Risk Misperceptions, Advantageous, and Demand for Cancer Insurance

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Risk Misperceptions, Advantageous Selection, and Demand for Cancer Insurance

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Abstract: Spinnewijn (2013) posits that risk misperception can lead to advantageous selection in insurance markets. Subjects who are "baseline pessimistic" believe that their risk of damages is higher than it actually is and overinsure relative to their true risk type. Insurees who are relatively optimistic about the marginal return to effort, dubbed "control optimistic" will overinvest in effort, lowering their ex-post insurance claims. These two forms of misperception work together so that there is a negative correlation between insurance coverage and claims and advantageous selection results. We test this hypothesis using a survey of 200 women's demand for hypothetical cancer insurance. We elicit perceptions of baseline and control risk and use these, together with actual risks, to develop measures of baseline pessimism and control optimism. Controlling for risk aversion, cognitive ability and demographic traits, we show that willingness to pay for cancer insurance is increasing in baseline pessimism. We further show that control optimists invest more in effort, engaging in more preventative activities and fewer risky activities such as smoking. Taken together, this suggests that advantageous selection arising from risk misperception may indeed play a role in insurance markets. We show that welfare losses can be significant ranging from 4 to 9 percent of the insurance premium. Welfare losses are substantially lower when subjects are offered information about true cancer risks before making their purchase decision.

Key Words: Adverse selection, insurance markets, advantageous selection, risk perception

I. INTRODUCTION

Economists have long posited that asymmetric information with heterogeneous risk types can lead to adverse selection in insurance markets (Rothschild and Stiglitz 1976). Individuals with private information that they are high risk types buy more coverage than low-risk types. High-risk types will also have higher claims, leading to positive correlation between insurance coverage and claims. Positive correlation has been found in some markets, but rejected in others. For example, Puelz and Snow (1994) find evidence of adverse selection in the market for automobile insurance, by Chiappori and Salanie (2000) do not. Finkelstein and McGarry (2006) reject the hypothesis of adverse selection in their study of long-term care insurance.[1]

The frequent failure of empirical models to support adverse selection suggests that other types of private information such as risk attitudes, subjective perceptions of risk type, and cognitive ability may jointly affect demand for coverage and claims. For example, deMeza and Webb (2001) show that heterogeneity in risk preferences can lead to a negative correlation between coverage and claims. According to their model, risk-averse insurees will demand more coverage yet take more precautions against damages, leading to a negative correlation between coverage and ex-post claims which is indicative of advantageous selection. Fang, Keane and Silverman (2008) find a strong negative correlation between coverage and ex-post expenditures, implying advantageous selection, in the Medi-Gap insurance market. They find that cognitive ability is one of the primary sources of advantageous selection in this market.

A recent paper by Spinnewijn (2013) posits that heterogeneity in risk misperceptions may also affect the relationships between coverage and claims leading to advantageous or adverse selection depending on the type of misperception. Spinnewijn (2013) recognizes two dimensions of risk misperception. First, subjects may be relatively "baseline optimistic" so that they believe their risk of damages is lower than it actually is. Baseline optimistic subjects will demand less insurance than their more pessimistic counterparts. But whether misperception leads to advantageous or adverse selection depends on subjective beliefs about the efficacy of personal efforts to reduce damages. Insurees who are relatively optimistic about the marginal return to

[1] Cohen and Siegelman (2010) review the evidence for adverse selection in a number of insurance markts including automobile insurance, long-term care insurance, health insurance, and reverse mortgages.

effort, dubbed "control optimistic" will overinvest in effort, whereas those who are control pessimistic will underinvest in effort. Thus, insurees who are baseline pessimistic and control pessimistic will purchase more insurance and expend less effort in reducing damages, leading to a positive correlation between coverage and claims and adverse selection. Those who are baseline pessimistic and control optimistic will purchase more insurance, but expend relatively high effort in avoiding damages, giving rise to a negative correlation between coverage and claims and advantageous selection. Moreover, they will have a tendency to overinsure, resulting in welfare losses.

Studies such as deMeza and Webb (2001) and Fang, Keane and Silverman (2008) that have found advantageous selection in insurance markets have not controlled for the effects of risk misperception. If risk misperception is correlated with cognitive ability, risk attitudes, or demographic variables such as age, gender, income and education that also affect demand for insurance then models that omit misperception may overstate the influence of these other variables. Determining the source of selection is important. If risk misperceptions are the source, then helping insurees understand their baseline cancer risks and the effectiveness of preventative activities may well reduce their tendency to over insure and help mitigate welfare losses.

