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Summary

The Australian health system is characterised by a mix of public and private service and private health insurance is used in addition to a compulsory universal public insurance to finance health services. A series of reforms have been implemented over the years in order to expand the private sector with the objective to relieve the overburdened public health care system. While private coverage has expanded, a large proportion of the privately insured still opt for public treatment in hospitals. The objective of this paper is to investigate the determinants of individuals' choice between public and private hospital services, in particular, the impact of private health insurance status. It estimates a recursive trivariate probit system model with partial observability that allows for endogeneity of private insurance participation and potential selection bias as we only observe individuals' public/private choices for those who have visited a hospital in the past 12 months. Relative to the prevailing two-step estimation for sample selection or endogenous treatment, our full information maximum likelihood (FIML) approach is both consistent and efficient. The study identifies private health insurance status and income as important determinants of private hospital care utilisation. An individual with a private hospital cover has nearly 70 per cent higher chance to opt for private treatment in a hospital and a person within the tenth income decile group has 46 per cent higher probability to seek private hospital care than someone who falls in the third or lower income decile groups. To some extent other factors such as perceived quality of care in the public sector and cost of access are also found to have some impact on the use of private hospital care.

1 Introduction

The private sector can be an important actor in systems which are characterised by public-private provision of health services. The right mix of services from the two sectors can substantially contribute to the development of the health systems. In several countries including USA, France, Germany, Canada and New Zealand, the private sector plays a prominent role in the health care system.

The Australian health care system is also characterized by a mix of public and private health services. Private hospital insurance covers about 45 per cent of the population, one of the highest percentages of private coverage across OECD countries (Colombo and Tapay, 2003). According to the latest National Health Survey (NHS), in 2004-05 four out of ten hospital admissions and one in every four inpatient days were private (ABS, 2006b). However, the government still plays an important role in health financing covering more than two-third of the total health expenses in recent years. A significant proportion of the non-government funding is covered by individual out-of-pocket payments with private health insurance (PHI) funds contributing around 7 per cent to the total health expenditure. Cost pressures from an ageing population, new expensive medical technology, and the rising expectations from a better-educated and informed population are likely to present an enormous challenge to the Australian government in funding the health system and maintaining the efficacy of health delivery in the near future.

Australian policy makers recognise the important role of PHI in financing private hospitals. A number of public policy interventions such as tax rebates and penalties, and reduction of individuals' out-of-pocket payments have been implemented on several occasions in order to encourage PHI membership and ensure that there is no 'crowding out' of the private sector (Hall et al., 1999). Yet, the nineties was marked by a severe decline in private coverage, building enormous pressure on public hospitals. To stem the erosion

of PHI membership, several incentives and penalties were introduced in the late nineties including a tax penalty for high-income individuals without private cover, a 30% rebate on PHI premiums and a lifetime health cover. It is argued that the package of initiatives, in particular lifetime cover, has certainly increased PHI coverage but activity in the private sector has not picked up (Dawkins et al., 2004). According to the most recent National Health Survey (NHS), nearly 20 percent of those who had a private health insurance and were admitted in hospitals in 2004-05 chose to be treated as public patients at their most recent visit to hospitals (ABS, 2006b).

Failing to ease pressures on public hospital system, the role of such government policies has been a subject of heated debate among scholars in the field (Fiebig et al., 2006; Sundararajan et al., 2004; Deeble, 2002; Duckett and Jackson, 2000; Hall et al., 1999). Fiebig et al. (2006) claimed that private health insurance covers are taken purely for financial reasons and that the significant out-of-pocket costs associated with private treatment create disincentives to use private hospital care even for those with private insurance. It is also argued that the money could have been better spent if it were applied directly toward enhancing the capacity of public hospitals to meet the additional demand for health services (see Wilcox, 2001; Duckett and Jackson, 2000).[1] Concerns on equity of care-provision in terms of the disproportionate distribution of the tax rebates to high-income earners have also been raised in several studies (Hindle and McAuley, 2004; Butler, 2002; Wilcox, 2001). It is argued that the subsidy is skewed to the more affluent. According to the latest health survey (ABS, 2006b), close to 80 per cent of the richest 10 per cent of Australian households have private health insurance and nearly three quarter were admitted as private patients

