NBER WORKING PAPER SERIES

PREFERENCE HETEROGENEITY AND INSURANCE MARKETS:
EXPLAINING A PUZZLE OF INSURANCE

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NBER Working Paper No. 13746
January 2008
JEL No. G22,I11

ABSTRACT

Standard theories of insurance, dating from Rothschild and Stiglitz (1976), stress the role of adverse selection in explaining the decision to purchase insurance. In these models, higher risk people buy full or near-full insurance, while lower risk people buy less complete coverage, if they buy at all. While this prediction appears to hold in some real world insurance markets, in many others, it is the lower risk individuals who have more insurance coverage. If the standard model is extended to allow individuals to vary in their risk tolerance as well as their risk type, this could explain why the relationship between insurance coverage and risk occurrence can be of any sign, even if the standard asymmetric information effects also exist. We present empirical evidence in five difference insurance markets in the United States that is consistent with this potential role for risk tolerance. Specifically, we show that individuals who engage in risky behavior or who do not engage in risk reducing behavior are systematically less likely to hold life insurance, acute private health insurance, annuities, long-term care insurance, and Medigap. Moreover, we show that the sign of this preference effect differs across markets, tending to induce lower risk individuals to purchase insurance in some of these markets, but higher risk individuals to purchase insurance in others. These findings suggest that preference heterogeneity may be important in explaining the differential patterns of insurance coverage in various insurance markets.

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1. Introduction

The textbook approach to insurance markets emphasizes the role of private information about risk in determining who purchases insurance. In the classic adverse selection model of Rothschild and Stiglitz (1976), individuals with higher expected claims buy more insurance than those with lower expected claims, who may be out of the market entirely. This basic prediction of asymmetric information models of a "positive correlation" between insurance coverage and accident occurrence has been shown to be robust to a variety of extensions to the standard framework (Chiappori and Salanie 2000, Chiappori et al. 2006).

Evidence of this positive correlation has been found in several insurance markets, particularly acute health insurance and annuities.[1] Yet it many other insurance markets, those with more insurance appear to have the same or lower occurrences of the insured risk than those with less insurance. This phenomenon of "advantageous selection" has been documented in both large insurance markets such as life insurance (Cawley and Philipson 1999, McCarthy and Mitchell 2003) and Medigap insurance (Hurd and McGarry 1997, Ettner 1997, Fang et al. 2006), and in extremely thin markets such as long-term care insurance (Finkelstein and McGarry 2006) and reverse mortgages (Davidoff and Welke 2005). Moreover advantageous selection has been detected in an insurance market *despite* evidence that, as in the standard asymmetric information models, individuals also have private information about their risk type that is positively correlated with insurance demand (Finkelstein and McGarry, 2006). This discrepancy between theory and reality is even more striking given that moral hazard would tend to increase the risk occurrence of those with more insurance relative to those with less.

A potential explanation for this puzzle is that individuals may vary in their tolerance for risk in addition to their riskiness. When individuals are heterogeneous in their preferences as well as their risk type, the relationship between insurance coverage and risk occurrence can be of any sign (e.g. Fang et al., 2006, Finkelstein and McGarry 2006, Chiappori et al., 2007, Einav, Finkelstein and Schrimpf, 2007, Jullien et al.,

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[1] Cutler and Zeckhauser (2000) review a large literature that tends to find a positive correlation between insurance coverage and risk occurrence in health insurance, although important exceptions such as Cardon and Hendel (2001) exist. Evidence of the positive correlation in annuities has been documented in the U.S. (Mitchell et al., 199), the U.K. (Finkelstein and Poterba 2002, 2004, and 2006) and in Japan (McCarthy and Mitchell 2003).

2007). For example, individuals with lower tolerance for risk may not only demand more insurance but may also invest in activities that lower their expected claims. Such preference effects could offset standard asymmetric information effects to produce an advantageously selected equilibrium in which those with lower expected claims demand more insurance; as a result, the insurance market may exhibit *over-insurance* relative to the first best, rather than the under-insurance of classic, uni-dimensional adverse selection models (de Meza and Webb 2001).

