Adverse Selection in Australian Private Health Insurance

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Abstract: In this paper, we examine adverse selection in Australian private health insurance using both cross-sectional and panel data of Household, Income and Labour Dynamics in Australia (HILDA) Survey. We find that adverse selection exists in this industry, but its scope has been reduced due to the effect of government policies as well as individuals' heterogeneous preferences and risk aversion.

1. Introduction

Adverse selection is one of the major sources of market failure and inefficiency that threaten the viability and sustainability of the insurance market. Adverse selection relates to the fact that unhealthy people who need health care are more likely to take out health insurance than healthy people. It is one source of the current and forecast increases in the benefit outlays of health insurance, directly accounting for the ongoing and significant increases in private health insurance premiums. The link between asymmetric information in insurance market and inefficient outcomes has been well documented in an influential theoretical literature (Powell and Goldman, 2016). If the insurance plan consists a mix of sick and healthy people, insurers tend to charge higher premiums to cover the potential losses and claims.

Adverse selection is a particular concern in Australia because in a mixed private–public health insurance market, the regulation of premiums is under a community-rating rule. This means that all policyholders pay the same premium for the same product, regardless of health-related risk factors such as age, health status or other characteristics likely to predict future expenditures. In the existing of a universal public insurance system and community rating rules in Australia, adverse selection' effects would be expected to be strong. However, in fact, the existing studies in the Australian private health insurance have documented mixed evidences on risk selection.

This study examines the presence of adverse selection in the Australian private health insurance using the longitudinal data from the Household, Income and Labour Dynamics in Australia

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(HILDA) Survey in the wave 9 (2009) and wave 13 (2013), investigating the feature of risk selection into PHI cover and its tendency based on the updated characteristics of the population and government policies.

The paper is organised as follows. A brief overview of private health insurance in Australia is provided in section 2. Section 3 presents the literature review on risk selection. Section 4 presents the methodology and data. The empirical results are discussed in Section 5. The last section concludes the paper.

2. Overview of private health insurance in Australia

As of June 2018, 11.26 million Australians (45.1% of the population) have private health insurance for hospital service cover and 2.28 million people (9.1%) had general treatment/extras cover. During 2004-2014, the proportion of population subscribing to private health insurance has increased steadily. The number of policyholders covered for hospital treatment increased from 8.6 million in June 2004 to 11.09 million in June 2014.

Insurance types offered by the private health insurance in Australia include hospital cover, general treatment cover (ancillary or extras cover) and ambulance cover. Some certain services are not allowed to be covered by private health insurance[3]. Australians are eligible to access an universal insurance system and they get free access to "a system of high-quality public hospitals", however, the proportion of population is covered for private hospital treatment by private health insurance is high (Doiron et al., 2008). Medicare covers for inpatient care in public hospital system, physician services and other outpatient care as well as prescription drugs. Private health insurance provides care for private patients in a public or private hospital, ancillary services (out of hospital services) that are generally not funded by Medicare and does not cover medical services which are covered by Medicare.

The operation of private health insurance in the health care system is different between countries. Olivella and Vera-Hernández (2013) summarised three types of private health insurance, including purely private framework [the example is a segment of the US population, who is ineligible for public insurance and have to choose private health insurance], complementary to public insurance [in France, Belgium, the US Medicare, where individuals get a basic insurance from public program but purchase private insurance to cover additional

[3] More details are available at: http://www.privatehealth.gov.au/healthinsurance/whatiscovered/privatehealth.htm

treatments which are not covered by public program], or substitute to public insurance [in the UK, Finland, Italy, Spain, New Zealand].

Buchmueller et al. (2013) argued that in the framework of Olivella and Vera-Hernández (2013), private health insurance in Australia mostly appears for substitute coverage. Private health insurance in Australian is not tied to employment, reflecting demand side factors more than in most other countries and the asymmetric information impact is more recognizable (Doiron et al., 2008).

In Australia, the community rating rule in private health insurance is an important feature and mandatory. According to this rule, premiums are charged to all individuals with same price for a given plan regardless of health status, age, gender of any other characteristics. Community rating introduces a high source of asymmetric information and has been claimed for the adverse selection phenomenon. It could lead to "adverse selection death spiral" in which healthy consumers would opt out of the insurance if premiums are set too expensive to cover for potential losses or claims from sicker consumers. Then again, with a pool of sicker policyholders, insurers tend to set even higher premiums, leading to a vicious cycle.

Since the introduction of the universal public insurance (the Medicare program) in 1984 and as the result of the community rating regulation, the holders of private health insurance had decreased, the fact that many observers demonstrated as the presence of adverse selection [Industry Commission 1997[4], Barrett and Conlon (2003b)], the Australian government enacted several policies to reverse this decline trend, including a means-test premium subsidy (issued in 1997, then after being replaced by a 30 per cent rebate on all purchases of private health insurance), Medicare levy surcharge (1 per cent of income tax imposed on high income individuals who do not hold private hospital insurance) and Lifetime Health Cover (promulgated in 2000, encouraging customers to take out and uphold private health insurance before the age of 30 or they will be subject to a 2 percent loading per annum if joining at 31 years old or after). These reforms have been described as both "carrot" and "stick" approaches, simultaneously encouraging PHI uptake and penalising who do not hold private health insurance. With these policies, especially the Lifetime Health Cover, the percentage of holders of private health insurance has begun to increase. According to the Private Health Insurance Quarterly Statistics released in February 2017 by APRA, 86.05% of adults with hospital cover

[4] Available at: http://www.pc.gov.au/ data/assets/pdf file/0006/156678/57privatehealth.pdf

have a certificated age of entry of 30, with no penalty loading. At the end of December 2016, 1.1 million people are subject to a Lifetime Health Cover loading.