[1]Many other scholars have criticised government subsidies as an ineffective policy to address demand pressures in public hospitals. Vaithianathan (2002) claimed that subsidising private health care rather than insurance was a more effective way of reducing the demand pressures off the public sector because premium subsidy would only expand insurance coverage without reducing the demand for public health services. Wright (2006) was also critical about premium subsidy which he argued does not affect demand in private hospitals, rather the private hospital and the doctor respond to the subsidy by increasing the prices they charge and the quality of the private hospital experience.

in 2004-05 at their most recent admission, whereas only about 20 per cent of the poorest 10 per cent of Australian households have a private cover and about 18 per cent sought private care.

In the context where the Government is spending billions in terms of tax incentives to encourage private coverage and take pressure off the public system, an improved understanding of the factors that influence an individual to seek public or private care in hospitals and the role of PHI towards this decision cannot be more emphasised. Although the demand for private health insurance has received a lot of attention in the literature, only a small body of research (Fiebig et al., 2006; Rodriguez and Stoyanova, 2004; Savage and Wright, 2003; Propper, 2000) has examined its role in public/private health care utilisation. The objective of this study is to investigate the determinants of individuals' choice between public and private hospital care. The study also sheds light on the potential substitution between public and private hospital admissions in a system where private health insurance compounds the chances of substitution by providing a duplicate coverage. This paper additionally makes a contribution in terms of the econometric approach. In most prior studies the decision to seek no care or private care or public care has been modelled using a multinomial logit model on the assumption that all three decisions are affected by the same covariates. In contrast, in this study we model the hospital admission decision in two parts on the assumption that the decision to get hospital care and the decision to choose to be treated as a public/private patient are two distinct processes. We argue that these two decisions are influenced by different sets of factors although they may be correlated with each other. We also account for the potential endogeneity of private health insurance participation in the decision of choosing private care. In addition, we only observe individuals' choice of public or private hospital care for those who visited a hospital in the last 12 months. This may result in sample selection bias if only data for those admitted in hospitals are used. We therefore estimate a recursive trivariate probit system model

with partial observability that allows for endogeneity of private insurance participation and potential selection bias. Our full information maximum likelihood (FIML) approach is more efficient than the prevailing two-stage estimation in the literature to account for the endogeneity of public health insurance and for sample selection. The paper is set out as follows: Section 2 gives a brief overview of public and private health insurance and hospital utilisation in Australia. Section 3 discusses briefly the relevant literature. The econometric framework is outlined in Section 4. Section 5 describes the data and the results are discussed in Section 6. Section 7 presents a few predicted probabilities and Section 8 makes some concluding remarks.

2 Australian health insurance and hospital utilisation

Health insurance was totally private and voluntary until the eighties. In 1984,compulsory universal public insurance scheme, Medicare, was introduced to provide basic public hospital care and core medical facilities. Medicare patients receive free care in public hospitals but they have no choice of treating doctor. However, individuals can purchase a private insurance cover - hospital and/or ancillary - and benefit from an improved medical service not covered by Medicare. A private hospital cover allows a patient to get treatment either in a private hospital or as a private or semi-private patient in a public hospital with the doctor of his or her choice. In the Australian context, private health insurance thus performs both duplicate and supplementary functions unlike in countries such as Canada and the UK where the emphasis of private health is to cover costs of services not provided through the public system.[2] However, the Government has ensured that services already

[2]The Australian approach to duplicate private health insurance presents some unique elements. Besides providing cover for in-hospital accommodation (bed, nursing, meals) funds can also duplicate coverage offered by the public system for a range of in-hospital services provided to Medicare patients in public hospitals, including rehabilitation, psychiatric and palliative care (Colombo and Tapay, 2003). Note that there are three major roles that private health insurance can play within the context of a public health insurance program (Dhalla, 2007) First, private health insurance can be used as a source for primary

subsidised by Medicare are not covered by private insurers. Consequently, private patients are reimbursed a share of the medical costs related to in-hospital services already subsidised by Medicare, while the remaining 'medical gap' is generally covered through their PHI policy or from out-of-pocket payments.[3]