When risk type is endogenous to risk tolerance, the correlation between preferences for insurance and expected claims need not be the same across markets. A risk averse person might invest in annuities and as well as engage in behaviors that decrease mortality; thus, for annuity purchasers there would be a positive correlation between insurance holdings and the insured risk of living a long time. The same person might also buy life insurance, however, leading to a *negative* correlation between the mortality risk that life insurance insures and life insurance holdings. Whether this potential countervailing preference effect materializes in practice, and whether it is large enough to offset the standard asymmetric information effects, is an empirical question.[2]

The existing evidence is consistent with a potentially important role for preference heterogeneity in understanding insurance market equilibria. A growing empirical literature has found evidence of substantial preference heterogeneity in insurance demand. Examples include automobile insurance (Cohen and Einav 2007), long-term care insurance (Finkelstein and McGarry 2006), reverse mortgages (Davidoff and Welke 2005), Medigap (Fang, Keane and Silverman 2006), and annuities (Einav, Finkelstein and Schrimpf 2007). These papers raise the possibility that heterogeneity in preferences may be as or more important than heterogeneity in risk in explaining insurance demand. They also suggest that the correlation between preferences for insurance and expected claims is not the same across markets. For example, in both annuities and auto insurance there is evidence that those with greater preferences for insurance have higher expected

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[2] For example, it is not a priori clear that more risk averse individuals will invest more in activities that lower their expected claims. Preventive activity has a first order effect on the mean of the risk distribution; more risk averse individuals care about reducing the variance of this distribution, which may be positively or negatively correlated with the mean (see e.g. Dionne and Eeckhoudt, 1985 and Jullien et al., 1999).

insurance claims, which would reinforce the standard asymmetric information effect (Einav, Finkelstein and Schrimpf, 2007; Cohen and Einav, 2007). However, in Medigap, long-term care insurance and reverse mortgages, those with higher preferences for insurance appear to have lower expected claims, creating offsetting advantageous selection (Fang et al, 2006, Finkelstein and McGarry 2006, Davidoff and Welke 2005). These findings raise the possibility that differences in the relationship between preferences and expected claims may help explain the observed differences in whether the market appears advantageously or adversely selected.

In this paper, we examine the relation between risky behaviors, insurance purchases, and risk occurrence in five different insurance markets: life insurance, acute health insurance, annuities, long-term care insurance, and Medicare supplemental insurance (Medigap). The analysis is highly complementary to the studies of individual insurance markets discussed above. Indeed, the same data source was used in earlier studies of long term care insurance (Finkelstein McGarry 2006) and Medigap (Fang et al. 2006), although we examine a different set of preference measures. Our main contribution is to show results across several different insurance markets using a common data set and empirical framework.

1. Data and empirical framework

Our analysis uses individual-level data from the Health and Retirement Study (HRS). We use the sample of people aged 51 to 61 in 1992 to examine the holding of term life insurance and private acute health insurance among prime-age individuals. We use a second HRS cohort, the Asset and Health Dynamics (AHEAD) sample, to examine Medigap insurance, long-term care insurance, and annuities among people aged 65 to 90 in 1995. We use the panel nature of these data to track mortality and nursing home outcomes for individuals in both panels through 2002. Table 1 presents key summary statistics for each sample.[3] The average age in our 1992 HRS sample is 56 and in the 1995 AHEAD sample it is 79.

Our basic test is to examine how measures of risk tolerance are related to the occurrence of risk, and to whether the individual has insurance. Risk tolerance is not easily measured. We proxy for

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[3] We use individual sample weights when calculating the means. The regressions presented later in the paper are unweighted.

risk tolerance using five measures of behaviors that likely capture individual risk aversion: smoking; drinking; job-based mortality risk; receipt of preventive health care; and use of seat belts. While each of these variables will reflect factors in addition to risk tolerance, results that are consistent across the variables suggest that risk tolerance is an important part of their variability.

We show results from two main types of analysis, designed to examine, respectively, the relationship between risk tolerance and insurance demand, and between risk tolerance and risk occurrence. We therefore estimate the following two equations by OLS:

$$\mathbf{1}(insurance)_i = \beta_0 + \beta_1 Behavior_i + X_i\Gamma + \varepsilon_i \tag{1}$$

$$Riskoccurence_i = \alpha_0 + \alpha_1 Behavior_i + X_i\Pi + \eta_i \tag{2}$$

In these equations $\mathbf{1}(insurance)_i$ is an indicator variable for whether the individual has a particular type of insurance, $Riskoccurence_i$ is a measure of the occurrence of the risk the insurance in question would cover, $Behavior_i$ is one of our measures of risk tolerance, and X represents covariates. We describe each in more detail in turn.

1.1 Insurance and risk occurrence measures

We measure life insurance by whether the individual has term life insurance in the 1992 HRS; approximately 50 percent of the sample has this insurance.[4] The risk occurrence measure for life insurance is whether the individual dies between 1992 and 2002; 13 percent die.