The purpose of this study is to investigate the effects of risk preferences, perceived risk type, and demographic & cognitive factors on the demand for cancer insurance and expected ex-post claims.[2] Moreover, we seek to test whether information about cancer incidence and prevention strategies reduces misperception and, consequently, adverse and advantageous selection related to misperception. We choose cancer insurance because much is known about how demographics and behavioral choices influence disease risk for many cancer types. Thus, given sufficient information, we can predict objective disease risk for subjects. Understanding how information influences selection will give rise to better risk communication devices and strategies that can help people choose the level of insurance and preventative effort that corresponds to their true risk type and tolerance.

[2] We study three common cancers in women: breast, bladder, and colon cancer.

We conduct an online survey of the demand for a hypothetical cancer insurance policy using 200 women subjects aged 18. Survey subjects are contracted using Amazon's Mechanical Turk platform. In the survey, we elicit baseline risk perceptions, perceptions of the efficacy of prevention efforts and controllable risk factors related to three cancers: breast, colon, and bladder. We query subjects about their behaviors that may either reduce or increase risks for these three cancers. We elicit estimates of the subject's degree of risk aversion based on a constant relative risk aversion utility function using the Holt and Laury's (2002) elicitation method. We measure cognitive ability using a short intelligence assessment. We also elicit demographic characteristics such as income, education, and age that may affect demand for cancer insurance. Half of the subjects are given an information booklet that reports cancer incidence, prevention strategies, and the effectiveness of those strategies in reducing cancer occurrence. The other half will not receive this information.

We estimate measures of baseline and control optimism for each subject by comparing their risk perceptions to objective estimates of their personal risk. To calculate baseline optimism, we calculate their objective relative risk using The Harvard Cancer Risk Index described in Colditz et al. (2000). The optimism measure is simply their stated relative risk minus the objective risk. We control for control optimism in two dimensions: misperceptions about the increase in relative risk arising from risky activities such as smoking or excessive alcohol use and misperceptions related to the effectiveness of cancer-prevention strategies.

Given the risk misperception measures, we estimate two classes of models. The first model seeks to measure how control optimism affects choices to engage in prevention activities or risk increasing activities. We hypothesize that control optimists will be less likely to engage in risky activities and more likely to engage in preventative activities, such that the expected cost of their claims is lower than their more pessimistic counterparts. The second class of models explores the effect of baseline optimism on demand for insurance. We model demand as a function of the monthly premium, the coefficient of risk aversion, cognitive ability, and baseline optimism. We hypothesize that baseline optimists will demand less insurance, all else equal.

The results indicate that most subjects (90% or more) are baseline pessimistic so that they think their relative cancer risk is higher than it actually is. We find that baseline pessimists who are simultaneously control optimistic are willing to pay more for insurance but engage in less risky behavior and more preventative activity than the other subjects. This pattern of demand and behavior is consistent with a negative correlation between coverage and claims that is evidence of advantageous selection. Conversely, subjects who are control pessimistic and baseline pessimistic buy more insurance, but engage in more risk and less prevention, indicating a positive correlation between coverage and claims that is associated with adverse selection. These findings offer strong support for Spinnewijn's (2013) hypothesis that risk misperception can lead to selection in insurance markets.

We also find that the marginal effect of baseline risk misperception on premium for insurance is attenuated for subjects who received the cancer-risk information booklet prior to completing the survey. Thus, welfare losses are significantly smaller when people properly align their perceived risk of cancer to objective assessments of their relative risk.

II. LITERATURE REVIEW

Rothschild and Stiglitz (1976) introduced the theory of adverse selection, hypothesizing that even small amounts of asymmetric information in competitive markets can lead to significant distortions of market-clearing prices and quantities. They focused their study on the market for insurance, where they posited that when insurees of heterogenous risk types have private information about their level of risk, adverse selection may result. Individuals who know they are high-risk types tend to buy more coverage than low-risk types. High risk-types will also have higher claims, leading to a positive correlation between insurance coverage and claims. With the resulting downward sloping marginal cost curve, the average cost curve is at all times above the marginal cost curve, leading at best to an underprovision of insurance to those with the lowest levels of risk, and depending on the risk premiums individuals place on insurance, a complete unraveling of an insurance offering is possible (see Einav and Finkelstein (2011) for a more detailed discussion).

