

# A study of Australian individuals' Private Health Insurance

ETC4420 Microeconometrics Assignment

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## Introduction

### Motivation of this study

Healthcare is one the most important topics in almost every country. An efficient combination of services from public and private health institutions in a country can certainly facilitate the development in that country and also enhance its residents' welfare. Given people's behavior in healthcare relies heavily on the health insurance coverage, government policy could play a significant role in this scenario. For example, policies encouraging people to buy private health insurance (PHI) can also increase the private hospital usage. Hence, the study of how policies impact individuals' decision on purchasing PHI becomes more and more important. Having accurate estimations of the marginal effect of certain policies on the PHI purchasing decision would be extremely useful for government to make right decisions in the future. As for the statement that "people's behavior in healthcare relies heavily on the health insurance coverage", it is intuitively true. But we still need to confirm its validation.

What's more, we want to study to what extent does the health insurance coverage affect the individuals' behaviors. For ease of exposition, only the relationship between the utilization of dental service and the PHI status will be studied in this paper. But the results can be generalized to other cases including private health service usage etc.

## **Problem statement**

Therefore, in this study, we are interested in two questions.

Firstly, what are the determinants of Australian individuals' decision on PHI purchase and how are these determinants affecting the people's choices? Secondly, is an individual's dental service usage affected by his/her PHI status? More specifically, we want to find out the treatment effect of "having private private heal insurance" on dental service usage. We will discuss these two questions separately in the following paper.

## **Literature review**

Despite of the fact that a lot of studies have been conducted relating the demand for private health insurance, not much of them asked the question about how PHI is affecting the healthcare utilisation. (Srivastava, Zhao, and others 2008) In terms of dental health services, there are even fewer. Related to our second question in this study, Dawkins et al. (2004) found that making more people purchase PHI does not necessarily increase the utility of the private health services.

Although Srivastava, Zhao, and others (2008) studied the impact of private health insurance on the individuals' choice of public versus private hospital services, not directly relate to the dental care service, the methodology, RUM analysis and the recursive trivariate probit system model, used in their paper shed light on this study.

However, it is also worth noting that "having PHI which covers dental service" does not necessarily mean "paying nothing" for insured people. To illustrate this, please refer to figure 1. According to Chrisopoulos et al. (2016), "in 2013, half (50%) of people aged 5 and over had some level of private health insurance with dental cover. More people living in Major cities (53%) had insurance than in Inner regional (45%) and Outer regional areas (44%). People living in lower income households were less likely to have dental insurance than those in higher income households. Most (77%) adults with some level of health insurance that covered dental made co-contributions towards the cost of dental visits. One (1) in 10 insured adults (10%) paid all their own expenses. Of these, approximately 19% reported that this caused a large financial burden. Total expenditure on dental services (except those in hospitals) in Australia was AUD 8,706 million in 2012–13, an increase from AUD 5,945 million (adjusted for inflation) in 2002–03. The largest source of funds for this overall dental expenditure was individuals, paying directly out of pocket for 58% of total dental costs." Hence, maybe the question is more interesting to researchers is the impact of "all free dental service" on "dental visits". And this needs more care than simply using PHI status.

