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Do Bad Risks Know It? Experimental Evidence on Optimism and Adverse Selection*

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Subjects who overestimate their performance in experimental tasks unrelated to travel are less willing to insure against failing in the task and also less inclined to buy travel insurance. This suggests intrinsic optimism influences insurance demand and diminishes adverse selection.

Keywords: optimism; forecast error; selection effects; insurance.
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"….there is diversity in conduct in situations involving uncertainty due to differences in the amount of confidence which individuals feel in their judgments….this degree of confidence is in large measure independent of the "true value" of the judgments and powers themselves"

Frank Knight, *Risk, Uncertainty, and Profit*, 1921

1. Introduction

Young men are more likely to be involved in serious motoring accidents than young women. Were gender dependent premiums illegal, the standard Stiglitz and Rothschild (1976) model of insurance, in which all that differs between people is their expected loss, implies that males will be more likely to purchase comprehensive insurance. Yet this prediction of a positive correlation between insurance cover and accident rates is questionable.[1] Young males are more risk tolerant, hence less inclined to insure. They also tend to be excessively confident of their driving ability, leading to reckless behavior but blinding them to the benefits of insurance. Men may therefore choose lower cover than women, despite being more accident prone. That is, selection is advantageous not adverse.[2]

If diverse beliefs do partially explain who buys insurance, this strengthens the case for paternalistic interventions such as requiring comprehensive insurance.

This paper measures optimism as forecast error in whether an experimental task is successfully completed and finds it is correlated with travel insurance purchase, suggesting intrinsic optimism matters for insurance decisions.

[1] This property is formally derived by Chiappori, Julien, Salanie and Salanie (2006). Studies failing to find evidence of adverse selection include Chiappori and Salanie (2000) Dionne, Gourieroux and Vanasse (2001) for motoring insurance. Advantageous selection, is found by Cawley and Philipson (1999) and McCarthy and Mitchell (2003) for life insurance, Finkelstein and McGarry (2006) for long-term health-care cover, Hurd and McGarry (1997), Ettner (1997), Fang et al. (2008) for Medigap insurance, Huang, Tzeng and Wang (2006) for fire insurance and Davidoff and Welke (2005) for reverse mortgages.

[2] Hemenway (1990) coined the term "propitious selection". The reason the CJSS result excludes advantageous selection is that imperfect competition, costly claim processing and irrational expectations are disallowed (see de Meza and Webb (2001) and Koufopoulos (2007)). Theoretical studies of the selection effects of optimism in various contexts include Brown (1974) de Meza and Southey (1996) ,Van den Steen (2004), Spinnewijn (2008).

2. The Model

People differ in their probability of suffering a fixed monetary loss. Willingness to pay (*wtp)* for insurance is therefore $wtp_i = W(prob_i, R_i(t), Z_i)$, $W_{prob} < 0, W_R > 0$, where $prob_i$ is *i's* subjective assessment of the probability of avoiding loss, R_i *is a* risk aversion parameter, *t* a shift parameter and *Z* a vector of other variables. If the true probability of avoiding loss is $prob_i^*$, optimism is $prob_i - prob_i^* = O(g(t_i) + s_i, prob_i^*)$ where *g* is a "genetic" component, a bias that carries across settings, and *s* is a random, situation-specific, evaluation error.[3] The reason $prob_i^*$ appears in the optimism function is that when the true probability of success is high, the scope for overestimation is low. Specifically, optimism could be interpreted as mistakenly assigning fail states as successes. For example, if the proportion of mistakes were constant, then $O = \alpha(1 - prob_i^*)$. More generally, $-1 < O_{prob^*} < 0$.

