Source of advantageous selection: Evidence using actual health expenditure risk

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Abstract

In a market where insurers are not allowed to risk rate, we find evidence of advantageous selection using observed health expenditure risk. Selection is driven by income and optimism about the future. This may explain insurers' profitability, despite community rating.

Keywords: health insurance, health expenditure risk, adverse selection

JEL Codes: I1

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Introduction

In contrast to the standard prediction of adverse selection in insurance markets, where high risk individuals purchase more insurance, numerous studies have found evidence of advantageous selection (Einav and Finkelstein, 2011). Recent studies include: Finkelstein and McGarry (2006) which provides evidence of advantageous selection in the market for long-term care insurance among elderly population in the US; Fang, Keane and Silverman (2008) which provides evidence of advantageous selection in the US Medigap market for individuals aged 65 and over; Doiron et al. (2008) and Buchmueller et al. (2008) which find advantageous selection in the market for duplicate private health insurance in Australia; Bolhaar, Lindeboom and Klaauw (2012) which provide similar evidence for Ireland; and Lee (2012) which concludes that insurers in South Korea price discriminate to induce advantageous selection. As a measure of individual health expenditure risk, these studies rely on proxies of health status, such as a self-assessed health rating available in many surveys, predicted health expenditure from a secondary data source, or the unexplained variation in individual's demand for health services. Rarely, is individual insurance information available together with the individual's health expenditure, the most comprehensive measure health expenditure risk.

Knowing the sources of advantageous selection is important for several reasons. First, it may increase the profitability of insurance firm by allowing them to design contracts, or to price discriminate, on the basis of the selection mechanism. Second, it may identify problems in the insurance market. For instance, Fang, Keane and Silverman (2008) find that cognition is the primary source of advantageous selection in the US Medigap market, suggesting that the insurance purchase process in this market may be so complex that only those with good cognitive ability can enter the market. Third, it can characterise populations according to health risk which may in turn help in designing a targeted program for the sub-population with the highest health expenditure risk – to prevent future catastrophic health expenditures.

In this paper we use a large Australian survey data set, linked to the administrative health records of respondents, to directly examine the relationship between health insurance demand and health expenditure. The survey data contains information about individual insurance status and socio-economic characteristics, while the administrative health data contains expenditure on both in-hospital and out-of-hospital health services. The sum of these expenditures is the health expenditure risk score for each individual.

The Australian health care system is ideal for examining advantageous selection: insurance firms are not allowed by law to refuse applicants and must use community rating when setting their premiums. This limits insurers' ability to screen ('cream-skim') applicants. As in many European countries and Canada, Australian private health insurance cover is duplicate insurance. Private hospital cover is often bundled with supplementary coverage for ancillary services, such as dental and optical care. Australia's universal health care system fully covers services in public hospitals and heavily subsidises out-of-hospital services and prescription drugs. The government also subsidises private treatment through a universal subsidy to private health insurance premiums, of 30% with a higher subsidy for those aged above 65. For the past decade, private health insurance coverage has been around 56-60%.

Method and data

To examine the nature of selection, the insurance demand model should include only the risk measure and those variables that insurers can use to set premiums. Under community rating system, insurers

cannot use individual characteristics such as age and chronic conditions to risk rate, so we estimate a binary choice model for insurance demand (probit) solely as a function of total health expenditure. Previous evidence leads us to expect a negative coefficient, indicating advantageous selection. We sequentially add observed individual characteristics to the model and observe changes to the coefficient on total health expenditure. The variable that switches the coefficient sign from negative to positive can be interpreted as the source of advantageous selection.

The survey data comes from the 45 and Up Study which is a representative survey of non-institutionalised older individuals aged 45 and over, fielded once in New South Wales (NSW) between 2006 and 2009. In 2010 NSW had a population of 7.23 million with 39% aged over 45. The sample consists of 263,737 respondents. Linked health expenditure data covers (i) private and public hospital admissions; (ii) emergency department (ED) presentations; (ii) medical services such as doctor consultations and diagnostic tests; and (iv) prescription pharmaceuticals.[1] For each survey respondent, we calculate total expenditure in the survey year. Hospital expenditures are imputed using NSW Department of Health costing rules.[2] For hospital admissions, expenditure varies by diagnosis, hospital type, type of care (overnight, same day, transfer, mental health unit, non-acute care units such as rehabilitation), length of stay, hours in the intensive care unit and use of ventilation machine. For ED presentations, expenditure varies by hospital type, urgency status and whether the patient is subsequently admitted. Annual hospital expenditures are combined with fees for medical services and prices for pharmaceuticals during the year which are directly observed in the data.