The seminal paper by Rothschild and Stiglitz (1976) spurred a robust set of theoretical and empirical literature. Much of the empirical work involved estimating correlations between the amount of insurance coverage and ex-post expenditures on claims predicted by Rothschild and Stiglitz (1976). A positive correlation suggests adverse selection. For example, Chiappori and Salanie (2000) analyzed data from automobile insurance contracts for young French drivers and find that, when observables are adequately taken into account, there remains no evidence of asymmetric information. They posit this may be because young drivers do not know about their risk levels, and older drivers do not know more about their risk levels than do the insurance companies. However, Cohen (2005) performed a similar examination of automobile insurance data and found a significant positive correlation between coverage and ex post claims for more experienced drivers, suggesting these more experienced drivers may have learned about their own risk types to a greater extent than had their insurers and less experienced drivers, leading to information asymmetries that result in adverse selection.

De Meza and Webb (2001) noted several previous studies that found either a lack of evidence of adverse selection, or even a negative correlation between coverage and risk types. They proposed a model in which an additional factor, risk aversion, plays a key role: they posit that less risk-averse people are less likely to take precautions, but also less likely to purchase insurance. This then leads to a negative correlation between coverage and risk, and therefore advantageous selection, particularly in the presence of significant administrative costs.

In a similar vein, Fang, Keane, and Silverman (2008) found advantageous selection in the market for Medigap insurance (a supplement to Medicare). They found that, controlling only for gender, age, and state of residence (the determinants of policy prices), Medigap policyholders spent on average $4,000 per year less on health care than similar-aged Medicare recipients who do not purchase Medigap insurance. However, when Fang, Keane, and Silverman (2008) included a robust set of controls for health, they found that those with Medigap spend about $2,000 more than those without Medigap. They controlled for additional individual attributes and found that when cognitive ability is controlled for, a negative correlation between coverage and ex-post claims is found, indicative of advantageous selection. They proposed that as cognitive ability is correlated with both good health and the purchase of health insurance, it leads to a negative correlation between Medigap coverage and health risk.

Underscoring the sometimes complex dynamics underpinning the demand for insurance, Finkelstein and McGarry (2006) identified multiple forms of private information that can potentially affect the correlation between insurance coverage and risk occurrence. They proposed that it is possible for two or more types of private information to have offsetting effects, leading to behavior that lacks a correlation between risk type and coverage. In the long-term care insurance market, they identified wealth and healthcare preventive activities as being positively correlated with insurance coverage, and negatively correlated with risk.

A range of other studies have produced varying results, which the authors attribute to the particular characteristics of the markets under study. For example, Davidoff and Welke (2004) found evidence of advantageous selection in the reverse mortgage insurance market. He (2008) found adverse selection in the life insurance market with significant correlation between mortality risk and life insurance coverage.

Cohen and Seigelman (2010) review the previous decade's work and find that a large number of empirical studies produced varied results: some studies found evidence for adverse selection, other studies finding an absence of such evidence, and some studies even found evidence for advantageous selection. They posit six broad reasons why adverse selection may not occur in certain markets: "1) the absence of useful private information; 2) the existence of private information for some but not all policyholders in a market; 3) policyholders' inability or failure to use the private information that they have; 4) the presence of superior information or predictive power on the part of the insurer; 5) propitious selection resulting from interaction between risk and risk aversion or other policyholder characteristics associated with an increased tendency to purchase insurance; and 6) institutional arrangements."

More recently, Spinnewijn (2013) proposed that risk misperception may lead to selection in insurance markets. His model assumes two types of risk misperceptions which, acting together, can lead to either adverse or advantageous selection. Policyholders who are "baseline optimistic" believe their risks of experiencing insured events are lower than they actually are; such individuals will tend to have less demand for insurance coverage, ceteris paribus. Those who are "control optimistic" believe their efforts to mitigate against potential negative health effects are more effective than they actually are. Control optimistic individuals, believing that the marginal return to effort is higher than it actually is, overinvest in effort and thereby reduce

their expected ex-post claims relative to an individual with accurate or pessimistic views about the return to effort. All other things being equal, an individual who is control optimistic is likely to have lower claims, due to their greater amount of preventative care and avoidance of risky health behaviors.

According Spinnewijn (2013), then, someone who is baseline pessimistic and control pessimistic will purchase more insurance and take fewer preventative measures, leading to adverse selection and a positive coverage-risk correlation. Conversely, an individual who is baseline optimistic and control optimistic will take more preventative measures and have less relative risk, but purchase less insurance, also leading to a positive coverage-risk correlation. If on the other hand an individual is baseline pessimistic and control optimistic, she will have higher demand for insurance but also take greater preventative measures, leading to a negative coverage-claims correlation and to advantageous selection. Similarly, an individual who is baseline optimistic and control pessimistic will have low demand for insurance and also take fewer preventative measures and have higher expected claims, supporting a negative coverage-risk correlation.