Figure 1 depicts the observed probabilities of PHI purchase and hospital care utilisation based on the 2004-05 NHS survey. Out of the 17 percent that were hospitalised in the previous 12 months, almost 47 per cent had a private hospital cover other than the compulsory public insurance. Certainly the majority of them (80%) opted to be admitted as private patients. Yet, a significant proportion - nearly 20 percent - chose to be treated as public patients at their most recent visit to hospitals. On the other hand, out of those who did not have a private cover (53% of the sample), about 93 percent were admitted to hospitals as Medicare patients and a small 7 percent chose to be treated privately with their own resources.

coverage, to fund healthcare for individuals who are not eligible for public health insurance (e.g., new immigrants) or those who choose not to obtain public health insurance, if opting out of the public health insurance plan is permitted, or where public health insurance is unavailable. Second, private health insurance can be used as duplicate coverage, to cover healthcare needs that are already provided for by public funds. This is the case, for example, in the United Kingdom, Australia, New Zealand and Ireland, where individuals with private health insurance can bypass public sector waiting lists and obtain care privately. This form of private health insurance is often referred to as double coverage. Third, private health insurance can serve a supplementary role, either to cover care that is unavailable in the public sector (as with pharmaceuticals and dental care) or to cover the cost of fees associated with obtaining services within the public sector (as with co-payments).

[3]Generally Medicare refunds 75% of the Medical Benefit Scheme (MBS) fee for medical practitioners' services. The MBS is a set of medical fees scheduled by the Government. The private patient needs to pay some or all of the costs for a range of services such as hospital accommodation; theatre fees; intensive care; drugs, dressings and other consumables; prostheses (surgically implanted); diagnostic tests; pharmaceuticals; and doctors' services. Private health insurance may cover some or all of these charges for those who are insured (PHIAC, 2007b).