As expected, we find those with high expenditure risk are less likely to buy insurance, implying advantageous selection. This is shown in Figure 1. However, there are a small number of individuals with very low risk who also have low demand for private health insurance. This suggests non-linearity in the insurance-risk relationship. We therefore consider more flexible specifications of expenditure based on percentile groups. We find that a flexible specification allowing 20 different slopes for the insurance-risk relationship provides a good fit. We use this model to investigate sources of advantageous selection.

Table 1 summarises variables used to study the source of advantageous selection. The sample insurance rate is higher than the national average because our sample is an older cohort and has higher income than the national income for the 45+ population (27% of respondents have annual income greater than $70,000 compared to 15% nationally). Annual health expenditure is positively skewed with the average ($4,400) lying in the 16th of the 20 percentile groups.

We test risk aversion, cognitive skill and expectation as potential sources of advantageous selection. Risk tolerance is often suggested as the primary source of advantageous selection in many economic studies of investment choice and risky behaviours. We have two potential measures of risk tolerance: whether the individual has ever smoked and whether the individual has undertaken health screening tests (prostate cancer screening (PSA test), bowel screening or mammogram). Both measures reduce the extent of advantageous selection although screening produces more dramatic change to the insurance-risk gradient. To test the impact of cognition, we use responses to the question on how an

[1] The data linkage is performed by the Centre for Health Record Linkage (CHeReL) using a probabilistic matching on first name, surname, date of birth and address (see http://www.cherel.org.au/ for details). The linked, de-identified data is released under ethics approval.

[2] Source: *Costs of Care Standards 2009/10*. We validate these expenditures by comparison with publication by Australian Institute of Health and Welfare (AIHW). A simple linear regression of the AIHW costs by diagnostic group on the imputed costs has an R-square of 0.966 with a slope coefficient of 0.940. We take this good fit and strong correlation as providing support for the validity of our imputed hospital cost estimates.

individual rates his/her memory. To test for the impact of the planning horizon, we use self-assessed quality of life which is likely to be positively related to longevity expectation and optimism, both of which affect health investment decision (e.g., Coelho and Mezza, 2012).

Results

Table 2 shows changes in the sign and significance (indicated with asterisk) of the insurance-risk relationship across the distribution of expenditure risk, as individual characteristics are added to the insurance model. We choose the 25th percentile group as the reference because, as shown in Figure 1, this approximates the location of the turning point in the insurance-risk relationship. The sign of the coefficients on other percentile groups indicates the impact relative to the reference group. In the base model which contains no individual characteristics, insurance is negatively related to risk, consistent with the prior expectation of advantageous selection. Controlling for risk tolerance does not change this relationship. Next, controlling for education flattens the insurance-risk relationship, except at the extremes. Adding income flips the insurance-risk signs to positive for higher risk groups, suggesting that income may be a source of advantageous selection. It also increases the fit of the model (pseudo R-squared). Adding cognitive ability does not change the sign or statistical significance for any group. Similarly, adding expectations and age does not change the sign and significance patterns.

Corresponding to Table 2, Figure 2 Panel (A) illustrates the change in the insurance-risk gradient as individual characteristics are added to the base model. The base model represents the insurance risk gradient for the average person in the sample and it shows advantageous selection. We construct a 'representative' individual guided by the median or the majority characteristic in Table 1: low risk tolerance as measured by never smoked, education set to trade/diploma, annual income between $40,000 and $50,000, good cognition is good and very good quality of life. First, we control for risk tolerance and illustrate the insurance-risk gradient when risk tolerance is low. Low risk tolerance shifts the base insurance rates upwards, but insurance-risk gradient is unchanged. Controlling for education, set at trade/diploma, the insurance-risk relationship becomes flatter but remains downward sloping. Income changes the insurance-risk gradient to positive. Good cognitive ability has very small impact. In contrast, very good expectations have a large impact on insurance demand, both as a demand shifter and as a variable that steepens the insurance-risk gradient in middle risk percentiles. Controlling for all individual characteristics, we find evidence for strong adverse selection. However we also find that expectation can switch advantageous to adverse selection without controlling for income and cognition. Figure 2 Panel (B) illustrates the risk-insurance gradient for different age bands. We find that age is largely a demand shifter but has little impact on the gradient.