III. SURVEY

To test for the influence of risk misperception on selection, we conducted an online survey of 200 women aged 18 and over on Amazon Mechanical Turk (AMT). The AMT web service is essentially a labor market designed to match employers who need short tasks completed which require human intelligence to workers willing to complete the task. The tasks, which typically require between 5 and 45 minutes to complete, range from surveys and writing brief product descriptions to transcribing audio recordings. Employers sign up for the service and post task descriptions together with a per task compensation amount.

AMT has become increasingly popular over the past five years with social science and business researchers because of the ease of use of the platform and the streamlined and rapid process for recruiting study volunteers. Buhrmester, Kwang, and Gosling (2011) found that AMT is an inexpensive source for high-quality data. They showed that participants are slightly more diverse than a typical internet sample and much more diverse than a sample based on university students. They also found that the data quality was at least as high as a standard internet or telephone survey design.

The survey used a split-sample design. One half of the participants began the survey with information about the causes, risk factors, and prevention strategies for one of the three cancers of interest (Colon, bladder and breast). Following the information section, these subjects began the questionnaire. The other half of the subjects commenced with the questionnaire without any prior information given about cancer risks. The task was described to potential participants as a survey related to their beliefs about the cancer risks that would take about 30 minutes. Subjects were given $4.50 to complete the survey.

The questionnaire has six components, described below.

3.1 Risk Perception

In this section, subjects were first asked to grade the decrease in relative risk contingent on undertaking specific preventative activities. For each cancer, "dummy" prevention strategies that were actually not effective in reducing the cancer risk were added.[3]

Subjects were then asked about their perception of the increase in the relative risk of developing a given cancer related to designated risk factors. The risk factors considered varied with the cancer.[4] For example, risk factors for breast cancer included taking birth control pills and hormone replacement therapy and other factors specific to breast cancer risks, whereas risks for colon cancer included excessive red meat consumption and a low-calcium diet.

Following the questions about relative risks, subjects were asked to state their own personal risk of getting each one of the cancers in their lifetime compared to the typical woman. The possible outcomes ranged from zero risk of getting the cancer (Zero. There is no chance of me getting this cancer), to very high risk (very much above average, five times or more above average).

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[3] The relative risks for each preventative activity were presented as both ranges and qualitative descriptors as follows: not effective does not reduce cancer risk, somewhat effective reducing risk by 10% to 20% of the average, moderately effective reducing risk by 30 to 60% of average, very effective reducing risk by 60 to 80% of average, and extremely effective reducing risk by more than 80% of average.

[4] The relative risks for each characteristic or behavior were presented as both ranges of relative risk and a qualitative descriptor as follows no risk increase, small risk increase, risk is higher but less than double the average risk, moderate risk increase where the risk is 2 to 4 times the average risk, large risk increase of 4 to 8 times the average risk, and very large risk increase where risk is more than 8 times the average risk.

3.2 Risk Preference.

This section elicited a range of risk aversion coefficient for the Constant Relative Risk Aversion utility function defined over mortality risks rather than financial risks using the sequential multiple price list auction. Details of this aspect of the experiment can be found in Riddel and Kolstoe (2013). Briefly, the subjects read the following text describing the gambles they will face:

Hypothetical Health Risk: Assume you have been diagnosed with a disease that will certainly be fatal in a year without treatment. There are two treatments, but neither is effective 100% of the time. Assume the costs of the treatment are the same, and neither treatment has side effects.

The subjects were then given a sequence of paired lotteries, and asked to select the one they preferred. For example, the first gamble presented was:

Treatment A means a 30% chance of 8 more years of life and a 70% chance of 2 more years. Treatment B gives a 90% chance of 1 more year (the treatment fails) and a 10% chance of 13.5 more years.

In subsequent gamble pairs, the outcome in treatment B was varied so that E[A]-E[B] decreases and eventually becomes negative. The analyst notes where the subject switches from preferring lottery A to preferring lottery B, which defines an inequality over the indicated prospects. Later switch points indicate higher levels of risk aversion.

3.3 Health History

Subjects were asked a detailed history of their activities, behaviors, and family history for things that may influence their risks of contracting the three cancers of interest. Questions covered their reproductive history, their hormone use, their family history of the cancers in question, and any health related behaviors such as exercise, vitamin use, smoking, and alcohol use. The responses to these questions were used to determine their actual risk of getting each of the cancers.