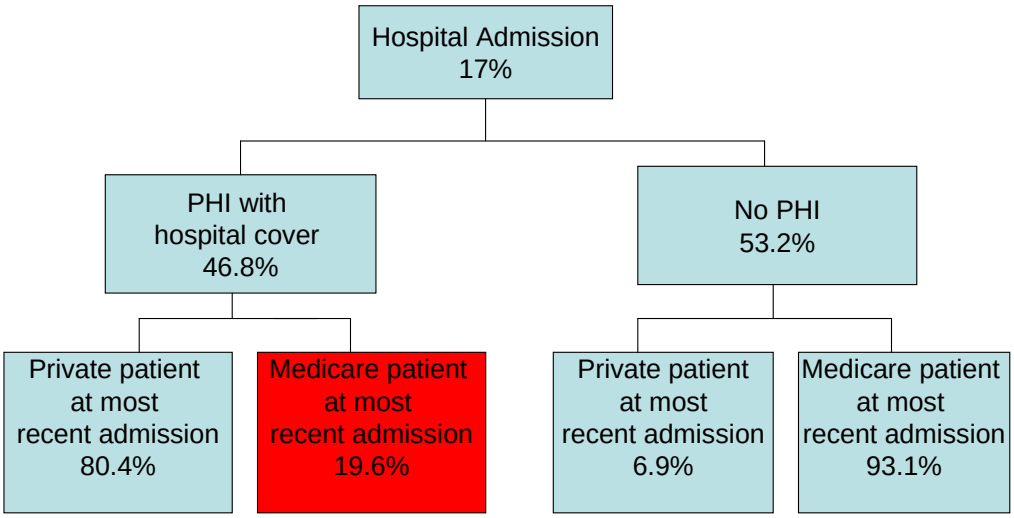
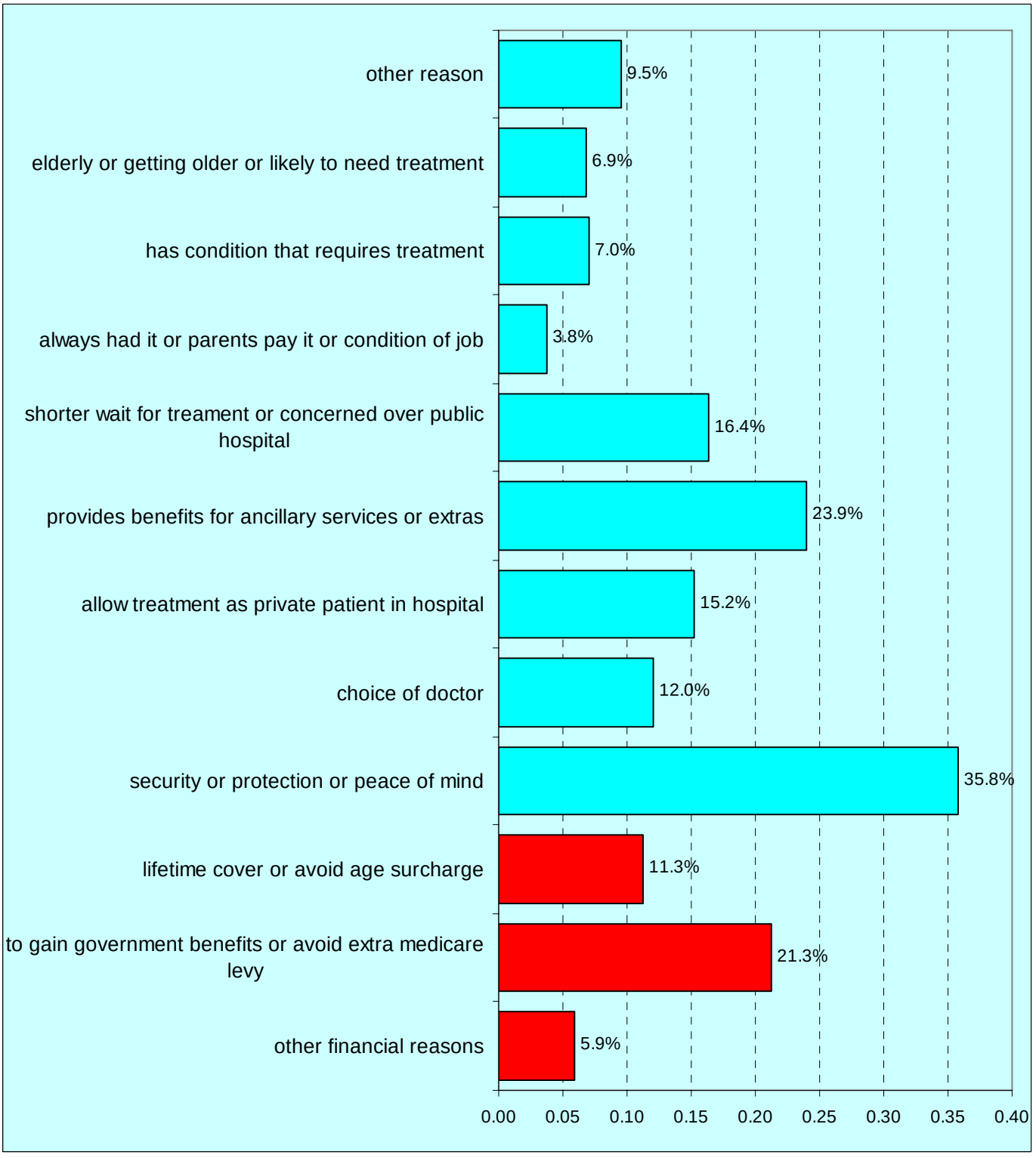