We measure acute private health insurance in the 1992 HRS by whether the individual has private health insurance through a current or former employer, a spouse's employer, or the non-group market; we exclude individuals who report coverage through a government program (e.g. Medicaid, Medicare, CHAMPUS or CHAMPVA) from the analysis of the acute health insurance market. About 86 percent of the sample has acute private health insurance; of this 86, the vast majority (82 percent) have employment-related coverage. The corresponding risk occurrence measure is whether the individual reports any hospital use in the previous

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[4] Another 21 percent own whole life insurance but no term policy. We focus on term life insurance which is a pure insurance vehicle, rather than whole life insurance which combines an insurance vehicle with a savings instrument.

two years; 9 percent of the sample does. Hospital use is a strong predictor of medical expenses, which is the actual insured risk but which we do not directly observe in the data.

Our third measure of insurance, from the AHEAD, is whether an individual has an annuity in 1995. Approximately 7% of the 1995 AHEAD sample has an annuity.[5] The corresponding risk occurrence measure is the opposite of that for life insurance, specifically whether the individual *survives* from 1995 to 2002; 62 percent of the sample survives.

Fourth, we measure whether the individual has Medicare supplemental coverage (termed Medigap) in the 1995 AHEAD. Medigap policies cover many of the expenses not insured by Medicare, including coinsurance and deductibles.[6] We define an individual as having Medigap if he has a (non-government provided) health insurance policy in addition to Medicare.[7] Nearly 70 percent of the sample has Medigap coverage. Our corresponding risk occurrence measure is the medical expenses reported in 1995 arising from hospital and doctor visits that could have been covered by a Medigap policy; the mean is $911.[8]

Finally, we define an individual has having long term care insurance in the 1995 AHEAD if they answer a question about this coverage affirmatively.[9] About 10 percent have long term care insurance. The corresponding risk occurrence measure is whether the individual goes into a nursing home between 1995 and 2002; about one-quarter of the sample does.

1.2 Behavior measures

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[5] Holding an annuity is defined as an affirmative answer to a question in the survey asking if he has annuity income from a source other than Social Security or a Defined Benefit Pension. Because our sample for this analysis consists of those aged 65 or older, we do not believe that many will start receiving annuity payments at a later date.

[6] During the period of time covered by our data, some Medigap policies also provided prescription drug coverage.

[7] The question asks, "Not counting long-term care insurance or [Medicare, Medicaid, government health insurance] do you have any health insurance that pays any part of hospital or doctor bills? (Sometimes this is called a Medi-Gap policy)."

[8] The HRS reports the number of doctor and hospital visits an individual experienced since the previous interview (approximately 2 years). To translate these numbers into an estimate of expenditures not covered by Medicare we assume an uncovered (by Medicare) expenditure of $100 for the first and second doctor visit in a two year period (i.e. the annual Medicare part B deductible in 1995) and $20 for each additional visit (i.e. the 20% part B coinsurance). We also assume a cost of $716 for each hospital visit (ie.. the Medicare Part A deductible in 1995). No attempt is made to account for hospital stays beyond 60 days at which a copayment kicks in; this is a very rare event in our sample. We do not attempt to measure other potentially covered expenses such as prescription drugs. We do not also impute total spending for acute health insurance as it would require more detailed information than is available about medical care utilization.

[9] The question in the 1995 wave of AHEAD is "Aside from the government programs, do you now have any insurance which specifically pays any part of long-term care, such as, personal or medical care in the home or in a nursing home?

We have five behavior measures that we observe in both the HRS and AHEAD samples. Three are measures of risky behavior: (1) whether the individual currently smokes (2) whether the individual has a drinking problem (defined as three or more drinks per day), and (3) the mortality rate per 100,000 employees in the individual's industry-occupation cell (for the HRS) or occupation cell (for the AHEAD).[10] On average, in our 1992 sample of near-elderly, 27 percent of people smoke, 5 percent have a drinking problem, and the average mortality risk by industry-occupation cell is 4 fatalities per 100,000 employees. Smoking rates are lower in the elderly (7.6 percent of the sample), reflecting the strong difference in mortality by smoking status at older ages.

We also construct two measures of active steps individuals can take to reduce mortality and healthy risk: (1) the fraction of gender-appropriate preventive health activity undertaken,[11] and (2) whether the individual reports always wearing a seat belt. For our 1995 AHEAD sample, we observe these measures contemporaneously in 1995. Unfortunately, for the 1992 HRS sample, these measures are first available in 1996. Our analysis of the preventive health behaviors and seat belt use for the 1992 insurance variables therefore suffers from potential sample selection bias; to observe this behavior the individual must survive until 1996. On average in the 1992 HRS sample, individuals undertake 60 percent of gender-appropriate health activities, and 80 report always wearing a seat belt. For the 1995 AHEAD sample, the figures are 65 percent and 83 percent.