Concluding remark

Income as the primary source of advantageous selection in Australia can be partly explained by financial incentives to hold private health insurance. A tax penalty of 1% of income applies if a high income individual or family does not have private health insurance, and this penalty can be more expensive than the insurance premium for standard cover. In addition, there is a 30% government subsidy to insurance premiums. As a result, government policies provide incentives for high income earners to enter the insurance pool. The effect of income may also reflect the well-known positive link between income and health. What is more interesting is the large impact of the quality of life variable which captures expectations about the future. This result supports previous evidence that those with better self-assessed health are more likely to buy insurance; indeed, using self-assessed health instead of quality of life produces a similar insurance-risk gradient. This suggests that insurance demand may be largely driven by individual heterogeneity in optimism about the future. As such, insurance holders

tend to be those who are less likely to make claims, which may explain the profitability of Australian private health insurers, despite the community rating system.

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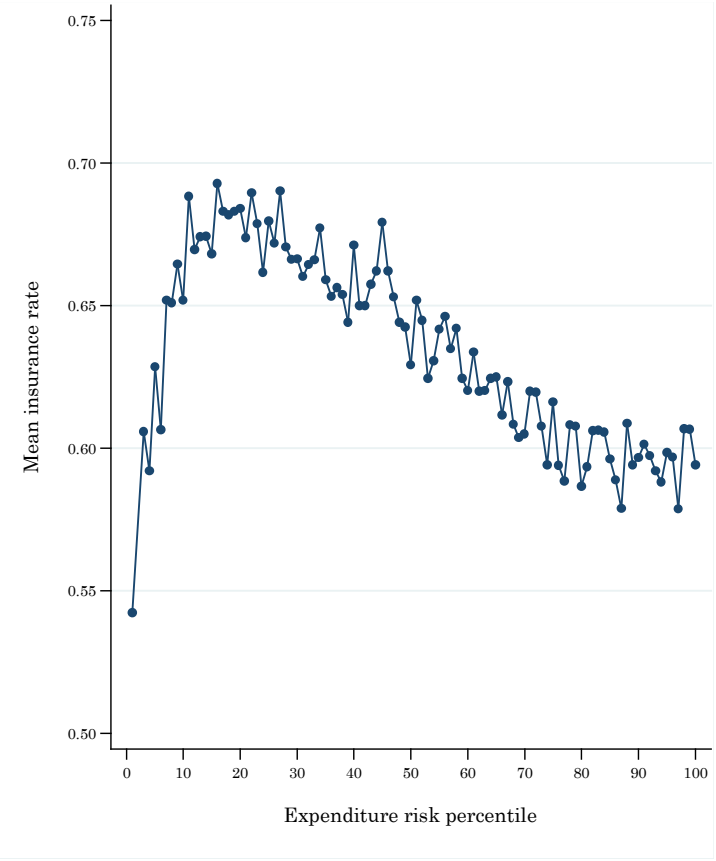
Figure 1: Insurance rate by percentile of expenditure risk



Note: The x-axis is 100 groups of sample respondents, sorted by their total health expenditure. Each marker corresponds to each group, showing the sample insurance rate. Group 1 and 2 however are pooled together as all respondents in these groups have zero expenditure.

