance Premium (Comp)
Low risk averters	89	47%	7.9	7538	4.5	35	65%	13	78	36%	184
High risk averters	80	56%	8	6233	5.3	36	66%	14	70	33%	145
p-value		12%	36%	13%	5%	23%	44%	21%	2%	67%	83%

- High risk averters earn higher incomes and have a lower BM coefficient (drive more carefully)

Risk perception

	Subjective probabilities and costs			Objective probabilities and costs
	Customers	Panelists	p-value	
Glass breakage probability	24%	27%	13.5%	7%
Glass breakage cost (Euro)	240	251	23.61%	270
Fire probability	7%	7%	72.33%	0.6%
Theft probability	14%	15%	17.46%	1%
Natural catastrophes probability	12%	12%	45.95%	0.3%
Natural catastrophes cost* (Euro)	1948	2475	9.15%	1900
Small claims probability	24%	26%	13.13%	NA
Medium claims probability	20%	21%	40.21%	8%
Large claims probability	16%	16%	55.5%	2%

- Subjective probabilities and costs are nearly the same between both samples
- Subjective probabilities are much higher than objective ones

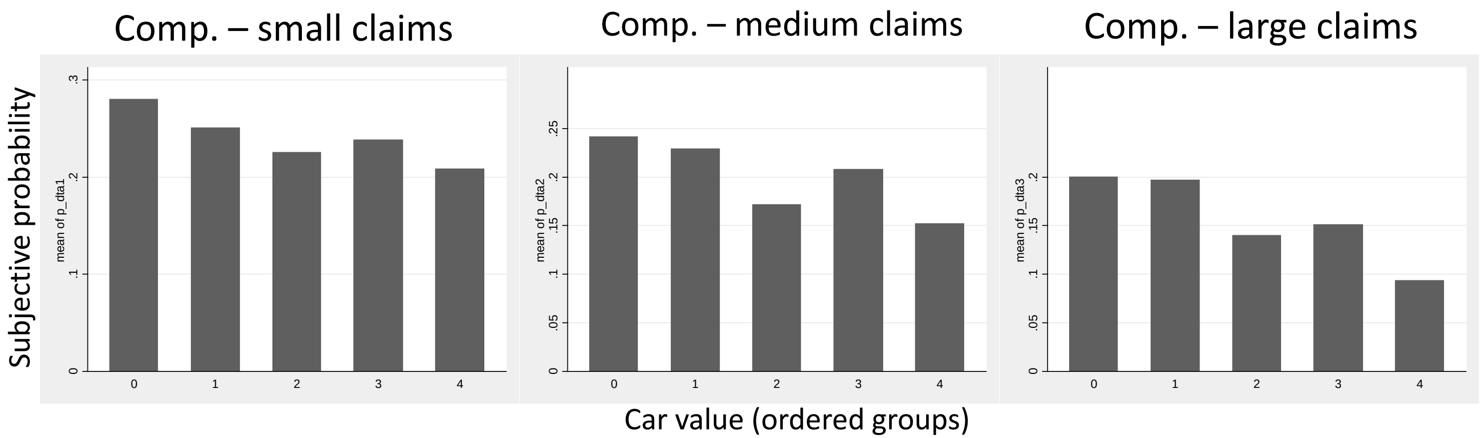
Risk perception

	N	Full comp. %	Car age	Car value	Income	Age	Gender (M=1)	Driving license age	BM coefficient	Risk aversion	Insurance Premium (Comp)
HSP	77	50%	8.4	6043	4.5	35	61%	13	76	5.4	165
LSP	92	53%	7.3	7994	5.4	36	71%	15	72	5.6	166
p-value		73%	18%	2%	3%	44%	19%	29%	23%	38%	93%