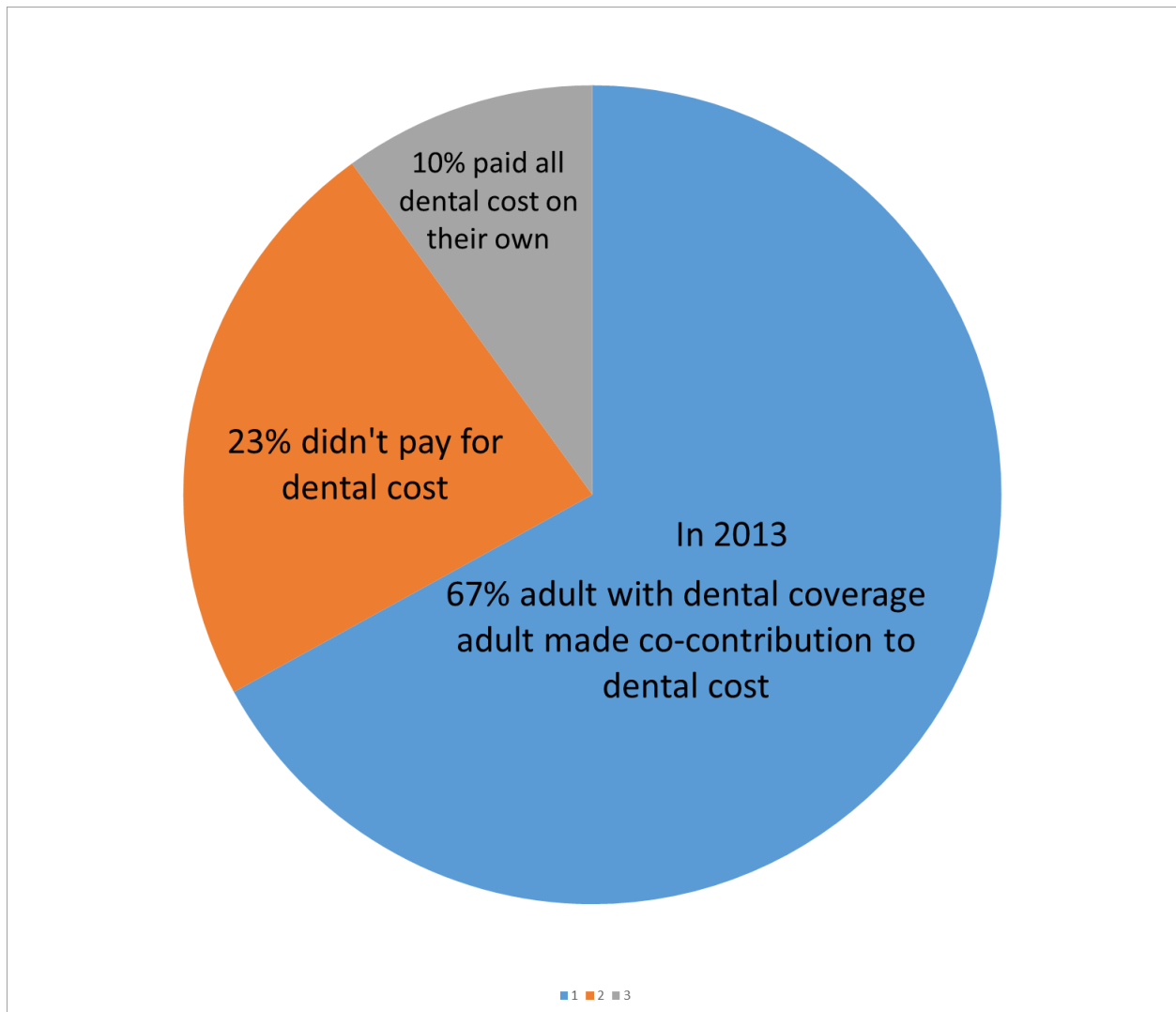


Figure 1: A description of the co-payment paid by insured people in 2013.

# Econometric Framework

## Multinomial logit

In related to our first question, there are four types of PHI status, “without PHI”, “only cover hospital”, “only cover ancillary” and “cover both hospital and ancillary”. There are no apparent natural orders in them. And we also don’t have observability issues whatsoever since our sample was randomly selected from the whole population in Australia as described in data section in this study. Therefore We use Multinomial Logit (MNL) to model it.

Suppose the utility for individual  $i$  choosing choice  $j$  is given by:

$$U_{ij} = x_i' \beta_j + \epsilon_{ij} \quad (i = 1, \dots, N; \quad j = 0, 1, \dots, J)$$

where  $x_i$  only vary by  $i$  and are the same across  $j$ , and  $\beta_j$  differs by choice  $j$ . We observe  $y_i = j$  iff.  $U_{ij} > U_{ik} \quad \forall k \neq j (j, k = 0, 1, \dots, J)$ , using a Type I extreme value distribution with  $F(\epsilon_{ij} = \exp[-\exp(-\epsilon_{ij})])$ . Probabilities:

$$P_{ij} = P(y_i = j) = \frac{e^{x_i' \beta_j}}{\sum_{k=0}^J e^{x_i' \beta_k}} \quad (j = 0, 1, \dots, J)$$

where  $\beta_0$  is standardized to be zero. So

$$P_{i0} = P(y_i = 0|x_i) = \frac{1}{1 + \sum_{k=1}^J e^{x_i' \beta_k}}$$
$$P_{ij} = P(y_i = j|x_i) = \frac{e^{x_i' \beta_k}}{1 + \sum_{k=1}^J e^{x_i' \beta_k}}$$

J=3 in this study.