Although the proportion of population purchasing private health insurance has increased with the issuance of these "carrot" and "stick" polices, some studies (Butler, 2002, Connelly et al., 2010) still cast doubt on the effectiveness of these policies on arresting adverse selection.

Moreover, in the context of population aging and suffering more chronic diseases, and the fact that over recent years, "the average increase in PHI premiums was consistently greater than the national consumer price index", the re-examination of adverse selection phenomenon in the health insurance market is an important study.

3. Literature Review

3. 1. Adverse Selection

The private asymmetric information existing in insurance market has been claimed for the presence of adverse selection in a variety of studies, in which the policyholders would be better informed about the probability, distribution and size of risk or losses and use this information to choose their insurance plans. Cohen and Siegelman (2010) reviewed a large number of the empirical studies and insisted that evidence of adverse selection within health insurance markets was found in a significant body of empirical studies, people in poorer health choose plans that offer more generous coverage or policyholders who purchase more insurance coverage tend to be riskier (Bajari et al., 2011, Cameron and Trivedi, 1991, Cutler and Reber, 1998, Cutler and Zeckhauser, 1997, Ettner, 1997, Finkelstein, 2004, Haddad and Anbaji, 2010, Pauly and Zeng, 2004, Savage and Wright, 2003, Wolfe and Goddeeris, 1991, Bajari et al., 2014, Lotfi et al., 2015, Sapelli and Vial, 2003, Olivella and Vera-Hernández, 2013). Adverse selection has been documented in the context of employer-provided health insurance (Bajari et al., 2014, Powell and Goldman, 2016), the public health insurance program (Polyakova, 2016) or the private insurer-provided health insurance program (Conlon, 2001, Savage and Wright, 2003).

Adverse selection has existed in the different insurance framework, including in the pure private insurance setting, in the private insurance system that is complementary to the public insurance such that in Ireland (Bolhaar et al., 2012), or in private insurance system which is substitutive of the public system such as the system in the UK (Olivella and Vera-Hernández, 2013).

Private asymmetric information in favour of the policyholders is central to the analysis of adverse selection in health insurance, in which high risk individuals have private information about their latent health status which is unobserved by the insurers (Bajari et al., 2014, Dardanoni and Li Donni, 2012). A positive correlation between high coverage plan selection and higher risks of customers is anticipated in the asymmetric information theory (Dardanoni and Li Donni, 2012, Haddad and Anbaji, 2010). A large literature tested for the existence of asymmetric information by relating insurer's health care expenditures to the levels of insurance coverage - high-risk policyholders tend to purchase more insurance coverage - following the first positive correlation test introduced by Chiappori and Salanie (2000) (Lustig, 2010). Hopkins and Kidd (1996) argued that "asymmetry of information is a health care market feature which makes discrimination between risk groups difficult and expensive. In Australia, regulation of private health insurance markets institutionalizes adverse selection by prohibiting statistical discrimination between risk groups". Polyakova (2016) tested the cross-sectional positive correlation between insurance coverage and health care expenditure for a prescription drug public insurance program in the U.S and concluded there were "a large degree of asymmetric information: the most generous plans attracted individuals whose annual drug spending was more than a standard deviation above the spending in the least generous plans".

Econometric approach to test for adverse selection and the presence of positive correlation between risk-coverage in the literature was summarized in the review of Cohen and Siegelman (2010). The first approach which has been extensively used is to run a regression, in which policyholders' risk is a dependent variable, independent variables include the insurers' choice of coverage and a vector of their risk characteristics that are known to the insurers. An alternative approach is based on the bivariate model. The bivariate model includes two equations determined together, one for the choice of coverage and the other for risk-as a function of the policyholders' characteristics. The finding of a positive correlation between the two residuals in the two models reflects coverage-risk correlation. Recently, some researchers introduced new approach such as multivariate discrete finite mixture model (Dardanoni and Li Donni, 2012), smooth mixture of tobits model (Keane and Stavrunova, 2016) or semiparametric analysis (Bajari et al., 2014). The choice of models have also depended on the data available, as some researchers tested for the evidence of a separating equilibrium in which higher risk insurers opt for more comprehensive coverage, some others which based on survey data examined the relationship between risk and the probability of purchasing health insurance (Buchmueller et al., 2013). It is worth noting that the major limitation of previous studies when

using proxies for the comprehensive level of insurance cover which had not been available in the data source is that there were no consistent metric, the used variables were diverse, from total charges, admission and length of hospital stay to number of GP visits or number of specialist visits (Deb et al., 2006).