We examine both the simple, unconditional bivariate relationship between each of these behaviors and either insurance coverage or risk occurrence. We also report results in which we control for covariates (X) designed to capture the risk classification used by insurers. Conditioning on the characteristics used in pricing insurance is crucial for papers testing the predictions of standard adverse selection models, as these

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[10] The mortality rates are from Viscusi (2003), who uses data from the U.S. Bureau of Labor Statistics Census of Fatal Occupational Injuries. We define industry-occupation cells (or occupation alone) based on current job (if any), including self employment. If the individual is not currently employed we use the most recent job or, if this variable is missing, the most significant prior attachment. If the individual has never held a job (or all of these measures are missing) the measure of industry-occupation mortality risk is missing.

[11] These activities are: whether the individual had a flu shot; had a blood test for cholesterol; checked her breasts for lumps monthly; had a mammogram or breast x-ray; had a Pap smear; had a prostate screen. See Finkelstein and McGarry (2006) for a study using these variables in this manner.

predictions are about how people behave *conditional* on the menu of contracts they face (Chiappori and

Salanie, 2000). However, when examining the influence of preferences on insurance demand and risk type,

the unconditional relationships may be of greater interest, since we are primarily interested in how

preferences mediate the insurance – risk occurrence relationship through their impact on both risky behavior

and insurance valuation. We thus emphasize the unconditional relationships although we present the

conditional relationships as well for completeness and for comparability with the existing literature.

Appendix A describes the risk classification controls in detail.

2. Results

2.1 Insurance demand and risky behavior

Table 2 examines the relationship between the various behaviors and each of the five insurance products.

It reports the results from estimating equation (1) both with (even columns) and without (odd columns)

conditioning variables. The results are remarkably consistent across behavior measures and across insurance

types. Individuals who engage in more risky behavior are systematically less likely to have each type of

insurance; the results are not sensitive to whether or not we control for risk classification.

The relationships between risky behavior and insurance coverage are particularly strong for preventive

health activity and seat belt use – which are positively and statistically significantly correlated with having

each insurance product – and for the mortality rate of the individual's industry-occupation cell – which is

negatively and statistically significantly correlated with each type of insurance coverage. Similar patterns are

present – but are somewhat less robust – for smoking and drinking. Smokers are statistically significantly

less likely to have life insurance, annuities, Medigap, and private health insurance, but there is no discernable

relationship between smoking and long-term care insurance. Individuals who drink are almost always less

likely to have each type of insurance, but the results are rarely statistically significant.[12]

Our interpretation of these findings is that more risk averse individuals both invest in more risk reducing

(less risky) behavior and value insurance more. Consistent with this, we find suggestive evidence of a

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[12] Both smoking and drinking are thought to be addictive and altering one's behavior along these dimensions is likely to
be more difficult that deciding to wear a seat belt or get a flu shot. They may therefore be less representative of current
preferences than other variables.

negative relationship between risk aversion and risky behavior. As a proxy for risk aversion, we use the respondents' answers to questions concerning their willingness to engage in various hypothetical income gambles.[13] This variable is available only for the 1992 HRS sample. Based on the answers, we form four ordinal categorical variables of decreasing risk aversion and examine their relationship with risky behavior. About 65 percent of the sample falls in the most risk averse category; the remainder are roughly evenly split across the other three risk aversion categories.

Table 3 reports our results concerning the relationship between various risky behaviors and these ordinal measures of risk aversion. Overall, the evidence suggests that those who are in the least risk averse category are more likely to engage in various risky behaviors (or less likely to engage in risk reducing behaviors) than those in the most risk averse category, although the differences are statistically significant only for the risky behaviors measures, and not for the risk reducing behaviors.[14]

2.2 Risky behavior and risk occurrence

Table 4 examines the relationship between risky behavior and risky outcomes, equation (2) above. As in Table 2, we report both unconditional and conditional estimates, and focus on the unconditional estimates.