HSP/LSP: Subjects who reported High/Low subjective probabilities

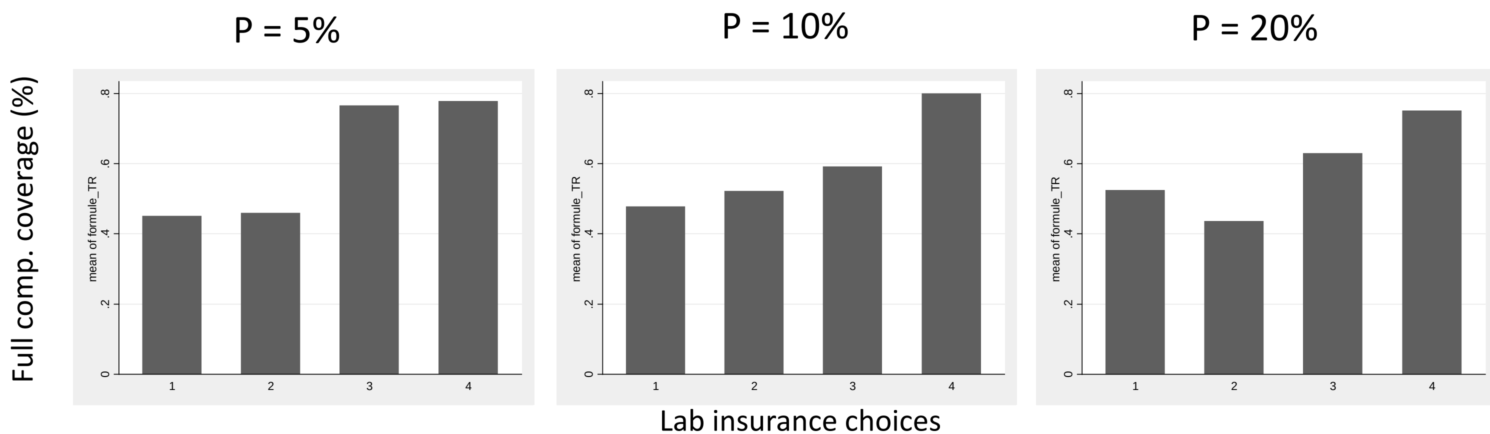
- Significant correlation between vehicle value and subjective probabilities
- Men report lower subjective probabilities. This is in line with many studies that address gender effect on risk perception (see for example (DeJoy, 1992), (Weber, Blais, & Betz, 2002)).

Negative correlation between subjective probabilities and car value



- Expensive vehicles are most likely to have better safety and crash-avoidance features

Lab insurance choices



- High correlation between Lab insurance choices and coverage levels

	N	TR	Car's age	Car's value	Revenue	Age	Gender	Driving license's age	BM coefficient	Subj. probability	Premium
High Cov	106	44%	7.1	7584	4.9	36	66%	14	76	35%	175
Low Cov	63	56%	9.1	5800	4.9	35	55%	14	72	34%	148
p-value		8%	36%	5%	51%	75%	55%	57%	88%	61%	12%