In Australia, as noted by Buchmueller (2008) that "adverse selection has been a particular concern" with community rating rule, which is a major cause of adverse selection (Brown and Connelly, 2005). Hopkins, S. and M. P. Kidd (1996) used the 1989-1990 National Health Survey data and examined a number of important determinants for demand of private health insurance. They indicated there were three sets of variables including health status, material wellbeing and the relative importance of the private and the public health insurance coverage. Their paper also shown the geographical location is an important variable for private insurance decision partly explained by the differences in the supply of private versus public facilities and the private insurance price. Moreover, on the whole, privately insured individuals were documented as sicker population. Barrett and Conlon (2001) used the ABS National Health Surveys in the year 1989 and 1995 to evaluate the presence of adverse selection in insured population and the risk composition of the insurance fund membership. They also assessed a possibly continuing process of adverse selection by examining the changes in the policyholders' characteristics between the two surveys. Their findings suggested the occurrence of adverse selection in both 1989 and 1995, "in terms of the age distribution of membership and especially the number of health conditions suffered", and the process of adverse selection accelerated over the period. Barrett and Conlon (2003a) used the ABS National Health Surveys in the probit model to examine private insurance coverage over the period 1989-1995. The explanatory variables were classified in two broad groups: the first group are basic demographic and socioeconomic variables such as sex, marital status, education, gross annual income, immigrant status, the number of dependent children; the second group are variables providing information of health conditions and health risk-related behaviours. They concluded the decline in insurance coverage during this period evidenced the adverse selection appearance in the insured population. The decision to purchase private health insurance was found to be positively correlated with individual's health status and health risk behaviours.

Australia experienced the long-lasting decline trend in holding private health insurance as the result of community rating rule and the Government issued the policies to capture its negative effect side on the private health insurance market. Since the universal public insurance named

Medicare Program was established in 1984, from the mid-1980s to the 1990s, private health insurance coverage was shrinking (50% of Australian purchased private health insurance in June 1984 while by June 1997, the rate is only 32%) (Buchmueller, 2008), many observers argued this declined trend as the result of adverse selection dead spiral (Barrett and Conlon, 2003b). The policy reforms between 1997 and 2000 including the 30% price subsidy (or rebate) policy and Lifetime health cover policy have been received considerable discussion in the existing literature for its impact on increasing enrolment coverage in private health insurance plans (Ellis and Savage, 2008).

Lifetime health cover scheme was introduced by the Australian Government in 2000 to address the age-based adverse selection which imposes penalties for late buying private health insurance in life. However, several studies shown that adverse selection may be reduced, but has still remained in the private health insurance market. Ellis and Savage (2008) claimed that the broadening in the age distribution of private health insurance, illustrating by the fact that the policy reforms increased "the enrolment substantially for all but the highest-age decile of families and for about the youngest 70% of singles", mark a reduction in adverse selection. On the other hand, Connelly and Brown III (2006) insisted that although the Lifetime cover scheme was an important step towards demonstrating that age-based penalties to arrest adverse selection, "it has been shown theoretically and empirically that the policy has not stabilized adverse selection". An another argument raised by Brown and Connelly (2005) as the "Lifetime cover implicitly assumes that the vast majority of older people are high-risk, but there are many older low-risks who are not attracted by this scheme". This argument was accompanied by the data in 2000 from the Australian Institute of Health and Welfare that in the 70+ year old cohort of Australians, 36.4 percent had insurance while 63.4 percent did not and it was likely many of these are older low-risk people. By an empirically-based probabilities of illness, they documented that "the older low-risk types will not buy private insurance under Lifetime Health cover" and this scheme would not arrest adverse selection.

Although a number of previous studies documented adverse selection in health insurance, advantageous selection has also been recorded. This section below provides discussion on advantageous selection found in the literature.

3.2. Advantageous Selection

In contrast to the classic theoretical prediction and the textbook models of standard adverse selection, previous studies found advantageous selection in health insurance. Advantageous

selection (or propitious selection) is found with the presence of negative risk-coverage correlation which is opposite to the positive sign in the existence of adverse selection (Bolhaar et al., 2012). In a well-known article introducing the testing for asymmetric information in insurance markets, Chiappori and Salanie (2000) insisted that "risk is not the only possible source of informational asymmetry and probably not the most important one. There are good reasons to believe that individuals know better their own preferences and particularly their level of risk aversion—an aspect that is often disregarded in theoretical models". This type of risk selection has been reported in a number of empirical studies (Buchmueller, 2008, Cardon and Hendel, 2001, Doiron et al., 2008, Fang et al., 2008, Grunow and Nuscheler, 2014).