The first two panels examine the relationship between more risky (less risk reducing) behaviors and mortality in the life insurance sample (Panel A) and the annuity sample (Panel B). The results show a broad pattern that more risky behavior (smoking, drinking, and higher mortality occupations and industries) is associated with (usually statistically significantly) higher mortality, and that investment in risk reducing behavior (preventive health activity or seat belt wearing) is associated with (usually statistically significant) lower mortality. These findings suggest that preferences for insurance – and their differential relationship with risk in life insurance and annuities – may be able to explain the different patterns observed in these two

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[13] The survey questions as respondents if they would be willing to trade a good job with a steady income equal to their current family income for a new job with a "50-50 chance it will double your (family) income and a 50-50 chance that it will cut your (family) income by a third." A second question increases or decreases the possible gain / loss in income depending on the response to the initial question. These responses can be used to group people into four risk-tolerance categories.

[14] Using additional assumptions (e.g. that the utility function exhibits constant relative risk aversion) and data, Barksy et al. (1997) construct measures of average risk tolerance for the four categories and find even more pronounced relationships between risk aversion and risky behaviors than what we report using the ordinal measures.

markets of the relative risk profile of those with more insurance. Individuals who engage in less risky (more risk reducing) behavior demand both more life insurance and more annuities (Table 2) and have higher mortality (Table 4). From the insurance company perspective, this makes them lower expected cost for life insurance (less likely to die and make a claim), thus offsetting the standard adverse selection pattern, but higher expected cost for annuities (less likely to die and stop making claims), thus reinforcing the standard adverse selection pattern.

Life insurance is one of the largest private insurance markets in the world. Previous work has demonstrated that the market does not exhibit higher ownership rates among higher risk individuals, as standard adverse selection or moral hazard models would predict (Cawley and Philipson 1999, McCarthy and Mitchell 2003). Nor does variability in financial exposure explain ownership patterns (Bernheim et al. 2003a 2003b). Our empirical results suggest that heterogeneity in risk tolerance may be able to provide a sensible explanation for the observed patterns of coverage. Specifically, we find that individuals who engage in more risky behavior are both higher mortality risk and less likely to purchase insurance.

Panel C examines at the relationship between behaviors and subsequent use of nursing homes. Although there is no systematic relationship between risky behaviors and nursing home use, we find that individuals who engage in more risk reducing behavior – be it preventive health activity or seat belt use – are less likely to go into a nursing home between 1995 and 2002. This finding was previously documented by Finkelstein and McGarry (2006) over a different time period, who argue that the link between more risk reducing behavior, demand for insurance, and expected claims may explain why the insured do not, on average, have higher nursing home use than the uninsured.

Panel D looks at the relationship between the various behaviors and the risk Medigap insures of medical expenditures not covered by Medicare. The results are mixed; some risky behaviors are correlated with lower medical expenditures while others are correlated with higher medical expenditures; the same ambiguity is present for the risk reducing behaviors. The results are similar if we use the number of doctor visits or the number of nights spent in a hospital as the dependent variable (not shown). Some of these behaviors therefore act to offset the standard asymmetric information effects, while others serve to reinforce

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them. Fang et al. (2006) have documented additional sources of advantageous selection in Medigap. In particular, those with higher cognitive ability are both more likely to purchase Medigap and have lower expected claims.

Finally, Panel E looks at the relationship between the various behaviors and whether the individual has any hospital use, which is an important component of the costs that acute private health insurance would cover. The results are similar if we use the number of doctor visits or the number of nights spent in a hospital as the dependent variable (not shown). Again the results are mixed; some risky behaviors are correlated with lower utilization while others are correlated with higher utilization.

3. Interpretation and Conclusions

Our analysis yields two main findings. First, in all five markets, we find that individuals who engage in what are commonly thought of as risky behaviors (smoking, drinking, or prior employment in jobs with higher mortality rates) or who do not take measures to thought to reduce risk (preventive health activities or wearing of a seat belt) are systematically less likely to hold each of these insurance products.[15] Second, we find that these same individuals tend to have higher expected claims for life insurance and long term care insurance, but lower expected claims for annuities; for Medigap and acute health insurance, there is no systematic relationship between the behavior measures and expected claims.

These results can help to explain the puzzle of insurance we started with: why is adverse selection not more common? In annuity markets, there is clear evidence of adverse selection: people who live longer are more likely to buy insurance. The standard adverse selection model is one explanation for this, but so is variation in risk tolerance; people who have less risky behaviors live longer and are more likely to buy annuities. In life insurance, our results suggest that differential risk tolerance can help explain why people with lower mortality rates have more insurance. Similarly, in the case of long-term care insurance, people who use more preventive care or are more likely to wear seat belts buy insurance more readily but also stay

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[15] Here we use the term "risk" to denote the chance of what is generally considered to be an undesirable event for the individual (namely, worse health or death). Of course, in the context of insurance purchasing, the "risk" depends on what is being insured. For example, from the insurance company's perspective a high mortality individual will be "high risk" as a life insurance consumer but "low risk" as an annuity buyer.

out of nursing homes. For acute health insurance, the lack of any systematic offsetting effect of risk tolerance may explain why the preponderance of studies have found that this market is, on net, adversely selected. In the case of Medigap, other sources of advantageous selection than risk tolerance appear to be necessary to understand why this market is on net advantageously selected; indeed, Fang, Keane and Silverman (2006) have documented that those with higher cognitive ability are both more likely to purchase Medigap and have lower expected claims.