Figure 1: Observed Probabilities of PHI and Hospital Utilisation

Against this background, it is interesting to examine the reasons why individuals choose to take up private health insurance.[4] Such data has been collected in the recent NHS surveys where individuals have provided one or more reasons that led them to purchase a private health insurance cover. Figure 2 depicts the various reasons advanced by those who purchased insurance in the five years prior to the survey. While individuals mostly purchased PHI because it would provide security, protection or peace of mind, a significant number of them also purchased insurance for reasons such as private hospitals allow them to get a doctor of their choice; and/or the conditions are better and waiting time shorter in the private sector. However, it is also interesting to note that a significant number of individuals also chose to buy PHI because of financial incentives. They are depicted by the three dark bars down the end of the chart. For instance, more than 20 percent of them chose to get insured also to gain government benefits or avoid extra Medicare levy. It is quite likely that individuals who were motivated to buy PHI because of financial reasons might be less likely to use the private system when they would require any medical care.

[4]Fiebig et al. (2006) provides a thorough analysis on this issue.

Figure 2: Reasons for purchasing private health insurance



3 Previous Research

While the demand for private health insurance has received significant attention in the literature, only a small body of research (Fiebig et al., 2006; Rodriguez and Stoyanova, 2004; Savage and Wright, 2003; Propper, 2000) has examined its role in public/private health care utilisation. A variety of estimation techniques have been used, in particular to address the issue of endogeneity.

A recent study by Fiebig et al. (2006) examined the relationship between health insurance and hospital admission in Australia. Their focus was more on the impact of insurance *type* - in terms of reasons for purchasing private health insurance - on the probability of hospital admission in Australia. The three levels of admission status they considered were 'not admitted', 'admitted as a Medicare' and 'admitted as a private patient' which they modelled using a multinomial logit. They found a significant association between the choice of individuals for hospital admission and the reasons for having PHI. Those whose underlying reasons for purchasing PHI was purely financial had lower probability of being admitted as a private patient than those who acquired PHI because of reasons such as preference for private care, the flexibility of choosing one's doctor and concerns over public hospitals' waiting lists.

A few other studies have been conducted on the national front examining PHI and hospital utilisation (Van Doorslaer et al., 2007; Savage and Wright, 2003; Hopkins and Kidd, 1996; Cameron et al., 1988). In particular, Savage and Wright (2003) examined private health insurance participation and the duration of stay in private hospitals although the focus of their work was on identifying any moral hazard behaviour and adverse selection in insurance purchase. An earlier study by Cameron et al. (1988) examined the impact of PHI on hospital admission and hospital days in Australia but made no distinction between public and private admissions.

Overseas, Propper (2000) modelled hospital admission status in the UK whileRodriguez and Stoyanova (2004) examined the effect of private insurance on public and private utilisation of physician services using Spanish data. Propper (2000) found that the demand for private health care was strongly determined by income, political allegiance, attitudes to the role of state in the provision of health care, and more importantly past use of health services. However, she could not explicitly control for participation in private health insurance given that such data was unavailable. Instead occupational dummies were used as instruments for corporate cover. Rodriguez and Stoyanova (2004), on the other hand, found private insurance to be a potential determinant of both type of physician (GP/specialist) and choice of sector (public/private).

Those few studies that have addressed the endogeneity of PHI have generally usedthe two-step estimation approach (Savage and Wright, 2003; Cameron et al., 1988). While such a limited information estimation method has computational simplicity, estimating a system of equations using a full information estimation technique generates more efficient estimators. However, only a handful of studies have estimated health service utilisation and health insurance demand in a joint framework (Zhang and Zhao, 2007; Harmon and Nolan, 2001; Holly et al., 1998). In addition, they have focused on the impact of private health insurance on the admission/non-admission in hospitals but not the choice of public/private sector. The current study addresses both: the issue of endogeneity using a joint framework and the choice of public/private hospital admission.

4 Econometric Framework

One popular economic formulation for analysing binary discrete choice behavior is the random utility model (Greene, 2003). The essential idea of the random utility model is that a consumer faces a choice between two alternatives, each of which has an associated

utility index describing the attractiveness of the alternative to the consumer. Utilities are unobservable but consumers reveal their preferences by choosing the alternative with the highest utility index.