If one-dimensional private information in favour of insurers is the central for analysis on adverse selection, the existing empirical literature on advantageous selection emphasizes "multiple dimensions of consumer heterogeneity, with adverse selection along some dimensions and advantageous selection along others**"** (Lustig, 2010). Multidimensional information found to be important in researches on advantageous selection. Buchmueller et al. (2013) explained that negative correlation may be observed in health insurance market because lower risk customers were outnumbered and they purchased health insurance for other factors rather than high expectation of claims. For example, low-risk people like to enrol into health insurance program because they are risk-averse. Bolhaar et al. (2012) examined the supplementary private health insurance in Ireland to test whether moral hazard and/or selection (either adverse or advantageous) were present. They found evidence for multidimensional asymmetric information which has important impact on the uptake of private health insurance and mental health was a source of advantageous selection. Finkelstein and McGarry (2006) argued the presence of multiple dimensions of private information in the long-term care insurance market in the U.S that was individuals either have private information on their high risk or have private information on their strong taste for insurance but expose low-risk.

Apart from multidimensional private information, Buchmueller et al. (2013) and Bolin et al. (2010) provided another explanation for the negative risk-coverage correlation, when insurers were able to obtain enough information about customers, discriminated them based on observable health-risk characteristics and set premium accordingly.

Risk aversion, cognitive ability, income are commonly referred as sources of advantageous selection, although a number of studies have still reached inconsistent results on these factors. Kiil (2012) reviewed 24 articles and 15 working papers studying the privately insured in the

universal health care systems and concluded that "the empirical evidence on the importance of risk preferences is sparse and points in different directions". Fang et al. (2008) found that insurers with the U.S Medigap insurance were likely spend less on medical care. They concluded that cognitive ability and financial numeracy were important sources of advantageous selection for the US Medigap insurance. However, they found "no evidence that variation in risk preferences, which is the primary focus of the theoretical literature on advantageous selection, explains the otherwise negative relationship between coverage and expenditure risk". Similarly, Bolin et al. (2010) observed "a negative correlation between risk and insurance but found no evidence of heterogeneous risk-preferences as an explanation" to their findings. Keane and Stavrunova (2016) also argued that "heterogeneity in private information about risk aversion does little to help explain advantageous selection". Meanwhile, risk attitude was suggested as source of advantageous selection in other studies (Hemenway, 1990, De Meza and Webb, 2001).

Moreover, while Johar and Savage (2012) found that "income as the primary source of advantageous selection in Australia can be partly explained by financial incentives to hold private health insurance", Bolin et al. (2010) examined the voluntary health insurance in Europe and concluded that they found no statistically significant effect of wealth and insurance.

Some other factors such as waiting time, mental health, optimism have also examined in the previous studies and were recommended as sources of advantageous selection. Johar et al. (2011) examined Australian private health insurance and suggested that "a source of favourable selection may be aversion to waiting among healthier people", Johar and Savage (2012) suggested optimism about the future was a determinant factor.

Several studies criticized that if model examining the existence of adverse selection in health insurance did not condition on the sources of advantageous selection, the results could be biased. Keane and Stavrunova (2016) criticized the findings of Bajari et al. (2011) and Bajari et al. (2014) on the substantial adverse selection as bias because they "do not allow for heterogeneous risk aversion, or correlation of risk aversion with expenditure risk". Johar et al. (2011) argued that omitting the waiting time from the model would result in "negative bias in the effect of bad health on insurance demand". Cutler et al. (2008) insisted that "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 Australian health insurance market, Buchmueller (2008) noted that "there is considerable evidence from Australia that individuals in poor health are less likely to have private

insurance". Moreover, Johar and Savage (2012) found that "those with better self-assessed health are more likely to buy insurance". Similar results could be found in the researches of Doiron et al. (2008), Ellis and Savage (2008), Leach et al. (2012), Banks et al. (2009), Buchmueller et al. (2013). Doiron et al. (2008) argued that "those persons who engage in risk-taking behaviours are simultaneously less likely to be in good health and less likely to buy insurance". Leach et al. (2012) found that "individuals with a mental health problem were less likely to have PHI [private health insurance] than those without a mental health problem". Banks et al. (2009) documented that "PHI (private health insurance) use is generally highest among those with the least need for health care. Whether or not people have PHI is more strongly associated with demographic and lifestyle factors than with health status". Buchmueller et al. (2013) claimed there were a negative correlation between health risk and insurance coverage, where 'insured adults for hospital care have lower hospital utilization and in better self-reported health compared to uninsured adults".

3.3. Mix of Risk Selection

Cohen and Siegelman (2010) reviewed the studies of risk selection in insurance markets and commended that the coverage-risk correlation "does exist in some markets and policy pools but not in others" and "the existing body of empirical evidence, informed by theoretical reasoning, provides good reasons to expect the existence of adverse selection to vary across markets and, indeed, even across segments of the same market". Indeed, a number of studies documented the mixed selection within the same market. For example, Powell and Goldman (2016) examined the risk selection based on the claim data from a large firm and concluded the favourable selection existed in the least generous plan and adverse selection was found in the most generous.

Clearly, individuals' risks tolerance and risk type are heterogeneous, then even if the classic asymmetric information effects present, the insurance coverage and risk relation can be of any sign (Cutler et al., 2008), this could explain why adverse selection is expected to vary across subgroups of the same market, resulting both types of risk selection exist.