3.4 Cancer Insurance Demand

The subjects next faced a single-bounded contingent valuation exercise to determine their demand for cancer insurance. The insurance was described as follows:

"Assume that there is an insurance policy available that will cover any and all costs related to the covered cancers. The cancers covered by the insurance are bladder cancer, breast cancer, and colon cancer. Considering your current budget, would you be willing to pay the following monthly premium for this insurance assuming it covered all related costs including diagnostic testing, office visits for specialists, hospital stays, treatment costs including chemotherapy and radiation, as well as FDA approved experimental treatments. There are no copays or deductibles and you would be able to choose your own doctors and hospitals. **Please assume that your current insurance will not cover these cancers and that you will have to pay all of the costs yourself if you get any of these cancers."**

Subjects were randomly assigned a bid amount ranging from $5 to $135 per month and asked if they would be willing to pay that amount for the insurance as described.

3.5 Cognitive Ability.

Subjects were asked to answer a series of 7 questions used in the Wonderlic cognitive ability test. The subject scored a one on each question if they gave the correct answer and a zero otherwise. Their cognitive ability score was measured as the sum of the individual scores.

3.6 Demographic.

Subjects were asked their age, income, ethnicity, education level, and marital status.

IV. CALCULATIONS FOR RISK PERCEPTIONS

We consider two types of risk misperception in this analysis. The first is control perceptions addressing the extent to which behaviors influence cancer risks and the second concerns baseline perceptions of the risk for each cancer. We further break down control perceptions into two components: 1) perceptions about the efficacy of strategies to control *risk* factors for cancer (such as smoking or excessive alcohol use) in reducing the baseline risk and 2) perceptions about the efficacy of *prevention* strategies (such as taking vitamins and exercising) in reducing baseline risk. Note that this distinction is finer grained than that described in Spinnewijn (2013) since we have two sources of control optimism rather than the prevention-based optimism described in that paper. In some ways, this is an artificial distinction, but it allows us to align our survey

questionnaire to the Harvard risk calculator. Moreover, we find that risk and prevention control optimism have different marginal effects on behavior. We will discuss this in more detail later.

4.1 Measures of Control Optimism

A subject is risk control optimistic if they believe that risk-avoiding activities are more effective than they actually are in reducing cancer risks. The survey contained a set of questions for each cancer about perceptions of the relative riskiness of different activities that increase cancer risk. Define the stated and actual relative risks of risky activity *j* for subject *i* as SRR_{Rij} and ARR_{Rij}, respectively where $j = 1,...m$ corresponding to *m* risky activities. The measure of risk control optimism is then $Risk\ Optimism_i = \sum_{l=1}^{3}\sum_{i=j}^{m} SRR_{Rij} - ARR_{Rij}$ for l=1,…3 represents the three cancer types. Thus, the measure of risk optimism is the sum of the over perceptions of each risky activity over all three cancers. As such, it is a general measure since it aggregates perceptions across both activities and cancers. When *Risk Optimism*>0, the subject believes that the relative risks of the activity are, in aggregate, higher than they actually are, and they would be more likely to invest effort in avoiding these risky activities. Similarly, a subject is prevention control optimistic if they overestimate the efficacy of prevention strategies. Define the stated and actual relative risks of prevention activity *i* as SRR_{Pij} and ARR_{Rj}, respectively where $k = 1,...q$ corresponding to *q* prevention activities. The measure of risk control optimism is then $Prevention\ Optimism_i = \sum_{l=1}^{3}\sum_{k=1}^{q} SRR_{Pik} - ARR_{Pik}$. When *Prevention Optimism*>0, the subject overestimates the efficacy of prevention strategies, in aggregate, and is more likely to overinvest in prevention strategies than someone who has accurate beliefs about prevention efficacy.

4.2 Measure of Baseline Optimism

We measure baseline optimism by subtracting a subject's stated lifetime risk of getting each cancer from the actual risk. The actual risk is calculated using the Harvard Risk Calculator based on their reported behaviors, health history, and demographics. As with the measures of control optimism, the variable $Baseline\ Optimism_i$ is the sum of the baseline optimism for each cancer and thus measures the aggregate optimism over all of the cancers. Values greater than

zero indicate the subject is believes their risk of the three cancers is lower than what an epidemiologist would predict.

V. RESULTS

5.1 Control Optimism and Behavior

To test whether risk and prevention control optimism affect behavior, we estimate a series of regressions where the dependent variable represents engagement in either prevention or risky activities with regressor Risk Optimism used when the dependent variable is a risky activity and regressor Prevention Optimism used when the dependent variable represents a prevention activity. The regression also control for cognitive ability, risk aversion, age, income, and education. Table I reports the results of these regressions.

