A study of Australian individuals' Private Health Insurance

ETC4420 Microeconometrics Assignment

Contents

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 purhcasing 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 extend does the health insurance coverage affect the individuals' beheviors. 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."

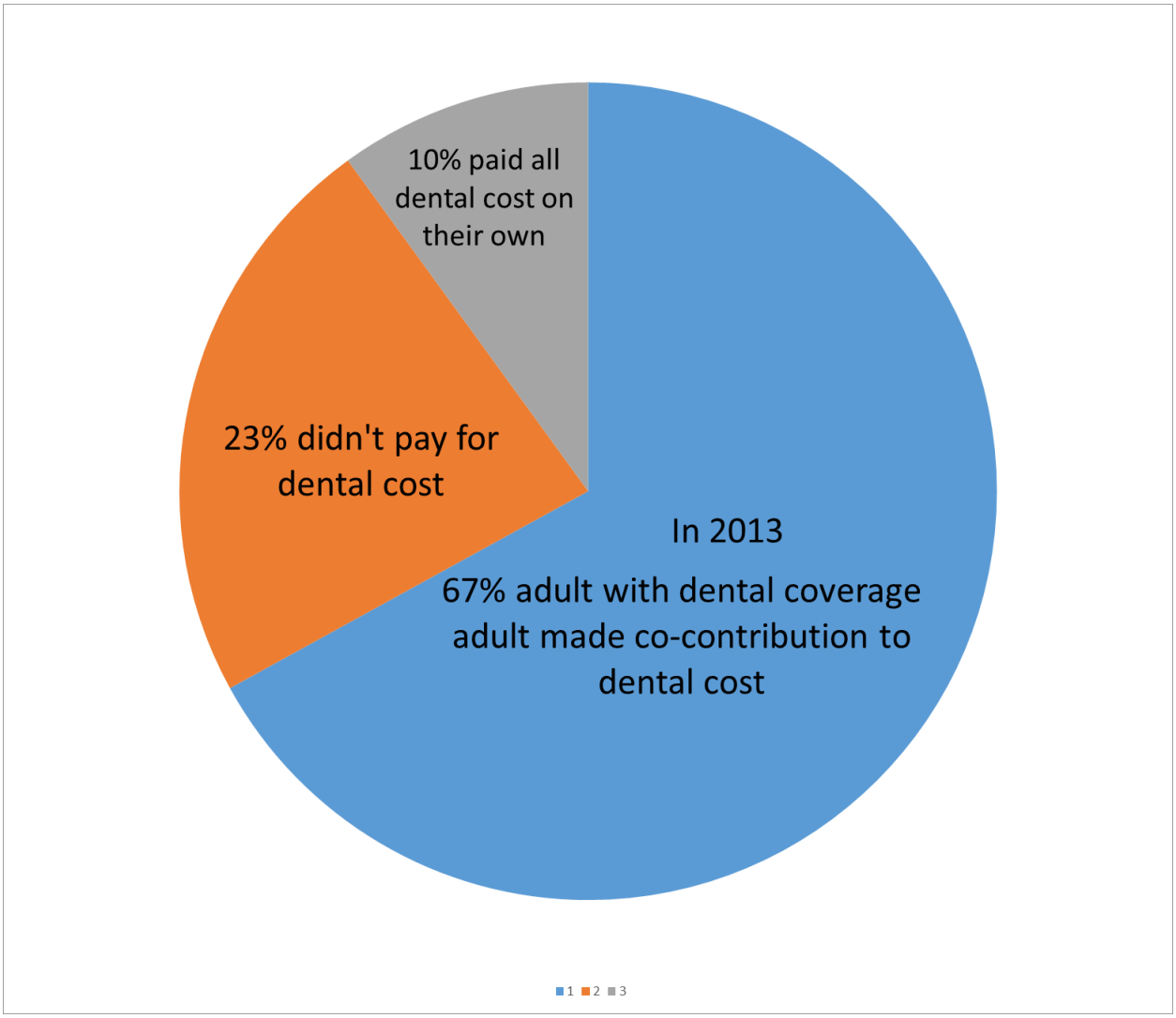

Figure 1: A description of the co-payment paid by insured people in 2013.

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.

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:

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

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

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

where β_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 because of the "self-selection" issues described in the discussion section. The model structure is given by:

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

$$T_i^* = x_{i2}' \beta_2 + \epsilon i 2, \; T_i = 1 \text{ if } T_i^* > 0, \; T_i = 0 \text{ otherwise}$$

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

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

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 because lack of information for people aged 14 years and below. What's more, from the cross tabulation with percentage between age band and types of PHI, we found that there are some consecutive age band having very similar distribution against types of PHI. Hence, we double checked the cross tabulation between original age band with dental visits. It turned out that we will not lose much information by doing re-grouping to the age band according to its behavior. Hence, we re-grouped the age band into six groups as given in the "definition of variables" table below and the first group "age 0-14" will be omitted from all regressions in this study.

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	age14 for age group 0-14 years, 0 otherwise (omitted from regression); age1519 for age group 15-19 years, 0 otherwise (ref category); 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 coutry, 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	excelh=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.
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).

Table 2: Average Marginal Effects obtained from MNL for the first question

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)

Results

Because the coefficients obtained in MNL has no meaningful interpretation, neither does its sign. Hence we do not report its estimation in this paper. The table below is the average marginal effect obtained from MNL.

Table 3: Cross tabulation between age and PHI types

Years	PHI=0	PHI=1	PHI=2	PHI=3	Total
15-19	741	91	67	601	1,500
20-24	742	50	39	304	1,135
25-29	813	45	61	361	1,280
30-34	921	86	59	589	1,655
35-39	880	124	72	667	1,743
40-44	813	138	73	741	1,765
45-49	716	136	79	689	1,620
50-54	547	127	60	712	1,446
55-59	537	138	56	677	1,408
60-64	494	121	45	514	1,174
65-69	440	97	26	359	922
70-74	454	90	31	290	865
75-79	414	101	16	192	723
80-84	301	82	3	128	514
85-	211	32	1	77	321

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 endogeniety 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 ne 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" characristic 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.

Table 4: Cross tabulation between age and dental visits

Years	Dental visits=0	Dental visits=1	Total
0-4	871	24	895
0-4	1,208	109	1,317
5-9	1,396	163	1,559
15-19	1,435	114	1,549
20-24	1,103	60	1,163
25-29	1,230	60	1,290
30-34	1,583	80	1,663
35-39	1,672	81	1,753
40-44	1,661	111	1,772
45-49	1,538	90	1,628
50-54	1,362	87	1,449
55-59	1,317	95	1,412
60-64	1,096	90	1,186
65-69	869	57	926
70-74	814	53	867
75-79	681	46	727
80-84	499	20	519
85-	311	14	325

Appendix

References

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