The Predictive Validity of Risk Attitudes for Insurance Demand

Short Abstract

We analyze the extent to which insurance demand can be explained by different theories of risk attitudes. In an incentivized experiment (n=1,730), we elicit utility curvature, probability weighting, loss aversion, and a preference for certainty. We then ask subjects to make insurance choices in twelve different scenarios, varying loss probability and loading. Our results show that probability weighting and loss aversion both help to explain insurance demand. However, we find that parameterized decision models have little to no predictive power for explaining insurance choices. We draw implications of our findings for future studies of insurance demand and welfare analyses on insurance markets.

Executive Summary:

To what extent do we understand the nature of the risk attitudes that underlie the demand for insurance? Understanding the extent to which different theories of risk attitudes help explain insurance demand is important both for our general understanding of decisions under risk and for analysis of insurance markets. Structural models estimated from market data are a potentially important tool for conducting counterfactual policy analysis. These models can also be used to evaluate welfare in insurance markets. However, risk attitudes can be complex and incorporate both classic notions of risk aversion stemming from the diminishing marginal utility of wealth as well as a host of alternative considerations, including loss aversion, probability weighting, and preferences for certainty.

Cohen and Einav (2007) pioneered an approach to estimating risk aversion from observed insurance choices and estimated substantial underlying heterogeneity in risk aversion. Cohen and Einav's approach is based on estimating parameters for concave utility functions in a classic expected-utility framework. However, a number of other papers have provided evidence that other behavioral considerations influence insurance demand (Sydnor, 2010; Abaluck and Gruber, 2011; Barseghyan et al., 2013; Handel, 2013; Handel and Kolstad, 2015; Bhargava et al., 2013). Handel (2013) and Handel and Kolstad (2015) incorporated "frictions", such as inertia and consumer confusion, into the concave-utility approach of Cohen and Einav (2007) and find that accounting for frictions substantially affects estimates of risk aversion. Sydnor (2010) and Barseghyan et al., (2013) provide evidence, however, that there is a more fundamental misspecification in assuming that insurance demand can be explained by classic risk aversion. These papers argue instead that insurance demand may be better explained by alternative behavioral models in which risk attitudes are driven by loss aversion and probability weighting. Barseghyan et al., (2013), in particular, estimate structural models from insurance data and conclude that insurance demand is explained better by probability distortions than classical concave-utility.

A fundamental problem in this literature is that insurance choices cannot easily identify these different models of risk attitudes. Any given willingness to pay for insurance can typically be rationalized by many different sources of risk preferences (Sydnor, 2010; Barseghyan et al., 2013). Observing multiple insurance decisions by the same person can aid in identification (Barseghyan et al., 2013), however, those type of data are rare and in general there is a lack of information to guide researchers understanding of how to model the demand for insurance.

In this paper we address this question from a new angle. Instead of trying to infer risk attitudes from insurance choices, we measure risk attitudes and then examine the extent to which those measures correlate with insurance decisions. We use an incentivized laboratory experiment to both measure risk attitudes and elicit demand for insurance. Insurance demand in market settings is partly influenced by institutional details, awareness and considerations outside of risk attitudes. The laboratory experiment gives us a controlled environment to isolate the links between underlying risk attitudes and insurance decisions. We conducted our experiment both with students at the University of Wisconsin and in an online experiment via Amazon's Mechanical Turk, recruiting a total of 1,730 subjects across the two platforms.

We elicit decisions about lotteries that provide measures of a set of distinct aspects of risk attitudes that have been identified in the literature: utility curvature, probability weighting, loss aversion, and a preference for certainty. Our elicitation procedure is an extension of the approach used by Tanaka et al. (2010) and can be used to generate both non-parametric scales for each risk attitude dimension and parametrized utility models incorporating these different risk attitudes.

To measure demand for insurance we expose participants to the possibility of a modest loss of their earnings in the experimental session. Participants then made a series of decisions about the amount of that loss they wanted to have insured (from 0% to 100%) in the event it occurred. Subjects made 12 insurance decisions for different combinations of the probability of loss and price of insurance (i.e., load).

We find moderate and statistically significant correlations between insurance demand and our non-parametric measures of inverse-s probability weighting and loss aversion. We find that a one-standard deviation increase in either the loss aversion or probability-weighting measure is associated with approximately a 2 percentage point increase in the fraction of loss insured, which is around a 4% increase in insurance demand in our context. In contrast, we find no correlations between insurance demand and measures of utility curvature or certainty effects. These results support the value of considering alternative risk attitudes – probability weighting and loss aversion – over classic utility curvature when modeling the demand for insurance.