3.4. Socioeconomic and Demographic Factors

Apart from individuals' risks characteristics and sources of advantageous selection such as risk tolerance, income, cognitive ability, a large number of the existing literature found that the socio-economic and demographic factors covariate with the uptake, selection and utilization of private health insurance. The additional control variables including education, income,

employment, family, marital status, gender, age, race have included in the studies on risk selection (Conlon, 2001, Barrett and Conlon, 2001, Finkelstein and McGarry, 2006, Finkelstein and Poterba, 2006, Doiron et al., 2008, Banks et al., 2009, Bolin et al., 2010, Johar and Savage, 2012). Risk selection has been affected by individuals' characteristics, socio-economic and demographic factors as well as institutional framework.

4. Methodology and Data

4.1. Methodology

Following Barrett and Conlon (2001), Doiron et al. (2008), Buchmueller et al. (2013) who used the survey data in their researches, we examine the relationship between health risk and the probability of having private hospital insurance coverage to test for the presence of adverse selection in private health insurance. Buchmueller et al. (2013) provided the argument for the validation of this approach in the Australian private insurance market. Moreover, Brown and Connelly (2005) argued that the classic adverse selection result in the community-rated premium system is that the high-risk person will be fully insured, whereas the low-risk person will not subscribe to insurance.

Our empirical method approach is similar to that used by Doiron et al. (2008), Lee (2012) , with the demand for individual's private health insurance is modelled as:

$$Di^* = \beta' Xi + \delta' Si + \gamma' Li + \varepsilon i, \quad Di = 1 \; Di^* > 0 \qquad (1)$$
$$Di = 0 \text{ if } Di^* \leq 0$$

Where Di is the observed insurance coverage, Di* is a continuous latent variable measuring the net benefit of purchasing PHI, Xi is a vector of individual characteristics, Si is the vector of self-assessed health status (SAHS) dummies, Li is the serious illness conditions, β-δ-γ are vectors of coefficients of probit regressions, ε measures unobserved factors on PHI demand and is assumed to be normally distributed.

We measure individual's health risk by the two indicators, SAHS and the presence of serious illness conditions. The first probit model contains only SAHS as an explanatory variable, then we add more characteristics variables and health illness condition variables to control for the heterogeneity across individuals.

Next, follow a method used by Lokshin and Ravallion (2005), we use the same set of explanatory variables, except for SAHS, to investigate the effect of more objective health variables (serious illness conditions) on the probability of PHI purchase in the probit model:

$$D_i^* = \lambda' X_i + \upsilon' L_i + \varepsilon_i, \quad Di = 1 \; Di^* > 0 \qquad (2)$$

$$Di = 0 \text{ if } Di^* \leq 0$$

and the ordered probit model with SAHS is an dependent variable:

$$S_i^* = \alpha' X_i + £' L_i + \mu_i, \; Pr(Si=j) = Pr(k_{j-1} < \alpha' Xi + £Li + \mu i \leq k_j) \qquad (3)$$

Where j is the category of SAHS, j = 0, 1,…4; α and £ are vectors of coefficients, k is a vector of cut-off points for the index, μi is assumed to be normally distributed.

4.2 Data and Descriptive Statistics

The data are from the Household, Income and Labour Dynamics in Australia (HILDA) Survey, which is nationally representative household-based longitudinal survey. The HILDA Survey has collected valuable information on household and family relationships, income, education, employment and health to reflect the stories of the same group of Australians over years. The first wave was conducted in 2001 and there are 17 waves so far. Information on serious illness condition which is an important variable in the model is only available in the wave 9 (2009) and wave 13 (2013), therefore the dataset was collected from wave 9 and 13.

All variables in the model are dummy variables, except for income, broadly classified into the two groups: the first group of variables relates to self-assessed health status (SAH), serious illness conditions and health-risk factors; the second group of variables provides information on demographic and socio-economic characteristics, including sex, income, education, occupation, family type, state of residence, remoteness area.

The serious illness conditions include: arthritis/osteoporosis, asthma, any type of cancer, chronic bronchitis/emphysema, type 1 diabetes, type 2 diabetes, depression/anxiety, other mental illness, heart diseases, high blood pressure/hypertension, other serious circulatory condition (stroke, hardening or arteries…). The health-risk factors consist of tobacco smoking, alcohol consumption, body mass index, insufficient physical activity, high blood pressure, and the level of distress.

A variable indicating whether a person has health concession cards (Government Health Care Card, Department of Veterans Affairs Orange Treatment Entitlement Card, Department of Veterans Affairs White Treatment Entitlement Card, Department of Veterans Affairs Gold Treatment Entitlement Card, Pensioner Concession Card, Commonwealth Seniors Health Card) is also included in the model.

The dataset in wave 9 and wave 13 consist of 13,301 and 17,501 individuals, respectively. Similar to Buchmueller et al. (2013), we remove those observations for persons less than 25 years old because it is not appropriate to include children or dependents (students) as independent observations in the model. We also delete observations being unemployment or out of labour force because they aren't able to make their own insurance choices. After cleaning the dataset, each wave consists of the same 3,917 individuals. The two-time balanced panel data comprises 7,834 observations.