The results indicate that control optimism is a significant determinant of prevention and risky activities. The variable Prevention Optimism is positive and significant predictor of daily multivitamin use, drinking one alcoholic beverage per day, and taking a daily aspirin. The coefficient is positive, but not statistically significant in determining physical activity. On the risk side, optimism about the degree of risk is a positive and significant predictor of whether or not the subject is a regular smoker.

Risk aversion influences some prevention and risky activities, but not others. More risk averse subjects are less likely to smoke and more likely to take multivitamins, but risk aversion is not shown to be significantly correlated with physical activity, aspirin or taking a daily drink.

Demographic variables and cognitive variables are shown to affect risk and prevention activities. The results indicate that subjects with higher cognitive ability are less likely to smoke and take a daily drink, all else equal. Cognitive ability does not influence vitamin or aspirin intake or Table physical activity. The more educated the subject is, the more likely they are to take multivitamins. Subjects with a bachelor's degree are more likely to report that they are physically active and less likely to smoke than others, all else equal. Older subjects are more likely to take a daily aspirin, but less likely to have a daily drink. Higher income subjects are less likely to be physically active and take multivitamins or aspirin. Married subjects are more

likely to smoke and more likely to take a vitamin daily. Caucasians are less likely to be physically active and more likely to smoke than other ethnicities.

I. Probit Models of Determinants of Health Risk and Prevention Activities.

	Phys active		Multivitamin		One Drink		Aspirin		Smoker	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Risk Averse	0.019	0.320	0.129***	0.001	0.019	0.333	0.062	0.143	-0.169***	0.000
Prevention Optimism	0.004	0.462	0.092***	0.005	0.058*	0.073	0.172***	0.000	----	----
Risk Optimism	----	----	----	----	----	----	----	----	0.006**	0.015
Cognitive Ability	0.005	0.473	-0.008	0.455	-0.114*	0.083	-0.001	0.498	-0.129*	0.058
Income ($000)	-0.005 **	0.050	-0.006**	0.018	-0.001	0.396	-0.007*	0.092	0.000	0.498
Caucasian	-0.543**	0.020	0.058	0.409	0.140	0.294	0.062	0.406	0.873***	0.007
Some College	0.043	0.452	0.303	0.230	0.046	0.462	-0.053	0.463	-0.116	0.380
Associate Degree	0.120	0.383	0.740**	0.047	0.405	0.216	0.517	0.196	-0.051	0.451
Bachelors Degree	0.470*	0.085	0.937***	0.007	0.310	0.247	0.582	0.135	-0.708**	0.031
Post Graduate Degree	-0.069	0.430	1.399***	0.001	0.483	0.173	0.392	0.267	-0.318	0.219
Married	-0.073	0.350	0.349**	0.039	0.116	0.305	0.344	0.092	0.314*	0.080
Age	-0.007	0.231	0.011	0.117	-0.033***	0.002	0.033***	0.004	0.007	0.240
_cons	1.031**	0.036	-1.617***	0.003	0.286	0.316	-3.093***	0.000	-0.233	0.350
Pseudo-R square	0.0648		0.1492		0.1296		0.2202		0.1838	
*, **, *** represent statistical significance at the 0.01, 0.05, and 0.10 level for a one-sided test.										

5.2 Baseline Optimism

To calculate the premium for insurance, we estimate a probit regression with the dependent variable $Yes = 1$ if the subject agrees to pay the stated amount for insurance and zero otherwise with regressors that include the bid amount, measures of baseline optimism, cognitive ability, risk aversion, and demographic characteristics that affect the demand for insurance. From this regression, we calculate the insurance premium the subject is willing to pay as:

$$WTP = \frac{\beta_1 Baseline\,Optimism + \beta_2 Cognitive\ \ Ability + \beta_3 Risk\ \ Averse + \lambda' Demographic\ Variables}{-\theta}$$

where $\beta_1, \beta_1, \beta_1$, and γ are the coefficients of the corresponding variables and θ is the coefficient of the bid amount in the probit regression Thus, the marginal willingness to pay the premium for any of the non-bid variables is the ratio of the variables coefficient to $-\theta$. For example, the marginal premium increase with an increase in cognitive ability is:

$$\frac{\partial WTP}{\partial Cognitive\ \ Ability} = \frac{\beta_2}{-\theta}.$$

Table II reports two probit models of demand for insurance as a function of baseline optimism risk aversion, and cognitive ability, the first without demographic controls and the second with demographic controls. In Model I, the bid amount is negative and significant, indicating that the higher the bid offered to the subject, the less likely they are to state that they would purchase the insurance at the proposed premium. The higher the subject's baseline optimism, the lower their demand for insurance so that subjects who tend to undererstimate their aggregate cancer risk are less likely to agree to purchase the insurance at the stated premium amount than those who either overestimate their cancer risk or assess it accurately. As a consequence, the willingness to pay for insurance is lower for subjects who are overly optimistic about their cancer risks. The effect is significantly attenuated for subjects who received the information on risk and prevention strategies prior to filling out the questionnaire, as evidenced by the positive and significant coefficient of the interaction of the optimism and information variables.