## Endogenous binary treatment for a binary outcome variable - EBVP

For the second question in this study, the EBVP model is used. Because the main outcome variable “whether having visited a dentist in past 12 months” ( $y$ ) is a binary variable. The treatment variable “whether having PHI” ( $T$ ) is also a binary variable and it is endogenous. The model structure is given by:

$$y_i^* = x_{i1}' \beta_1 + \delta T_i + \epsilon_{i1}, \quad y_i = 1 \text{ if } y_i^* > 0, \quad y_i = 0 \text{ otherwise}$$

$$T_i^* = x_{i2}' \beta_2 + \epsilon_{i2}, \quad T_i = 1 \text{ if } T_i^* > 0, \quad T_i = 0 \text{ otherwise}$$

where  $(\epsilon_{i1}, \epsilon_{i2}) \sim BVN(0, 0, 1, 1, \rho)$ ,  $-1 < \rho < 1$

$\rho$  is the correlation coefficient between  $\epsilon_{i1}$  and  $\epsilon_{i2}$

We will use the Maximum likelihood estimation because it gives consistent and efficient estimates. The log-likelihood function is

$$LogL = \sum_{y=1, T=1} \log \Phi_2[x'_{i1}\beta_1 + \delta T_i, x'_{i2}\beta_2, \rho] + \sum_{y=1, T=0} \log \Phi_2[x'_{i1}\beta_1, -x'_{i2}\beta_2, -\rho] \quad (1)$$

$$+ \sum_{y=0, T=1} \log \Phi_2[-x'_{i1}\beta_1 + \delta T_i, x'_{i2}\beta_2, -\rho] + \sum_{y=0, T=0} \log \Phi_2[-x'_{i1}\beta_1, -x'_{i2}\beta_2, \rho] \quad (2)$$

Results of interest: treatment effect of T on y:

$$TE_i = \Phi(x'_{i1}\beta_1 + \delta) - \Phi(x'_{i1}\beta_1)$$

## Data

Our data source is the 2004-05 Australian National Health Survey (NHS) which was conducted using a representative sample of the non-institutionalised residential population. The sample design ensured that individuals were randomly selected within each state and territory (*Information Paper, National Health Survey, Curf 2004-05* 2006). The data we use in this study is a randomly selected subset of 22,000 individuals from this data source.

To study the factors may having impact on PHI purchasing, we consider different potential areas, personal demographic, health condition, income and education. Relevant variables in our dataset was defined in table below. After checking the cross tabulation between type of PHI and age band, this study focus on people who are older than 14 years.

Table 1: Definition of variables

Area	Variables
Type of private health insurance cover	phi=0 for people without PHI, phi=1 for hospital cover only, phi=2 for ancillary cover only, phi=3 for both hospital and ancillary cover.
Whether having visited dentist in the past 12 months	dvisit=1 for people have visited dentist in last year, 0 otherwise.

Area	Variables
Age	age4 for age group 0-4 years, 0 otherwise (ref category); age59 for age group 5-9 years, 0 otherwise; age1014 for age group 10-14 years, 0 otherwise; age1519 for age group 15-19 years, 0 otherwise; age2039 for age group 20-39 years, 0 otherwise; age4064 for age group 40-64 years, 0 otherwise; age6579 for age group 65-79 years, 0 otherwise; age80 for age group 80 years and over, 0 otherwise.
Culture	Australia=1 for people born in Australia, 0 otherwise; English=1 for people born in English-speaking country, 0 otherwise; nonEng=1 for others, 0 otherwise (ref category).
Other demographic variables	male=1 for male, and 0 otherwise; married=1 if married or de facto, and 0 otherwise.
Long term medical conditions	condnoc=0 for people has no long term condition, 1 for having 1 long term condition, 2 for having 2 long term condition, 3 for having 3 long term condition, 4 for having 4 long term condition, 5 for having more than 5 long term condition.
General health assessment	exclh=1 for excellent health, 0 otherwise; verygood=1 for verygood health, 0 otherwise; good=1 for good health, 0 otherwise; fair=1 for fair health, 0 otherwise; poor=1 for poor health, 0 otherwise (ref category).
Education	degree=1 for a tertiary degree, 0 otherwise; dipcert=1 for having diploma or certificate, 0 otherwise; less12yr=1 for no qualification, 0 otherwise.
Income	income3=1 if weekly personal income falls in 1st to 3rd income decile, 0 otherwise (ref category); income4=1 if weekly personal income falls in the 4th income decile, 0 otherwise; income5=1 if weekly personal income falls in the 5th income decile, 0 otherwise; income6=1 if weekly personal income falls in the 6th income decile, 0 otherwise; income7=1 if weekly personal income falls in the 7th income decile, 0 otherwise; income8=1 if weekly personal income falls in the 8th income decile, 0 otherwise; income9=1 if weekly personal income falls in the 9th income decile, 0 otherwise; income10=1 if weekly personal income falls in the 10th income decile, 0 otherwise.