Overall, our findings suggest that preferences for insurance – and their impact on risk occurrence and insurance purchase – may help explain the different patterns of selection observed in different insurance markets. These preference effects thus provide a potential unifying explanation for the differential patterns in insurance coverage across different markets.

Our results have a number of implications. Most importantly, they suggest that in considering the nature of market inefficiencies created by private information in insurance markets, the possibility of over-insurance from advantageous selection should be considered in addition to the under-insurance concern of classic, uni-dimensional adverse selection models. The implications of this for welfare have received some attention (de Meza and Webb 2001) and are a fruitful subject for future research.

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Table 1: Summary Statistics

Variable	Sample	
	1992 HRS	1995 AHEAD
Average Age	56.0 (3.2)	79.0 (4.8)
% Male	47.6	39.8
% Married	76.8	52.5
Behaviors		
Smoker	26.9	7.6
Drinking problem	5.3	3.0
Mortality risk of industry-occupation cell	3.98 (5.50)	3.79 (4.13)
Percent of sex-appropriate preventative measures undertaken	60.0	64.9
Fraction always using seatbelt	79.6	83.0
Insurance		
% with Term Life insurance	50.7	---
% with Acute Private Health Insurance	86.1	
% with Medigap	----	69.5
% with Long-Term Care Insurance	-----	10.2
% with Annuity	----	7.5
N	11,913	7,183

Number of observations varies across variables due to missing values. The number of observations is unweighted. Individuals specific weights for 1992 and 1995 are used. The measure of any health insurance excludes those who are covered by a government programs (e.g. Medicare, Medicaid, CHAMPUS, CHAMPVA). Medigap includes any health insurance policy that supplements Medicare, it may be provided through a current or former employer (or spouse's employer) or privately purchased. Term life insurance includes those policies provided by an employer as well as those purchased privately.

Table 2: The relationship between risky (or risk reducing) behavior and insurance coverage.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
					Mortality Risk in		Preventative Health			
RHS var	Smoker		Drinking problem		Industry-Occupation cell		Activity		Always wear seat belt	

Panel A: Dependent Variable Is Term Life Insurance Coverage in 1992 (mean = 0.50)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Coeff	-0.034***	-0.021*	-0.017	-0.037*	-0.002*	-0.003***	0.115***	0.126***	0.063***	0.072***
	(.010)	(.011)	(.021)	(.022)	(.001)	(.001)	(.016)	(.017)	(.013)	(.013)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	11453	10385	11453	10385	10556	9582	9773	8952	9805	8983

Panel B: Dependent Variable is Annuity Income in 1995 (mean = 0.07)

Coeff	-0.027***	-0.030***	-0.013	-0.018	-0.003***	-0.004***	0.053***	0.052***	0.030***	0.029***
	(.009)	(.009)	(.016)	(.017)	(.001)	(.001)	(.010)	(.010)	(.007)	(.007)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	6420	6371	6393	6345	4878	4835	6251	6203	6408	6359

Panel C: Dependent Variable is Long-term Care Coverage in 1995 (mean=0.10)

Coeff	0.007	0.007	0.016	-0.007	-0.002**	-0.003**	0.082***	0.073***	0.037***	0.041***
	(.014)	(.015)	(.023)	(.025)	(.001)	(.001)	(.011)	(.014)	(.009)	(.010)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	6401	5396	6376	5377	4845	4145	6233	5312	6390	5394

Panel D: Dependent Variable is Medigap Coverage in 1995 (mean=0.65)

Coeff	-0.083***	-0.084***	-0.022	-0.022	-0.016***	-0.016***	0.187***	0.189***	0.058***	0.058***
	(.022)	(.022)	(.035)	(.035)	(.002)	(.002)	(.020)	(.020)	(.016)	(.016)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	6383	6383	6357	6357	4852	4852	6218	6218	6373	6373

Panel E: Dependent Variable is Any (non-governmental) health insurance coverage in 1992 (mean = 0.84)