However, we find that parameterized decision models have little to no predictive power for explaining insurance choices. We use the lottery choices to parameterize a series of utility models that have been used previously in the literature, including classic expected utility theory, cumulative prospect theory, rank-dependent expected utility theory, and a number of other models. We then apply the parameterized models to predict insurance choices.[1] Every one of these models, including the ones incorporating loss aversion and probability weighting, have low correlations with insurance demand. In fact, each of the parameterized utility models performs worse than random choice in predicting insurance decisions. There are two primary failings of the utility models for predicting insurance choice. First, the models predict strong sensitivity to the price of insurance. Subjects' actual insurance choices, however, responded to price in the expected direction but much more modestly. Second, the models all predict that a higher share of the loss should be insured when the probability of loss is low. Yet

[1] For prospect theory we consider a number of different models for the reference point that might be employed when considering insurance decisions.

subjects' actual decisions showed the reverse pattern, with more insurance purchased when the probability of loss was higher.

There are two key implications of our results. First, our findings support the idea that there is value in focusing more attention on the role of non-standard risk attitudes for understanding insurance demand. Moreover, our results suggest that it is not only a single motive of non-standard risk attitudes which drives insurance demand (as has been alluded to by Sydnor, 2010 and Barseghyan et al., 2013). Rather, we find significant effects on at least two of the motives. In contrast to the usual approach of falsifying theories as the unique explanation of a phenomenon, future research is thus tasked with allowing combinations of behavioral factors as possible explanations for insurance demand. The second key implication stems from our result that existing models of decision-making appear to have low validity for modeling insurance choices. This gives us reason to doubt the value of structural models of insurance demand. Both these implications call into question the usual ways in which welfare is analyzed in insurance markets. Insurance is generally thought of as welfare increasing due to the reduction of risk at the individual level. Non-standard risk attitudes do not necessarily evaluate risk reduction as utility improving in all scenarios (Kahneman and Tversky, 1979). Further, if structural models do not explain insurance demand well, it is questionable whether they should be used for counterfactual policy simulations and welfare analyses.

References

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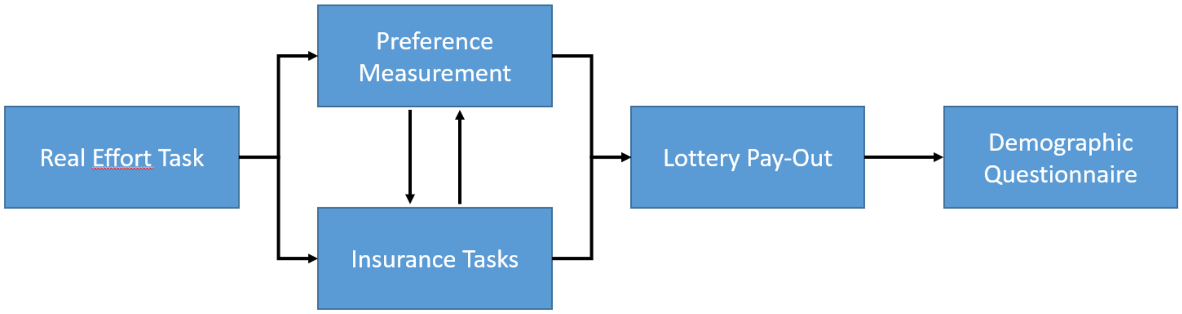
Figure 1. Experimental Design