Table 2: Average Marginal Effects

Variables	Y=0	Y=1	Y=2	Y=3
	dy/dx (sd)	dy/dx (sd)	dy/dx (sd)	dy/dx (sd)
age2039	0.291 ( 0.015 )	-0.027 ( 0.01 )	-0.01 ( 0.006 )	-0.254 ( 0.015 )
age4064	0.147 ( 0.015 )	0.016 ( 0.01 )	-0.01 ( 0.006 )	-0.153 ( 0.015 )
age6579	0.102 ( 0.017 )	0.047 ( 0.011 )	-0.022 ( 0.008 )	-0.128 ( 0.017 )
age80	0.171 ( 0.023 )	0.075 ( 0.012 )	-0.085 ( 0.019 )	-0.162 ( 0.023 )
Australia	-0.076 ( 0.01 )	-0.004 ( 0.006 )	-0.006 ( 0.004 )	0.086 ( 0.01 )
English	-0.021 ( 0.014 )	-0.021 ( 0.008 )	0.008 ( 0.005 )	0.034 ( 0.014 )
male	0.066 ( 0.007 )	-0.011 ( 0.004 )	-0.007 ( 0.003 )	-0.048 ( 0.007 )
married	-0.157 ( 0.007 )	0.022 ( 0.004 )	0.007 ( 0.003 )	0.129 ( 0.007 )
condnoc	-0.02 ( 0.002 )	0 ( 0.001 )	0.001 ( 0.001 )	0.019 ( 0.002 )
excelh	-0.221 ( 0.019 )	0.042 ( 0.012 )	0.014 ( 0.009 )	0.166 ( 0.02 )
verygood	-0.176 ( 0.018 )	0.031 ( 0.011 )	0.013 ( 0.009 )	0.132 ( 0.019 )
good	-0.133 ( 0.018 )	0.024 ( 0.011 )	0.017 ( 0.009 )	0.092 ( 0.019 )
fair	-0.062 ( 0.019 )	0.018 ( 0.012 )	0.017 ( 0.009 )	0.027 ( 0.02 )
degree	-0.171 ( 0.011 )	0.026 ( 0.006 )	-0.003 ( 0.005 )	0.148 ( 0.01 )
dipcert	-0.031 ( 0.008 )	-0.003 ( 0.005 )	0.005 ( 0.003 )	0.03 ( 0.008 )
income4	0.046 ( 0.013 )	0.001 ( 0.007 )	-0.005 ( 0.006 )	-0.042 ( 0.013 )
income5	-0.008 ( 0.013 )	-0.009 ( 0.008 )	0.003 ( 0.005 )	0.013 ( 0.013 )
income6	-0.01 ( 0.014 )	-0.001 ( 0.009 )	0.001 ( 0.006 )	0.01 ( 0.014 )
income7	-0.03 ( 0.016 )	-0.003 ( 0.01 )	0.008 ( 0.006 )	0.026 ( 0.016 )
income8	-0.1 ( 0.015 )	0.001 ( 0.009 )	-0.003 ( 0.006 )	0.102 ( 0.015 )
income9	-0.175 ( 0.015 )	0.016 ( 0.008 )	-0.005 ( 0.006 )	0.164 ( 0.014 )
income10	-0.313 ( 0.018 )	0.035 ( 0.009 )	-0.016 ( 0.008 )	0.294 ( 0.016 )
workft	-0.079 ( 0.012 )	0.003 ( 0.007 )	0.011 ( 0.005 )	0.066 ( 0.012 )
workpt	-0.089 ( 0.011 )	0.001 ( 0.007 )	0.008 ( 0.004 )	0.08 ( 0.011 )
unemp	0.129 ( 0.025 )	-0.049 ( 0.021 )	0.007 ( 0.009 )	-0.087 ( 0.027 )

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Area	Variables
Main occupation	workft=1 if employed full-time, 0 otherwise; workpt=1 if employed part-time, 0 otherwise; unemp=1 if unemployed, 0 otherwise; nlf=1 if not in the labour force, 0 otherwise (ref category).

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## Results

## Conclusion

## Discussion

For the second question. Because we assume this sample was randomly selected from the Australian population, both insured and uninsured people are observed. Therefore, there is no observability issue in this case. However, there may still be endogeneity problem in the model because people may “self-select” themselves into purchasing PHI. To be more specific, the unobservable factors affecting PHI self-selection may be correlated with the factors making a person seeing a dentist. For instance, for people who are highly risk averse, the chance for them to purchase PHI is higher than other people, and it is also likely that they visit dentists more frequently to prevent possible dental disease. Since the “risk averse” characteristic is unobservable, it will be left in the error terms. Thus regressor T (whether having PHI) will be positively correlated with the error term in the outcome Y (dentist visits) equation. And if this is the case, the effect of having PHI will be overestimated.

## References

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