The cross-section relationship between insurance and optimism depends on the nature of individual heterogeneity. If the only source of variation is the true probability of success,

$$\left(\frac{\partial O}{\partial wtp}\right)_{prob^*} = \frac{O_{prob^*}}{W_{prob}(1 - O_{prob^*})} > 0 \qquad (1)$$

Insurance buyers are those with low objective chances of success and they are the *most* optimistic (leading to a positive correlation property as in Rothschild and Stiglitz). In contrast, if the only factor determining who buys insurance is idiosyncratic expectation error, then in a cross section,

$$\left(\frac{\partial O}{\partial wtp}\right)_{s} = \frac{1}{W_{prob}} < 0 \qquad (2)$$

Insurance buyers are less optimistic about their chance of loss than the uninsured and some people with high chance of loss are uninsured due to false confidence. Equation

[3] What matters for the analysis is heterogeneous forecast error so pessimism is in principle possible. Optimism is though the dominant psychological finding (De Bondt and Thaler (1995, p. 389)).

3 shows this continues to be true if the genetic factor, *t*, that raises optimism does not increase risk aversion, as is plausible.[4]

$$\left(\frac{\partial O}{\partial wtp}\right)_t = \frac{1}{W_{prob} + W_R R'/O_1 g'} < 0 \qquad (3)$$

So if people differ enough in their psychology, or random evaluation errors are sufficiently important, it will be the uninsured rather than the insured that are most optimistic, weakening the link between insurance and loss propensity.

As $prob_i^*$ is not directly observable, there is the question how to test these implications. Define $B_i = prob_i - D_i$, where D_i is a dummy for whether *i* does actually succeed. According to rational expectations, $E(B_i) = 0$. A test of whether optimism unrelated to $prob^*$ plays a role in choices is whether *B* is significantly higher for the insured. Because the outcome variable is binary, *B* is never zero (even if expectations are rational) so standard errors will be high, making this a stringent test.

If dispositional optimism is present it will apply in different forecasting situations. People choosing insurance against some specific loss will tend to have below average optimism in other settings.

3. The Experiment

(i) Method

Each subject was assigned a task at which they could succeed or fail. They made two sets of nine choices then undertook the task. At the end of the experiment, one of the 18 questions was selected at random and the subject's winnings were calculated according to his/her choice on that question.

The first set of nine questions are designed to measure subjective (implicit) expectation of success. Subjects choose between winning a prize for succeeding in the

[4] The risk-aversion effect means a given wtp is achieved at a lower level of optimism so it is ambiguous whether the difference in optimism between insured and uninsured increases.

skill-based task or winning the same prize by means of a binary lottery with specified winning probability. Questions differ only in the (increasing) probability of winning the lottery. As just one question is randomly chosen for reward, each should be answered as if it were the sole question asked. Given the prize is the same for both options, expected-utility theory implies that, irrespective of risk preferences, the probability at which a subject switches to the lottery puts bounds on their subjective estimate of success in the skill based task. This is a version of the mechanism described by Karni (2009).

A possible objection to this procedure for the elicitation of expectations is that subjects may obtain utility from winning by means of their own efforts. Also, rejecting the lottery means never discovering whether it would have yielded more, eliminating regret. Both these effects imply that the switch point in these questions exceeds the subjective success probability. Finally, ambiguity aversion may mean that there is a preference for the lottery.

To provide an alternative measure of expectations, subjects made a direct (explicit) but unmotivated estimate of their probability of winning. In what follows we take expected success, *prob,* as the mean of these two expectations measures, but results are similar whichever measure is used.

In the second set of nine questions, subjects choose between a sure payment and a higher prize for succeeding in the assigned task. There is no payment for failure. Depending on the task, the prize for success increases across the questions or the safe payment does. The point at which the subject switches from the safe option represents their *wtp* to insure against failure in the experimental task.

(ii) The Tasks

Three tasks were conducted face-to-face by the experimenter. “Frazzle” is a game that requires a steady hand. Subjects must guide a loop round a wire course. If the loop touches the wire, a buzzer sounds. For one group of subjects winning required never triggering a buzz. This is “Frazzle 0”. “Frazzle 1” allows at most one touch. The third challenge was “Timing”, which involves counting down two minutes with an

accuracy of at least ten seconds. In all the face-to-face tasks the probability elicitation prize was £8 and in the second set of questions the safe option was £4 and the prize for success varied from £5 to £13. Eighty five student subjects from a variety of London School of Economics degree courses were each presented with one of these tasks.