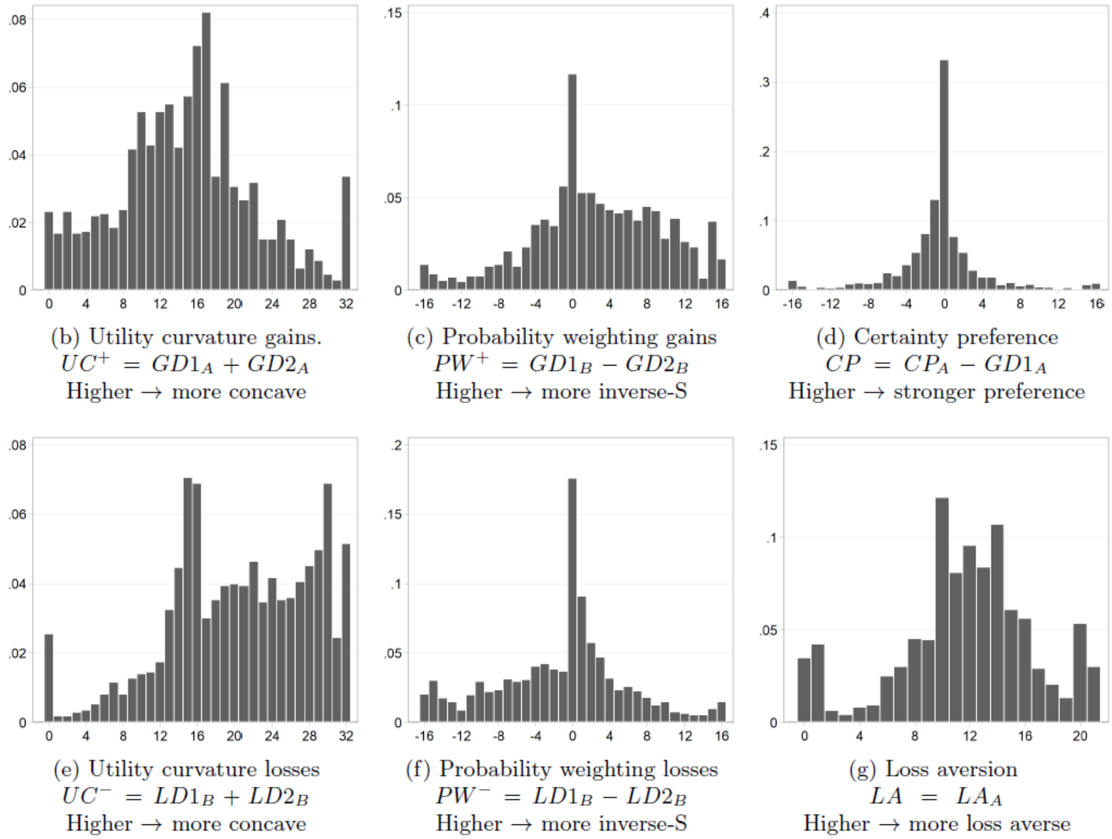


- Conducted in March 2018.
- n = 1,730: Amazon Mechanical Turk (1,352) and UW-Madison BRITE Lab (378).
- Possible earnings between $1 and $65 ($6.41 on average + $6 flat for in-person studies).

Table 1. Example Lottery-choice Table

	Gain Domain Table 1 (GD1)					Gain Domain Table 2 (GD2)			
	Lottery A		Lottery B			Lottery A		Lottery B	
p	20%	80%	20%	80%	p	90%	10%	90%	10%
$	*2.50*	*2.00*	*2.50*	*1.00*	$	*2.00*	*1.50*	*2.00*	*0.50*
	2.50	2.00	4.50	1.00		2.00	1.50	2.05	0.50
	2.50	2.00	4.75	1.00		2.00	1.50	2.10	0.50
	2.50	2.00	5.00	1.00		2.00	1.50	2.15	0.50
	2.50	2.00	5.50	1.00		2.00	1.50	2.20	0.50
	2.50	2.00	6.00	1.00		2.00	1.50	2.25	0.50
	2.50	2.00	6.50	1.00		2.00	1.50	2.30	0.50
	2.50	2.00	7.00	1.00		2.00	1.50	2.35	0.50
	2.50	2.00	8.00	1.00		2.00	1.50	2.45	0.50
	2.50	2.00	9.00	1.00		2.00	1.50	2.55	0.50
	2.50	2.00	10.00	1.00		2.00	1.50	2.65	0.50
	2.50	2.00	12.00	1.00		2.00	1.50	2.80	0.50
	2.50	2.00	15.00	1.00		2.00	1.50	3.00	0.50
	2.50	2.00	20.00	1.00		2.00	1.50	3.25	0.50
	2.50	2.00	30.00	1.00		2.00	1.50	3.50	0.50
	2.50	2.00	60.00	1.00		2.00	1.50	3.75	0.50

Figure 2. Non-parametric Preference Motive Scales



(b) Utility curvature gains. $UC^{+} = GD1_A + GD2_A$ Higher → more concave

(c) Probability weighting gains $PW^{+} = GD1_B - GD2_B$ Higher → more inverse-S

(d) Certainty preference $CP = CP_A - GD1_A$ Higher → stronger preference

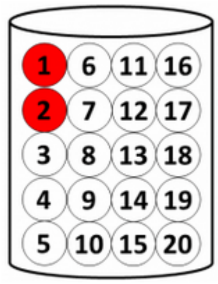
(e) Utility curvature losses $UC^{-} = LD1_B + LD2_B$ Higher → more concave

(f) Probability weighting losses $PW^{-} = LD1_B - LD2_B$ Higher → more inverse-S

(g) Loss aversion $LA = LA_A$ Higher → more loss averse

Figure 3. Example Insurance-decision Screen

You currently have $5.00.