As a first step to hospital utilisation, individual i has two possible courses of actions: to use hospital services or to forgo hospital care. The two outcomes can be specified as functions of observed individual characteristics such as health status, income and valuation of quality of care and other factors affecting the health care utilisation decision of individual i. The individual's utility for each choice is unobserved but he reveals his preference by choosing the alternative with the higher utility. The two outcomes can be defined as state-specific utilities $H^*_{Y_H}$ such that

$$\begin{aligned} H^*_{Y_H=1} &= \mathbf{x_H}'\beta_{\mathbf{H1}} + \varepsilon_{H1}; \\ H^*_{Y_H=0} &= \mathbf{x_H}'\beta_{\mathbf{H0}} + \varepsilon_{H0}. \end{aligned} \tag{1}$$

Individual i will choose hospital care to no care if $H^*_{Y_H=1} > H^*_{Y_H=0}$. Let Y^*_H denote the net utility from hospital utilisation, then

$$\begin{aligned} Y^*_H &= H^*_{Y_H=1} - H^*_{Y_H=0} \\ &= (\mathbf{x_H}'\beta_{\mathbf{H1}} + \varepsilon_{H1}) - (\mathbf{x_H}'\beta_{\mathbf{H0}} + \varepsilon_{H0}) \\ &= \mathbf{x_H}'\beta_{\mathbf{H}} + \varepsilon_H. \end{aligned} \tag{2}$$

Without loss of generality, Equation (2) is mapped to an observable binary discrete variable Y_H indicating whether the individual is admitted or not admitted to hospital:

$$Y_H = \begin{cases} 1 & \text{if } Y^*_H > 0 \text{ (i.e. individual is admitted to hospital)} \\ 0 & \text{if } Y^*_H \leq 0 \text{ (i.e. individual is not admitted to hospital)} \end{cases} \tag{3}$$

Once individual i decides to seek hospital care, he is faced with the decision whether to

get admitted as a private or as a public patient. Thus, the second step of his decision also involves two courses of actions: to seek private care; or to seek public care. Once again individual i reveals his preference by choosing the alternative with the higher utility. The net utility of private care can be written as

$$Y_P^* = \mathbf{x_P}'\beta_\mathbf{P} + \varepsilon_P \tag{4}$$

where Y_P^* is only observed for those individuals who have been admitted to hospitals. Given the two processes, a bivariate probit model with selection can be specified as follows:

$$\begin{aligned} Y_H^* &= \mathbf{x_H}'\beta_\mathbf{H} + \varepsilon_H; \\ Y_P^* &= \mathbf{x_P}'\beta_\mathbf{P} + \varepsilon_P; \end{aligned} \tag{5}$$

where $(\varepsilon_H, \varepsilon_P) \sim N[0, 0, 1, 1, \rho]$ and ρ is the correlation coefficient between ε_H and ε_P. Note that $(Y_P, \mathbf{x_P})$ is observed only when $Y_H = 1$.

An individual's decision to use hospital services (i.e. $\mathbf{x_H}$) is most likely to be influenced by variables such as medical need, lifestyle factors such as his smoking, drinking, eating and exercise patterns, and the importance of good health. The importance of good health is often positively associated with education and socioeconomic factors (Propper, 2000).[5] In terms of access, language or cultural differences can also determine hospital utilisation. Such factors may result into a lower level of awareness of health care availability and efficacy (Goddard and Smith, 2001) or a shyness to use health services.