Table 1: Sample mean and proportion

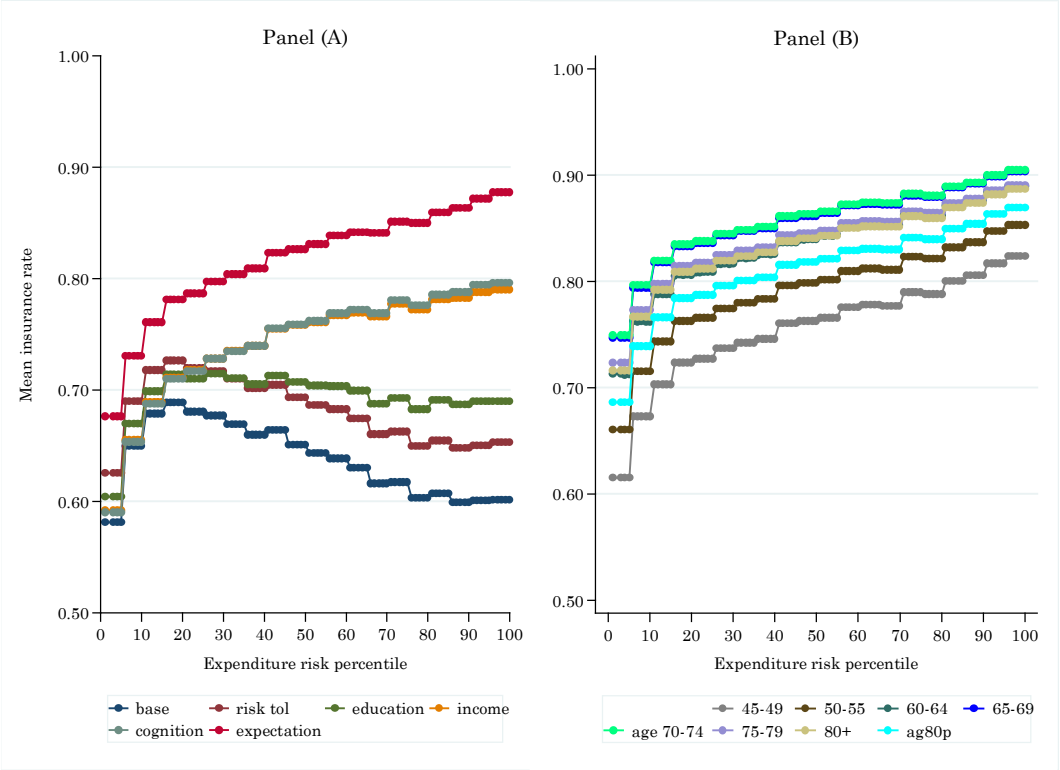
Variable	Level	Mean (s.d)			Mean
Insured		0.633			
Expenditure risk ($'000)		4.392 (9.219)			
Risk tolerance	Screen	0.856	**Cognition**	Excellent	0.125
	Ever-smoke	0.425	**(Memory)**	Very good	0.303
Education	School	0.134		Good	0.369
	Certificate	0.319		Fair	0.145
	Trade/diploma	0.318		Poor	0.024
	University	0.229		Missing	0.034
Income	<$5k	0.016	**Expectation**	Excellent	0.224
	$5k-<10k	0.040	**(Quality of life)**	Very good	0.353
	$10k-<20k	0.141		Good	0.269
	$20k-<30k	0.096		Fair	0.085
	$30k-<40k	0.079		Poor	0.016
	$40k-<50k	0.072		Missing	0.053
	$50k-<70k	0.104			
	>=$70k	0.234			
	Missing	0.217			

Table 2: Sign of insurance-risk relationship relative to the reference group

Percentile	Base	Risk tolerance	Education	Income	Cognition	Expectation	Age
5	**-***	**-***	**-***	**-***	**-***	**-***	**-***
10	**-***	**-***	**-***	**-***	**-***	**-***	**-***
15	-	-	-	**-***	**-***	**-***	**-***
20	+	+	+	-	-	-	-
25			*Reference group*				
30	-	-	+	+	+	+	+
35	-	-	+	+	+	+	+
40	**-***	-	-	**+***	**+***	**+***	+
45	**-***	**-***	+	**+***	**+***	**+***	**+***
50	**-***	**-***	-	**+***	**+***	**+***	**+***
55	**-***	**-***	-	**+***	**+***	**+***	**+***
60	**-***	**-***	-	**+***	**+***	**+***	**+***
65	**-***	**-***	-	**+***	**+***	**+***	**+***
70	**-***	**-***	**-***	**+***	**+***	**+***	**+***
75	**-***	**-***	-	**+***	**+***	**+***	**+***
80	**-***	**-***	**-***	**+***	**+***	**+***	**+***
85	**-***	**-***	-	**+***	**+***	**+***	**+***
90	**-***	**-***	**-***	**+***	**+***	**+***	**+***
95	**-***	**-***	**-***	**+***	**+***	**+***	**+***
100	**-***	**-***	**-***	**+***	**+***	**+***	**+***
Pseudo R-sq	0.004	0.0127	0.0682	0.1556	0.1591	0.1675	0.1728

Note: The sample size is 263,737. Each column is derived from a probit model of insurance demand with the variable indicated by the column title added to the model from the previous column specification. The 'Base' model includes only expenditure risk and year dummy variables. Additional individual characteristics are added sequentially. The final column controls for risk tolerance (measured by ever-smoked), education, income, cognition, expectation and income. * indicates statistical significance at the 0.1% level. A high critical value is chosen due to large sample size.

Figure 2: Insurance rate controlling for sources of advantageous selection



Note: The x-axis is 100 groups of sample respondents, sorted by their total health expenditure. Each marker corresponds to a group, showing the mean predicted probability of having insurance from a probit model. Each series in Panel (A) is derived from a "cumulative" model in the sense that additional individual characteristics are added sequentially: 'risk tol' includes only risk tolerance and holds its effect constant at low risk tolerance; 'education' includes risk tolerance and education with education level set to trade/diploma; 'income' includes risk tolerance, education and income with income set to $40k-50k; 'cognition' includes risk tolerance, education, income and cognition with cognition set to good memory; 'expectation' includes risk tolerance, education, income, cognition and quality of life with quality of life set to very good. Panel (B) shows the risk-gradient for the 'expectation' model split by age group.