You have a 10% chance of drawing a red ball and losing $3.00.

For every 10% of the loss you want to cover with insurance, you would have to pay about 3 cents. Please select your desired amount of insurance (if any) using the slider. The exact price of your choice will display below.

- **Insurance coverage: 34%**
- **Before drawing a ball, pay $0.10 for insurance.**

If you draw 🔴:	If you draw ○:
• $3.00 loss ∘ $1.02 covered by insurance ∘ $1.98 loss to you	• No loss

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Set Insurance Level 34

We encourage you to investigate several possible insurance choices by clicking around on the slider. Because it will directly impact your final payment, we want you to think carefully about your insurance choice. The website will let you advance after a short time, but please take as much time as you need for your answer. Make sure you have made your choice before clicking the button to continue when it appears.

Figure 4. Average Fraction of Loss Insured by Condition

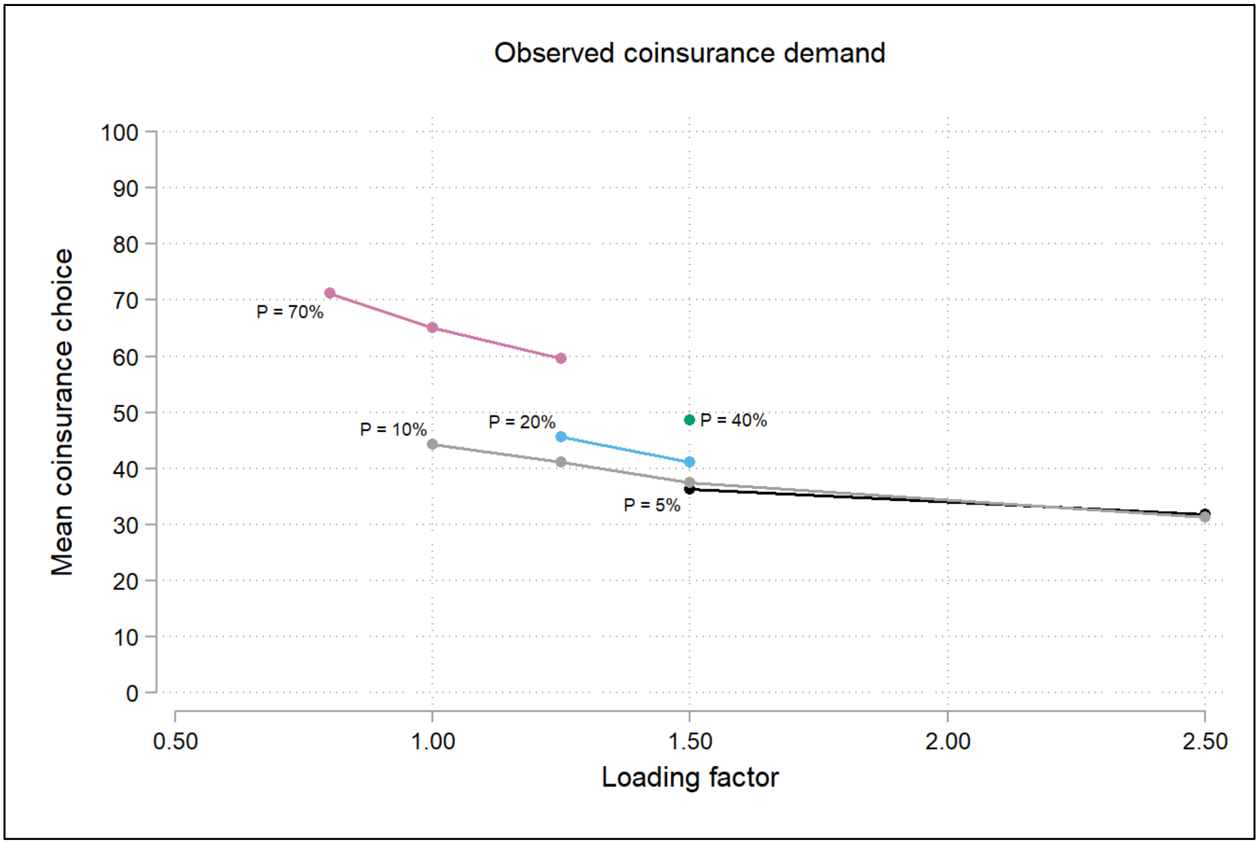