Another task was undertaken in class. Two glass jars were circulated in a first year management class of 56 students. One jar was identified as containing 151 pennies. The task was to estimate how many pennies the second jar contained. Success is an estimate within 15% plus or minus of the true number, 540. For the preference elicitation questions the prize was £200. In the second set of questions it was the safe payment that varied, from £20 to £180, with the prize for winning always £200.

(iii) Results

Table 1 reports on overall optimism. As measured by the motivated measure (*implicit forecast*), the mean expected success probability is 0.49, but there is considerable variation, with standard deviation 0.2. The mean direct forecast (*explicit forecast*) is 0.5 with standard deviation 0.23. In contrast to the relatively high expectations of success, only 26% of the subjects actually succeeded in the task. Applying a t test to the (noisy) measure *B*, the experimental data reveals overall optimism, significant at the 0.1% level.

Table 1: Subjective expectations of success and actual performance

	Frazzle 0 (n=24)	*Frazzle1* (n=23)	*Timing* (n=38)	*Pennies* (n=56)	*All* (n=141)
Success rate	0.13 (0.34)	0.35 (0.49)	0.32 (0.47)	0.23 (0.43)	0.26 (0.44)
Implicit forecast	0.41 (0.20)	0.5 (0.19)	0.56 (0.20)	0.48 (0.20)	0.49 (0.20)
Explicit Forecast	0.34 (0.20)	0.42 (0.18)	0.57 (0.17)	0.54 (0.26)	0.50 (0.23)

Standard deviations in brackets.

Travel insurance is amongst the better insurance buys in terms of its payback rate[5]. Subjects not purchasing it might be conjectured to be optimists. The first column of Table 2 is a regression of expectation of success in the experimental task on a dummy variable equal to one for the 81 subjects reporting that they normally buy travel insurance.[6] Task dummies are also included. Even though the tasks are unrelated to travel, the insured have significantly lower expectations of succeeding in them. This does not prove that the insured are more realistic. They may be less likely to succeed, though this does not turn out to be the case. The second column reports a regression of success in the task on the purchase of travel insurance. It can be ruled out at the 5% level that holders of travel insurance are less likely to succeed. Column 3 confirms this. Optimism as measured by *B* is significantly lower for those with travel insurance.

Table 2: Relative optimism of travel insured subjects

	Prob	*Success*	*Optimism*
Travel Insurance	-0.085***	0.13*	-0.22***
	(-2.67)	(1.80)	(-2.72)
	R^2 =0.16	R^2 =0.06	R^2 =0.08
	n=135	n=135	n=135

Prob is the mean of the implicit and explicit forecast of success. *Success* is a dummy equal to one if the task is completed. *Optimism* is *prob-success.* In all tables, *** means significantly above zero at the 1% level, ** at the 5% level, * at the 10% level (using robust standard errors) and all equations include task dummies. Only 135 subjects answered the travel insurance question.

Willingness to insure the experimental payoff is in principle measured by the switch point in the second set of questions. In the pennies task, the safe payment varies, but in the other tasks it is the prize for success that differs between questions. Hence, the ordering (and magnitudes) of the switch points differ. Dummies do not correct for this. Instead, subjects are grouped according to relative willingness to take the safe option. The *highinsure* dummy identifies the 19 out of 55 pennies subjects keenest to

[5] The ratio of claims paid to premium income is 67% for travel insurance compared to 78% for motor insurance and 54% for home insurance.
http://www.lovemoney.com/news/insurance/insurance/1069/insurances-that-rip-you-off (retrieved 03/09/2011)

[6] Personal characteristics are deliberately excluded from this equation. Suppose, for example, that relative to men, women have higher success rates, the same expectations but are more likely to buy insurance. Controlling for gender it might then be found that the insured are no more realistic. This though hides the fact that as hypothesised, insurance attract relatively realistic types, in this example women. If gender is used to price insurance then it would be relevant to include it. In practice for many kinds of insurance it may be illegal to set premiums according to gender. Our results are though similar if gender, age and nationality controls are used.

take the safe option (switch point £50 and below) and the 21 out of 85 subjects in the face-to-face experiments keenest to take the safe option (switch point of £10.5 and above). At the other extreme, *lowinsure* comprises the 10 pennies subjects with switchpoint of £110 and above and 17 face-to-face subjects with switchpoint £6.5 and below.