Model II suggest that controlling for demographic variables is important. The marginal effect of baseline optimism is significantly smaller when demographic variables are considered, with the coefficient of the optimism variable falling significantly in absolute value. The effect of information is stable, however. Older subjects are more likely to agree to purchase the insurance at the offered bid amount, whereas Caucasian subjects are less likely to purchase the insurance. Subjects with some college or a postgraduate degree are willingness to pay a higher insurance premium than subjects with only a bachelor's or associate's degree. Controlling for demographic variables changes the signs of the coefficients of cognitive ability and risk aversion: the coefficients of risk aversion and cognitive ability are positive, but statistically insignificant, in Model I and negative and insignificant in Model II.

The estimated, average, sample willingness to pay for cancer insurance is just shy of $60 per month in Model I, and just less than $70 per month in model II.

Table II. Probit Models of Premium for Insurance as a Function of Baseline Optimism, Risk Aversion, Cognitive Ability, and Control Variables

	Model I		Model II	
	Coeff.	p-value	Coeff.	p-value
Bid	-0.011***	0.000	-0.014***	0.000
Baseline Optimism	-0.058***	0.003	-0.037**	0.054
Infotreatment* Baseline Optimism	0.031*	0.057	0.030*	0.073
Risk Averse	0.008	0.415	-0.015	0.363
Smoker	0.389**	0.043	0.367*	0.077
Cognitive Ability	0.034	0.231	-0.018	0.396
Income ($000)	----	----	-0.001	0.319
Caucasian	----	----	-0.516**	0.020
Some College	----	----	0.943***	0.004
Associate Degree	----	----	0.879**	0.016
Bachelors Degree	----	----	0.630**	0.036
Post Graduate Degree	----	----	0.868**	0.017
Married	----	----	-0.112	0.287
Age	----	----	0.015**	0.028
WTP/month	$59.06		$69.13	

*, **, *** represent statistical significance at the 0.01, 0.05, and 0.10 level for a one-sided test.

5.3 Welfare Losses from Baseline Pessimism

The results indicate that most subjects (90% or more) are baseline pessimistic so that they think their relative cancer risk is higher than it actually is. This is not surprising since people tend to overestimate risks, like breast cancer, that are highly publicized and related to dread diseases (Slovic 1987, Fischoff et al. 1978). Other studies, such as Viscusi (1990) find that people similarly tend to overestimate the risks associated with lung cancer.

Spinnewijn (2013) shows that when insurers screen optimistic types by providing less coverage at a lower premium than that offered to pessimists, this comes at a cost to the individual who is pessimistic about their personal cancer risk. This is because the pessimist's true expected costs are lower than they anticipate, so they tend to overrinsure relative to their demand for insurance if they accurately understood their cancer risk. The lost marginal value of the policy attributable

to their pessimistic beliefs, all else equal, is then the negative of the partial derivative of WTP for the policy with respect to the optimism variable.

Thus for Model I, the lost marginal value is $0.058 / -0.011 = -\$5.27$ for subjects who did not view the information booklet and $(0.058 + 0.031) / -0.011 = -\$2.45$ for subjects who did view the information. These values are reported in Table III.

The corresponding figures for Model II are \$2.66 and \$0.52, respectively.

Welfare losses are roughly 4 to 9 percent (depending on the model used) for those without the additional information about cancer risks and between 1 and 4 percent who received the cancer information. Thus, welfare losses arising from overly optimistic assessments of personal cancer risk are significantly mitigated by providing specific information about cancer risks before subjects determine their willingness to pay for insurance.

Table III. Welfare losses due to Baseline Pessimism, With and Without Information on Cancer Risks

$$\textit{Model I} \quad \frac{\partial WTP}{\partial Baseline\,Optimism\ (no\,info)} = \$5.27$$

$$\textit{Model I} \quad \frac{\partial WTP}{\partial Baseline\,Optimism\ (with\ info)} = \$2.45$$

$$\textit{Model II} \quad \frac{\partial WTP}{\partial Baseline\,Optimism\ (no\ info)} = \$2.66$$

$$\textit{Model II} \quad \frac{\partial WTP}{\partial Baseline\,Optimism\ (with\ info)} = \$0.52$$

VI. DISCUSSION

The models show strong support for risk misperceptions as playing a key role in advantageous selection. Those who overestimate their cancer risk are willing to pay higher premiums. We also show that those who are overly optimistic about prevention activities engage in more preventative activities and fewer risky ones, suggesting that their claims will be lower than

subjects with more accurate beliefs. Together, these results imply a negative relationship between premium and claims that is indicative of advantageous selection.