Figure 5. Histograms of Fraction of Loss Insured by Condition

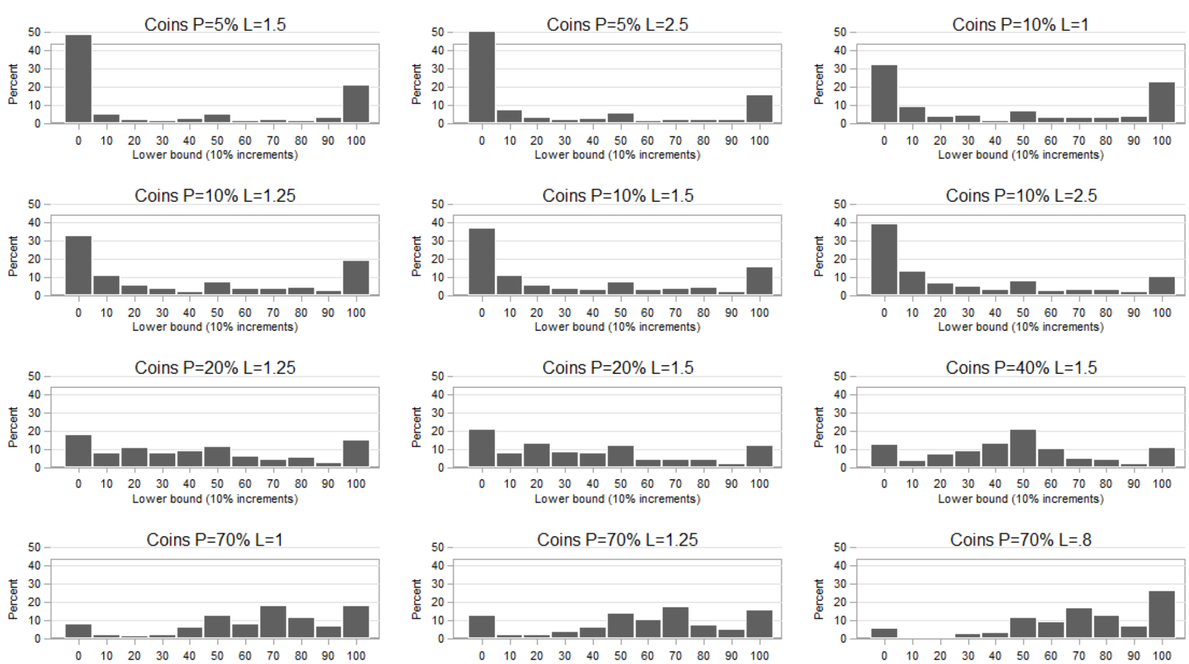


Table 2. Correlations of Insurance Choice and Non-parametric Risk-preference Scales

	(1)	(2)	(3)	(4)
UC (gain)	0.815	0.815		
	(1.181)	(1.181)		
UC (loss)	1.125*	1.125*	1.020	1.020
	(1.722)	(1.722)	(1.571)	(1.571)
PW (gain)	−0.067	1.000		
	(−0.098)	(1.178)		
Prob $\geq$ 40 $\times$ PW (gain)		−3.202***		
		(−3.840)		
PW (loss)	2.147***	3.283***	2.166***	3.615***
	(3.447)	(4.181)	(3.684)	(4.842)
Prob $\geq$ 40 $\times$ PW (loss)		−3.408***		−4.348***
		(−4.075)		(−5.369)
Loss aversion	1.913***	1.913***	2.148***	2.148***
	(2.779)	(2.779)	(3.228)	(3.228)
Certainty preference	−0.389	−0.389	−0.647	−0.647
	(−0.594)	(−0.594)	(−1.120)	(−1.120)
Prob $\geq$ 40		34.994***		34.994***
		(31.256)		(31.169)
N choices	20,760	20,760	20,760	20,760
N subjects	1,730	1,730	1,730	1,730
R-Sq	0.117	0.122	0.117	0.120
RMSE	35.186	35.098	35.191	35.132
FE	Question	Question	Question	Question
Clustered SE	Subject	Subject	Subject	Subject

Figure 6. Predicted Demand Patterns from Parameterized Utility Models