Coeff	-0.084***	NA	-0.046***	NA	-0.005***	NA	0.220***	NA	0.058***	NA
	(.009)		(.017)		(.001)		(.013)		(.010)	
Control	No		No		No		No		No	
N	10,945		10,945		10,207		9,411		9,448	

Note: Table reports results from OLS regressions. Dependent variable is given in panel headings. First row gives coefficient on right hand side variable listed at the top of the column. All right hand side variables are measured in the year insurance is measured (1992 or 1995 as indicated) except for preventive health activity and seat belt use for 1992 insurance coverage where they are measured in 1996. Additional controls consist of variables used by the insurance company to assess risk. They vary by insurance market. For life insurance and long-term care insurance we use an array of health measures, age, smoking status, and sex. For annuities we use age, spouse's age and sex. For Medigap coverage we use age. See Appendix A for a complete listing of control variables. Heteroskedasticity-robust standard errors are in parentheses. ***, **, * denotes statistical significance at the 1 percent, 5 percent, and 10 percent levels respectively

Table 3: The relationship between risk aversion and risky behavior

	Indicator for Smoker (1992)		Indicator for Drinking Problem (1992)		Mortality Risk in Industry-Occupation Cell (1992)		Preventive Health Activity (1996)		Always Wear Seat Belt (1996)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(19)
Most risk averse	--	--	--	--	--	--	--	--	--	--
Second most risk averse	0.011 (0.014)	0.003 (0.013)	0.004 (0.007)	0.004 (0.006)	-0.262* (0.157)	-0.113 (0.151)	0.005 (0.010)	0.002 (0.010)	0.009 (0.013)	-0.001 (0.013)
Third most risk averse	-0.006 (0.014)	-0.012 (0.014)	-0.004 (0.006)	-0.0099* (0.006)	0.141 (0.178)	0.102 (0.171)	-0.002 (0.010)	-0.003 (0.011)	0.001 (0.013)	0.001 (0.013)
Least risk averse	0.048*** (0.014)	0.041*** (0.013)	0.026*** (0.007)	0.023*** (0.008)	0.503*** (0.185)	0.249 (0.177)	0.017* (.010)	-0.012 (0.010)	-0.018 (0.013)	-0.014 (0.013)
Add'l controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	11,040	10,564	11,040	10,564	10193	9,755	9,481	9,087	9,512	9,119

Note: Table reports results from OLS regressions. Dependent variable is given in column headings. Risk aversion is an ordinal measure based on willingness to accept various hypothetical gambles; see text and Barsky et al. (1997) for more details. Additional controls consist of variables used by the insurance company to assess risk. They vary by insurance market (see endnote to table 2). Heteroskedasticity-robust standard errors are in parentheses. ***, **, * denotes statistical significance at the 1 percent, 5 percent, and 10 percent levels respectively.

Table 4: The relationship between risky (or risk reducing) behavior and risky outcome

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
RHS var	Smoker		Drinking problem		Mortality Risk in Industry-Occupation cell		Preventative Health Activity		Always wear seat belt	
Panel A: Dependent Variable Is Mortality 1992 to 2002 (mean = 0.13)										
Coeff	0.110***	0.089***	0.083***	0.029*	0.004***	0.001	-0.011	-0.005	-0.048***	-0.018**
	(.008)	(.008)	(.017)	(.016)	(.001)	(.001)	(.010)	(.010)	(.008)	(.008)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	11191	10141	11191	10141	10295	9348	10085	8988	10123	9023
Panel B: Dependent Variable is Mortality 1995 to 2002 (mean = 0.38)										
Coeff	0.098***	0.102***	0.021	-0.013	0.007***	0.002	-0.148***	-0.196***	-0.104***	-0.093***
	(.022)	(.022)	(.035)	(.036)	(.002)	(.002)	(.020)	(.020)	(.016)	(.016)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	6455	6403	6428	6377	5681	5072	6285	6234	6432	6382
Panel C: Dependent Variable is 0/1 any nursing home use 1995 to 2002 (mean=0.24)										
Coeff	-0.011	-0.021	-0.030	.003	-0.001	-0.002	-0.127***	-0.080***	-0.053***	-0.042***
	(.019)	(.020)	(.029)	(.031)	(.001)	(.002)	(.018)	(.020)	(.015)	(.016)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	6217	5307	6193	5288	4849	4070	6080	5227	6203	5306
Panel D: Dependent variable is Medical Costs in 1995 that could be covered by Medigap (mean= 911) [†]										
Coeff	-103.1***	-98.3**	-112.3**	-111.7**	9.3***	9.2***	305.1***	301.9***	-99.4*	-99.5*
	(40.2)	(40.5)	(54.5)	(54.6)	(3.6)	(3.6)	(36.6)	(36.6)	(59.9)	(60.0)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	6317	6317	6294	6294	4782	4782	6168	6168	6307	6307
Panel E Dependent variables is 0/1 entered a hospital in the preceding two years from 1992 (mean= 0.091)										
Coeff	-0.006	NA	0. 010	NA	0.002***	NA	0.060***	NA	-0.021***	NA
	(.006)		(.013)		(.001)		(.009)		(.008)	
Controls	No		No		No		No		No	