Table 1: Self-assessed health status (SAHS)

	2009				2013			
	Percentage	PHI (%)	No PHI (%)	Total	Percentage	PHI (%)	No PHI (%)	Total
Excellent	14.78	66.67	33.33	100	10.98	73.26	26.74	100
Very good	41.95	62.87	37.13	100	41.13	68.96	31.04	100
Good	34.69	57.84	42.16	100	36.66	62.40	37.60	100
Fair	7.84	55.70	44.30	100	10.21	59.00	41.00	100
Poor	0.74	55.17	44.83	100	1.02	70.00	30.00	100
Total	100	61.07	38.93		100	66.02	33.98	

Table 2: Serious illness conditions

	2009				2013			
	Percentage	% PHI	% No PHI	Total	Percentage	% PHI	% No PHI	Total
Serious illness conditions	34.11	65.04	34.96	100	39.14	67.06	32.94	100
No serious illness	65.89	59.01	40.99	100	60.86	65.06	32.94	100
Total	100				100			

Table 1 and 2 provides descriptive statistics for the sample proportion by insurance cover regarding self-assessed health status and serious illness condition, showing that healthy customers outnumber unhealthy customers in the insured pool. Around 56.73% are reported to have excellent/very good health, 43.27% are reported to have good/fair/poor health. For people with serious illness conditions, more than 65% are covered by private health insurance.

Table 3: Summary statistics

	2009		2013	
Variable	Mean	Std.	Mean	Std.
PHI	0.6107	0.4877	0.6602	0.4737
BMI	0.9977	0.7592	1.0485	0.7558
Self-assessed health (SAH)	1.3781	0.8556	1.4917	0.8574
Distress	0.0883	0.2838	0.1003	0.3005
Serious illness condition	0.3411	0.4741	0.3914	0.4881
No healthcare card	0.9137	0.2808	0.9099	0.2864

Drink	1.5131	0.7985	1.5236	0.7794
Smoke	0.8739	0.4233	0.8979	0.3785
Activity	1.0804	0.8790	1.0360	0.8685
Age	1.5126	0.7097	1.7427	0.5683
Occupation	3.5285	2.1188	3.4800	2.1396
Gender	0.4603	0.4985	0.4603	0.4985
Education	0.3390	0.4734	0.3480	0.4764
Family Type	1.6763	1.0373	1.6686	1.0437
Income	56,212	44,253	66,574	54,865
Remote Area	0.1414	0.4016	0.1356	0.3839
State	2.7018	1.6869	2.7115	1.6945

5. Empirical results

Table 4 presents the empirical results of probit regressions on PHI demand and explanatory variables in the sample of 2009 and 2013. Model I includes only SAHS as independent variables, serious illness conditions and health-risk factors are added in the model II, finally all socio-economic variables are included in the model III. To test for the presence of adverse selection, we focus on the two indexes of health risks: *SAHS and serious illness condition.*

With model I including only the SAHS dummies, there is significantly negative relationship between SAHS with probability of insurance coverage, individuals with the lower health status are less likely to be covered by PHI. This result supports advantageous selection rather than adverse selection. However, in Model II, we add health and health risk factors, this reduces the relationship between SAHS and PHI. In Model III, we add more socio-economic variables, this has strong effect in reducing the relationship between SAHS and PHI coverage. In fact, SAHS is likely not only to reflect health risks but also capture individuals' heterogeneity in risk preference and socio-economic characteristics such as age, education, income, family status, occupation.

In all models, a strong positive relationship is found between more objective measure of health and PHI coverage. People with serious illness conditions are more likely to purchase PHI, consistent with adverse selection where consumers buy insurance because they need more healthcare. Notably, the marginal effect of serious illness condition variable on PHI index in 2013 is much lower than that is in 2009 (0.041 and 0.077, respectively, results are not shown on the table 4). This finding suggests that there should be some factors affecting to the tendency of subscribing PHI among sicker people over time. We discuss it further below.

As would be expected, there is a strong increase of more than 88 and 54 percentage points in the year 2009 and 2013, respectively, between the probability of PHI cover for those aged less than 30 years old and those aged more than 66 years old. Ageing is one factor implying the need for more health care and captures undiagnosed health conditions. This result could be interpreted as the presence of adverse selection.

The importance of multidimensional private information is documented in risk selection of empirical studies. We find the sources of advantageous selection in PHI when picking up the effect of socio-economic variables. The results in both samples show that people with higher education, higher income are more likely to purchase PHI. Couple families are more likely to subscribe with PHI than lone person as children or dependents would get benefits from PHI coverage for the family type. Moreover, individuals without concessional healthcare cards or who live in city and inner regional areas are more likely to buy PHI. These results could be related to risk aversion, the effect of "carrot" and "stick" policies or because people prefer the convenience and facilities from private hospitals.

Overall, similar to the findings of Doiron et al. (2008), both adverse and advantageous selection into PHI coverage are found in our paper. Dardanoni and Li Donni (2012) studied the Medicare program which has offered insurance plan to the elderly in the United States and they found the significant selection originating from "the multidimensional nature of residual heterogeneity", both adverse and advantageous selection in this program existed.