Previous research shows that risk aversion and cognitive ability are possible sources of advantageous selection in insurance markets. Our models offer limited support for these hypotheses. More risk averse subjects are indeed less likely to smoke but more likely to take multivitamins, leading to lower claims. However, while the coefficient of the risk aversion and cognitive ability are positive in the willingness to pay model Model I, they are not statistically significant .

Despite the insignificance of risk aversion and cognitive ability in the premium models, we are hesitant to conclude that cognitive ability and risk aversion do not play a role in selection. Nevertheless, there is significant correlation between risk aversion, cognitive ability, and the demographic variables that may well induce multicollinearity problems in the probit models that could well be exacerbated by the relatively small sample size. We estimated two simple premium models that include the suspect variable and the premium bid amount as independent variables but exclude the other suspect variable, risk misperceptions and demographics. In these models, risk aversion is positive and significant (p-value=0.07) as is cognitive ability (p-value=0.004). We conclude that our models provide week evidence for advantageous selection arising from cognitive ability and risk aversion, but that more research that includes a larger sample as well as males is certainly warranted to explore these relationships in more depth.

Perhaps the most interesting results relate to the significant welfare losses from risk misperception. The pervasiveness of baseline pessimism in the sample indicates that the likelihood of individual losses is very high. Our results were obtained in the context of a hypothetical market, where insurance company promotional materials and insurance broker influence do not come into play. If people are swayed by marketing strategies that aim to sell more insurance, then willingness to pay for premiums, and welfare losses, may be even higher.

We show that welfare losses from baseline pessimism can be substantially mitigated by fairly inexpensive information provided to subjects before they make their choices for insurance. When subjects were given short but concise information about cancer risks and the efficacy of prevention activities, their level of pessimism was lower and the premium amount they agreed to

pay was lower. This has important policy implications. Of course, information about health risks can be valuable if it steers people to make better decisions about the level of effort they invest in prevention and how much risk behavior to undertake. This research indicates that an additional benefit of risk information is that it helps people make better decisions about much they spend to insure against risks.

VII. CONCLUSIONS

In this paper, we report the results of a survey of 200 women that aimed to analyze willingness to pay for cancer-care insurance premiums and factors that affect their demand for insurance. In particular, we seek to understand how factors such as cognitive ability, risk misperception, and risk aversion induce advantageous or adverse selection in the insurance market.

We offer evidence that supports Spinnewjn 's (2013) hypothesis that advantageous selection may occur as a result of subjective misperceptions about baseline cancer risks and the efficacy of preventative strategies. Our statistical results indicate that the more pessimistic a subject is concerning their baseline cancer risk, the higher their willingness to pay, in terms of the premium, for cancer insurance. We also find that those who over-estimate the return to preventative behaviors and overestimate the risk of negative health behaviors are more likely to invest in preventative effort and less likely to engage in risky activities.

We show that risk misperceptions lead subjects to over insure resulting in welfare losses. However, the welfare losses were significantly lower for subjects who were given information prior to the survey that informed subjects about which activities increased cancer risk and which preventative behaviors effectively lowered cancer risks.

The models control for other variables, such as risk aversion and cognitive ability, that have been shown in the past to lead to selection in insurance markets. We find weak evidence in support of risk aversion and cognitive ability as a source of advantageous selection.

The findings have important policy implications, leaving open the possibility of improving social welfare by encouraging insurance firms to provide accurate, subject-specific information about cancer risk and discouraging sales and marketing strategies that encourage potential customers to over insure.

This is the first empirical study that we know of that investigates risk misperception as a source of advantageous selection. We believe the results reported here are useful to researchers interested in risk communication, risk perception as well as selection in insurance markets. That said, there are limitations to the analysis. For one, the data is based on a hypothetical market so that people never actually purchased or refused the insurance. People may well make different choices in the hypothetical market to what they would choose in an actual market. Second, we examined preferences among women only for insurance against three common cancers. It may well be that men's preferences are distinct from women's or that the results would have been strengthened or weakened if we considered more types of cancer. Thus, these results are not generalizable to the market for cancer insurance in the US or elsewhere. These limitations provide interesting avenues to extend this research by augmenting the sample to include men as well as a broader range of cancer types.

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