Note: Table reports results from OLS regressions. Dependent variables are given in panel headings. First row in each panel gives coefficient on right hand side variable listed at the top of the column. All right hand side variables are measured in 1992 for Panel A and E except for preventive health activity and seat belt use which are measured in 1996; all right hand side variables in Panels C, D and E are measured in 1995. Additional controls consist of variables used by the insurance company to assess risk. They vary by insurance market. For life insurance we use an array of health measures, age, smoking status, and sex. For annuities we use age, spouse's age and sex. See Appendix A for further information. Heteroskedasticity-robust standard errors are in parentheses. ***, **, * denotes statistical significance at the 1 percent, 5 percent, and 10 percent levels respectively.

[†] costs not covered my medicare are proxied by $100 for the first and second doctor visit in a two year period and $20 for each additional visit + $716 (medicare deductible in 1995) for each hospital visit. No attempt is made to account for stays beyond 60 days at which the copayment kicks in. ($179 for days 61-90) 8 people have just one stay of more than 60 days, 48 people have more than one stay and a TOTAL of more than 60 days.

Appendix A: Definitions of risk classification controls

In this appendix we provide a detailed description of the controls for risk that we use in each insurance market. We base our decisions of which factors to include by inspection of the information insurers collect and use in pricing premiums. We discuss, in turn, our controls in each market. We also verified that our results are not sensitive to the addition or subtraction of many variables.

Life insurance classification risk: In the life insurance market the degree of underwriting depends on the size of the policy and the age of the applicant. In cases in which there is underwriting, the insured often undergoes an exam and / or receives a blood test. We include dummy variables indicating low (below 20) and high (above 30) body mass index. We also include indicators of difficulty with a series of activities of daily living (walking, getting in and out of bed, bathing, dressing and eating and the total number of such limitations), high blood pressure, diabetes or high blood sugar, whether the individual takes medication for diabetes, had cancer (other than skin cancer) , lung disease, heart disease or a heart attack, takes medication for heart disease, had a stroke, psychiatric problems, arthritis, asthma, kidney or bladder problems, high cholesterol, or a bone fracture. As a measure of cognitive function we include the number of words recalled immediately after having a list read and the number recalled after delay. We include indicators of whether the individual is married, smokes, dummy variables for individual ages, gender, male, number of limitations with respect to activities of daily living and an indicator of their depressive state based on CESD scores as recommended by Mehta et al. (2002).

Acute health insurance risk classification: Because health insurance is obtained primarily through an employer, and there is no underwriting for employer provided coverage, we do not conduct any analysis using control variables.

Annuity classification risk: In the United States, insurers providing annuities condition solely on age and sex. We use a complete set of dummy variables, one for each possible age, sex of the annuitant, and because many annuities are joint and survivor annuities (with benefits continuing as long as either spouse is alive), we also include dummy variables for the age of the spouse.

LTCINS risk: Applications for long-term care insurance policies collect a large amount of information on health status. We have indicators for nearly all such variables. Our controls include, dummy variables for age and spouse's age, whether the respondent is married, or male, and dummy variables indicating low (below 20) and high (above 30) body mass index. We also include indicators of difficulty with a series of activities of daily living (walking, bathing, dressing, eating and toileting, and the total number of such limitations), indicators of use of equipment to help with tasks (a wheelchair, walker, crutches, oxygen, or cane), difficulties with grocery shopping or medication, the number of limitations with respect to instrumental activities of daily living, whether the individual regularly takes prescription drugs, has been injured in a fall, is incontinent, has kidney trouble, congestive heart failure, heart disease, high blood pressure, diabetes, or takes medication for diabetes. Whether he has been diagnosed with cancer, high blood pressure, arthritis, lung disease, currently smokes, has had a hip fracture, has difficulty taking medication, has had a heart attack, takes heart medication, has had a stroke, has psychiatric problems, is cognitively impaired or depressed (Mehta et al., 2002).

Medigap risk: There is no underwriting if a medigap policy is purchased at age 65. We control solely for age.