Table 4	Sample 2009 (n=3,917)			Sample 2013 (n=3,917)		
(Selected variables)	Model I	Model II	Model III	Model I	Model II	Model III
SAH Category	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
Very good	- 0.1022	- 0.0857	- 0.0520	-0.1221**	-0.0916*	-0.0409
Good	- 0.2330***	- 0.1625**	- 0.0711	-0.3401***	-0.2267***	-0.1210**
Fair	- 0.2874***	- 0.2187**	- 0.1336	-0.4172***	-0.2791***	-0.1508**
Bad	- 0.3007	- 0.0971	- 0.0843	-0.5849***	-0.4578***	-0.3037*
Health and Risk factors						
Serious illness condition		**0.2351*** **	**0.2440*** **		**0.1351*** **	**0.1399*** **
High distress		- 0.3189***	- 0.2479***		- 0.2503***	- 0.1730**
Drink						
No alcohol		- 0.3383***	- 0.1601*		- 0.3471***	- 0.1682*
Moderate alcohol		- 0. 1380***	- 0.0477		- 0.1023*	- 0.0126
Smoke						
No smoking		0.6291***	0.4138***		0.7585***	0.5380***
Moderate smoking		0.3063**	0.2000		0.3613***	0.2575*
Exercise						
Less exercise		- 0.0300	- 0.0702		- 0.0310	- 0.1328**
Moderate exercise		0.1120**	0.0447		0.1092**	- 0.0048
Socio-economic factors						
Age						
30-40			0.2189***			0.1637
41-65			0.4310***			0.2977**
66+			0.8890***			0.5440***
Female			0.1100**			0.1250**
Bachelor or above			0.3515***			0.3209***
Family Type						
Type 1			0.3307***			0.3311***
Type 2			0.2245***			0.1968***
Type 3			0.2486**			0.3749***
Type 4			- 0.3284***			- 0.1828
Type 5			- 0.1499			- 0.2188
Income			8.30E-6***			6.75E-6***
Remote						
Outer regional area			-0.0957			- 0.1837**
Very remote area			-0.1320			0.0455
No healthcare card			0.5721***			0.4034***
Constant			- 1.4579***			- 1.1595***
Pseudo-R2	0.0038	0.0429	0.1639	0.0067	0.0478	0.1731
Prob>Chi2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

(Notes: *P<0.1, **P<0.05, ***P<0.01. Type 1: Couple without children, type 2: Couple with children/dependents, type 3: Couple without dependents, type 4: Lone parents with children/dependents, type 5: Lone parents without dependents)

Table 5 presents additional results on the correlation of serious illness conditions on PHI demand and self-reported health status, verifying the predictions of adverse selection. Individuals with more serious illness conditions are more likely to demand for PHI and more likely to report poor health status.

Table 5: Probit regression on PHI and ordered probit regession on SAHS

	Probit		Ordered probit	
	2009	2013	2009	2013
Selected variables	Coeff.	Coeff.	Coeff.	Coeff.
Serious illness condition	**0.2303***(0.0490)**	**0.1321***(0.049)**	**0.5764***(0.0039)**	**0.5102***(0.0383)**
Age			Yes	Yes
30-40	0.2171***(0.0789)			
41-65	0.4233***(0.073)			
66+	0.8744***(0.2103)			
Bachelor or above	0.3522***(0.0594)		Yes	Yes
Family Type			Yes	Yes
Type 1	0.3314***(0.075)			
Type 2	0.2258***(0.0706)			
Type 3	0.2488***(0.1034)			
Type 4	- 0.3265**(0.1279)			
Type 5	- 0.1561 (0.1734)			
Income	8.32E-6***		Yes	Yes
Remote			Yes	Yes
Outer regional area	- 0.0978 (0.076)			
Very remote area	- 0.1347 (0.1581)			
No healthcare card	0.5740***(0.086)		Yes	Yes
Constant	- 1.5045***(0.1650)			
Observations	3,917	3,917	3,917	3,917
Prob>Chi2	<0.01	<0.01	<0.01	<0.01

(Notes: *P<0.1, **P<0.05, ***P<0.01. Parentheses indicate standard errors. Type 1: Couple without children, type 2: Couple with children/dependents, type 3: Couple without dependents, type 4: Lone parents with children/dependents, type 5: Lone parents without dependents)

From the results from table 4 and 5, we could conclude that adverse selection exists in Australian private health insurance. The cream-skimming by insurers (if any) or government policies are not strong enough to reverse adverse selection.

In order to investigate the tendency of people purchasing PHI over time, we conduct further balanced panel analysis with same set of variables and the result is reported in table 6.