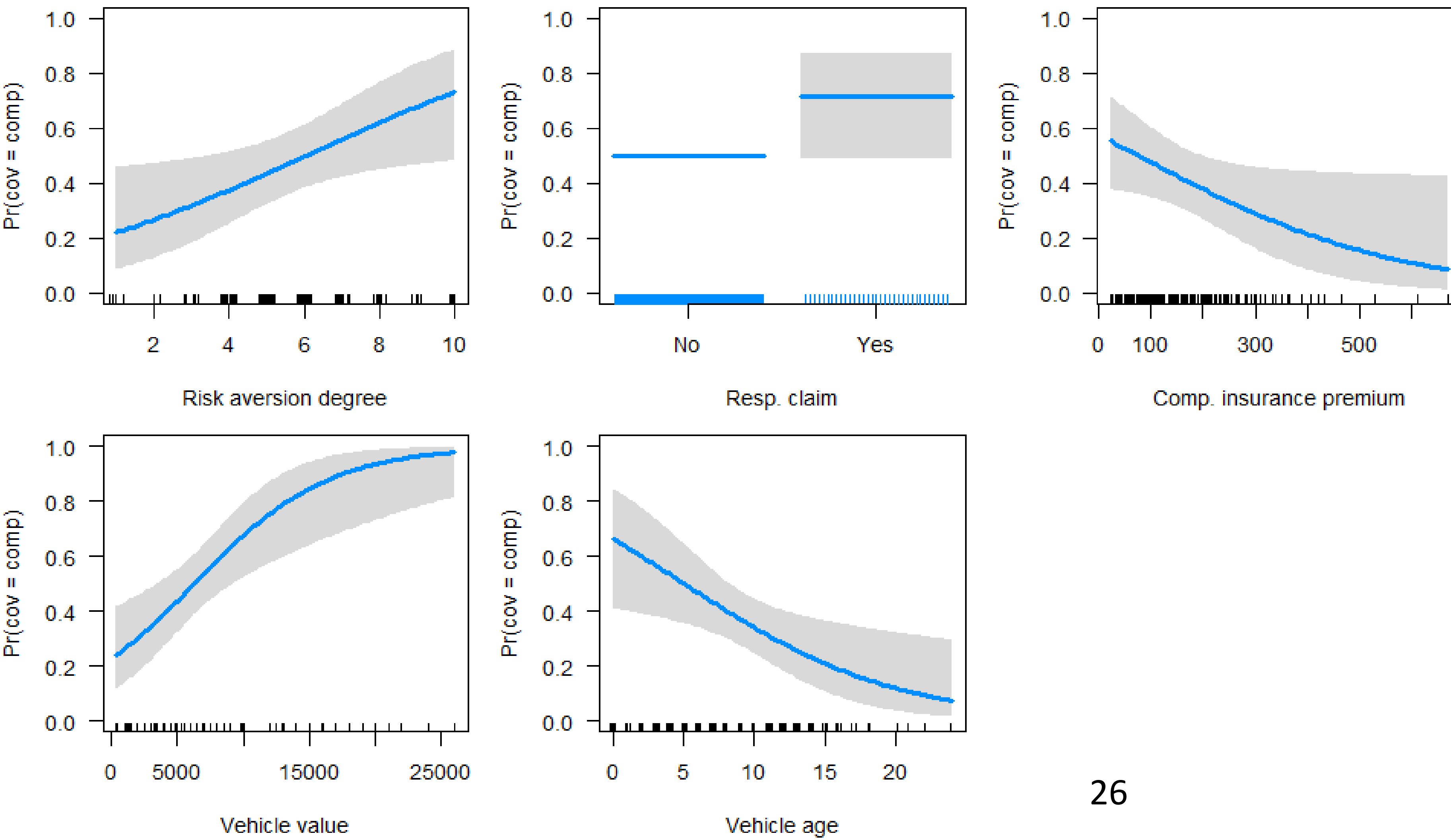
Econometric model

- Logit model for the full comprehensive choice (stepwise method)

Variables	Coef.	Sd. Error	Z	P>|z|	[95% conf. Interval]	
Risk aversion (Loss domain) **	0.252	0.111	2.260	2%	0.034	0.469
Previous claims (=1) *	0.932	0.502	1.860	6%	-0.051	1.915
Vehicle value ***	0.000	0.000	3.240	0%	0.000	0.000
Vehicle age **	-0.133	0.054	-2.460	1%	-0.240	-0.027
Commercial premium**	-0.004	0.002	-1.970	5%	-0.008	0.000
Intercept	-0.999	1.013	-0.990	32%	-2.985	0.987

- Ordered logit model has also been tested. The same variables are selected except for previous claims (p-value = 11%)

Comp. coverage w.r.t. model variables



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Main findings

- Significant correlation between risk aversion and full comprehensive coverage choice
- Validation of HL's measure in the loss domain as an appropriate risk preferences measure
- Subjective probabilities are much higher than the objective probabilities
- Subjective probabilities do not contribute to car insurance demand according to our result

- Further research could address the correlation between risk aversion, risk preferences and real claims , and test the adverse/advantageous selection hypothesis

Thank you!

Any question/suggestion?