The first column of Table 3 shows that *prob* is highly significant in explaining whether people take insurance when premiums are high and the second when they are low. This is consistent with standard theory.[7] In column 3, the slope coefficient of a regression of *success* on *prob* is positive but not significant and little of the variation is explained. So there is limited evidence of rational expectations. More importantly, the slope coefficient is significantly below unity at the 1% level. So low expectations are associated with both realism and insurance.

Table 3 Experimental Insurance Choices

	Highinsure	*lowinsure*	*Success*
Prob	-0.98*** (-6.09)	1.04*** (6.16)	0.25▪▪▪ (1.23)
	R^2 =0.3 n= 140	R^2 =0.28 n= 140	R^2 =0.04 n= 140

Highinsure is a dummy for subjects with the greatest preference for the safe option and *lowinsure* is a dummy for subjects with the lowest preference for the safe option. ▪▪▪ means significantly below unity at the 1% level. One subject made inconsistent choices in the second set of questions and was dropped.

[7] For the pennies task there was an independent measure of risk preference, which was highly significant in explaining insurance purchase.

Table 4: Relative optimism by WTP for task insurance

	Prob	*Success*	*Optimism*
Highinsure	-0.33*** (-7.63)	-0.04 (-0.33)	-0.29** (-2.36)
Middleinsure	-0.19*** (-6.06)	-0.07 (-0.7)	-0.12 (-1.12)
	R^2 =0.42 n=140	R^2 =0.03 N=140	R^2 =0.06 n=140

Prob is the mean of the implicit and explicit forecast of success. *Success* is a dummy equal to one if the task is completed. *Optimism* is *prob-success. Highinsure* is a dummy for subjects with the greatest preference for the safe option and *middleinsure* is a dummy for subjects who are neither *lowinsure* nor *highinsure.*.

Table 4 reports more directly on the role of optimism on experimental insurance. According to the first column, subjects keenest to buy insurance have very substantially higher expectations of loss relative to those with the lowest willingness to pay (*middleinsure* is a dummy for those not *lowinsure* or *highinsure*). As shown by the second column, there is no significant difference in success rates by level of insurance, so there is no evidence of adverse selection. The final column of Table 4 indicates that high demand for insurance is associated with significantly lower optimism than is low demand.

3. Conclusion

Empirical studies report mixed results on whether losses are increasing in insurance cover-the "positive correlation" property. As selection into insurance is plausibly based on many factors, not just expected loss, it is not surprising that adverse selection is sometimes weak or absent. If beliefs are not well correlated with true loss probabilities, this further undermines adverse selection. This experiment does indeed find that people who think they are more likely to suffer loss are more likely to insure, but beliefs are not well founded, tending to eliminate adverse selection. Most strikingly, buyers of travel insurance overestimate their chance of succeeding in experimental tasks unrelated to travel by less than non buyers, indicating dispositional optimism is a factor in insurance choice.

Diverse beliefs could reverse adverse selection, for example if expectations and success are negatively correlated. A more plausible channel by which advantageous selection can arise is if beliefs impact on moral hazard, as in the driving example. The experimental tasks here have limited opportunities for such effects, so it is not surprising that advantageous selection does no more than mute adverse selection. This is not to say that optimism is good for welfare. Using the coefficient on expectations in the insurance demand equation of column 1, Table 3, the effect of lowering expected success by the mean level of optimism is to raise the overall probability of choosing insurance at the high premium from to 28% to 51%.

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