Table 6: Balanced panel: probit regression on PHI

(Selected variables)	Coeff.	Std.Err	Coeff.	Std.Err
SAH Category				
Very good			-0.1649	0.1495
Good			-0.2296	0.1682
Fair			-0.1861	0.2238
Bad			-0.0005	0.4893
Health and Risk factors				
Serious illness condition	**0.3493*** **	**0.1101**	**0.3605*** **	**0.1118**
High distress	- 0.6089***	0.1539	- 0.5983***	0.1571
Drink				
No alcohol	- 0.5479***	0.2095	- 0.5537***	0.2096
Moderate alcohol	- 0.0984	0.1392	- 0.1001	0.1393
Smoke				
No smoking	1.4201***	0.1714	1.4011***	0.1721
Moderate smoking	1.1152***	0.2814	1.1072***	0.2815
Socio-economic factors				
Age				
30-40	0.7872***	0.1851	0.7959***	0.1856
41-65	1.2509***	0.2082	1.2713***	0.2089
66+	1.7132***	0.3929	1.7406***	0.3941
Female	0.2191	0.1523	0.2168	0.1524
Bachelor or above	1.6509***	0.1659	1.6415***	0.1661
Family type				
Type 1	0.9918***	0.1759	0.9967***	0.1762
Type 2	0.6545***	0.1728	0.6654***	0.1731
Type 3	0.9774***	0.2201	0.9841***	0.2203
Type 4	- 0.3561	0.2806	- 0.3439	0.2811
Type 5	0.0309	0.3692	0.0633	0.3701
Income	1.22E-5***	1.50E-6	1.22E-5***	1.50E-6
Remote				
Outer regional area	- 0.7256***	0.2176	- 0.7188***	0.2178
Very remote area	- 0.1356	0.4296	- 0.1168	0.4303
No healthcare card	1.1173***	0.1894	1.1172***	0.1898
Year 2013	**0.3197*** **	0.0702	**0.3265*** **	0.0705
Constant	- 3.4050***	0.4103	- 3.26851***	0.4225
Observations	7834		7834	
Prob>Chi2	<0.01		<0.01	

(Notes: *P<0.1, **P<0.05, ***P<0.01. Type 1: Couple without children, type 2: Couple with children/dependents, type 3: Couple without dependents, type 4: Lone parents with children/dependents, type 5: Lone parents without dependents)

The table 6 shows that there is strong tendency of people subscribing PHI over time when looking at the year's effect. There is a high increase of 32 percentage points for PHI cover in 2013 than that in 2009. According to the annual report 2013-2014 on operations of private health insurers (Private Health Insurance Administration Council-PHIAC), the number of people with PHI has been growing steadily, with year on year average increases of 2.5 per cent over the last ten years (2003-2013).

As shown by table 4, people with serious illness conditions in 2013 are less likely to purchase PHI compared to people with serious illness conditions in 2009. The reasons could be (1) sick people have dropped PHI for some reasons, (2) most of new people subscribing PHI are young healthy people. That means, factor driving the larger part of new PHI take-up between 2009 and 2013 is from advantageous sources rather than health status. In fact, according to the annual report 2013-2014 of PHIAC, the cover take-up was spread across age demographics with the largest increases in the 30-40 age group, likely reflecting the impact of Lifetime Health Cover policy on this age cohort.

To extend the analysis, we examine the effect of serious illness condition variable on PHI demand for four sub-samples in the 2013. We group individuals in the sample into 4 sub-samples: (1) Stable subscriber if people had PHI cover in 2009 and still had the cover in 2013; (2) Stable non-subscriber if people didn't have PHI cover in 2009 and still didn't have the cover in 2013; (3) New purchaser if people didn't have PHI cover in 2009 but purchased PHI cover in 2013; (4) Dropper if people had PHI cover in 2009 but have dropped the cover in 2013. Table 7 reports the summary for these sub-samples.

Table 7: Summary of sub-samples in 2013

No.	Type	Frenquency	Percentage
1	Stable subscriber	2,304	58.82
2	Stable non-subscriber	1,243	31.73
3	New purchaser	282	7.20
4	Dropper	88	2.25
	Total	3,917	100.00

We use ttest to examine the difference in means for people with serious illness conditions in these 4 sub-samples, the results are presented in table 8. As shown in table 8, there are more people with serious illness conditions in the type "Stable subscriber" than that in the type "Stable non-subscriber", statistically significant at the 0.1% level, emphasizing the presence of adverse selection in the insured pool.

Table 8: Difference in means for people with serious illness conditions in sub-samples									
	Obs.	Mean	Std.	P-value			Obs.	Mean	Std.	P-value
Stable subscriber	2304	0.4076	0.0102			New purchaser	282	0.3156	0.0277	
Stable non-subscriber	1243	0.3749	0.0137			Dropper	88	0.4432	0.0532	
Difference in means				0.058						0.0281

On the other hand, there are less people with serious illness condition in the type "New purchaser" than that in the type "Dropper", statistically significant at the 0.05% level, reflecting the cover take-up increases more healthier people in the insured pool overtime, as the results of advantageous selection and government policies.

Reasons for PHI dropping or non-subscription of serious illness people may come from the constantly increased premiums, cover exclusions or they have gradually realised that Medicare are adequate.

6. Conclusions

In this paper, we analyse the adverse selection into private health insurance in Australia using the HILDA dataset in the year 2009 and 2013. We find the existence of adverse selection by using the objective measure of health, people with more illness health conditions are more likely to buy private health insurance. On the other hand, our paper provides support for the dominant tendency of advantageous selection in the insured pool over time as the results of government policies and people are heterogeneous in preferences and attitude towards risk.

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