On the other hand, an individual's choice between private and public hospital care (i.e. $\mathbf{x_P}$) is very likely to driven by factors such as perceived quality of the public sector such as waiting list, the ability to choose the doctor, and the date and location of treatment. In

[5]For instance, those from lower social classes are more passive about their health conditions and the less educated ones often undermine the severity of their illnesses or the significance of some symptoms, and therefore delay seeking help. The importance of good health is also likely to be influenced by lifestyle factors such as drinking and smoking patterns, and exercise habits.

addition, the valuation of quality of care can also be a determinant of public/private care utilisation (Goddard et al., 1995; Goddard and Smith, 2001). For quality measures such as waiting time or the inability to choose the date and location of treatment which may prove to be inconvenient, variations in the individuals' valuation of time and convenience may be a positive function of income and type of employment.[6]

In terms of cost of accessing hospital care, an individual's choice between private and public treatment is largely influenced by his/her private health insurance status. The choice between private and public treatment is also a function of out-of-pocket payments. As pointed out by Forster (2005), gap payments not covered by private health and front end deductibles is often an issue for individuals who hold private health insurance. Although public health care is free of user charges, travel and time costs are also important considerations, in particular, for lower socioeconomic groups. The variations in costs across individuals are often triggered by travel expenses and loss of earnings.[7] Such factors are negatively associated with income. Both $\mathbf{x_H}$ and $\mathbf{x_P}$ also include a range of standard socioeconomic and demographic variables such as age, marital status, main occupation, level of education attained and income.

Note that the private health insurance status which is an important determinant of the choice between public and private care is a potentially endogenous variable. For instance, an unobserved variable, say allergy or risk aversiveness influences both the health service utilisation and the private insurance decision. Sometimes the effect of PHI is also interpreted as moral hazard (Savage and Wright, 2003; Cardon and Hendel, 2001; Vera-Hernandez, 1999; de Meza, 1983). For instance, people will be more inclined to seek health services and doctors will be more inclined to recommend them when all costs are covered.

[6]Self-employed may need to forgo their income while waiting for medical treatment. Similarly, the inability to choose the date or place of treatment may lead to a loss of income and at the extreme, employment for workers in casual jobs.

[7]the same nominal price may have different implications on wealthy and poor individuals.

Because of adverse selection and endogeneity, sometimes the effect of insurance purchase is overestimated. To address the issue of endogeneity of private health insurance participation, the model is augmented to a system of three equations. If Y_3^* represents the propensity the individual i to purchase a private hospital insurance cover, then the structural form of the simultaneous model is given as

$$\begin{aligned} Y_I^* &= \mathbf{x_I}'\beta_\mathbf{I} + \varepsilon_I; \\ Y_H^* &= \mathbf{x_H}'\beta_\mathbf{H} + \varepsilon_H; \\ Y_P^* &= \mathbf{x_P}'\beta_\mathbf{P} + \gamma Y_I + \varepsilon_P. \end{aligned} \tag{6}$$

$(Y_P, \mathbf{x_P})$ is observed only when $Y_H = 1$. Here, the error terms in the three latent equations jointly follow a multivariate normal distribution, that is $(\varepsilon_I, \varepsilon_H, \varepsilon_P)' \sim MVN[0, \sum]$. The variance-covariance matrix Σ is given by

$$\Sigma = \begin{pmatrix} 1 & \rho_{IH} & \rho_{IP} \\ \rho_{IH} & 1 & \rho_{HP} \\ \rho_{IP} & \rho_{HP} & 1 \end{pmatrix},$$

where ρ_{ij} is the correlation coefficient between ε_j and ε_k $(j, k = I, H, P; j \neq k)$. Under this assumption, the set of equations (6) results in a Multivariate Probit (MVP) model that jointly estimate the three probit models.The MVP specification with potentially non-zero off-diagonal elements in Σ allows for correlations across the disturbances of the three latent equations which embody unobserved characteristics of the same individuals. Note that the assumption of unit variance ensures that the parameters can be identified separately from the variance of ε (Greene, 2003). The system of equations also allows the estimation of various conditional probabilities such as:

$$P(Y_P = 1 | Y_H = 1, Y_I = 1; \mathbf{x_H}, \mathbf{x_P}, \mathbf{x_I}) = \frac{\Phi_3(\mathbf{x_I}'\beta_\mathbf{I}, \mathbf{x_H}'\beta_\mathbf{H}, (\mathbf{x_P}'\beta_\mathbf{P} + \gamma \mathbf{Y_I}); \Sigma)}{\Phi_2(\mathbf{x_I}'\beta_\mathbf{I}, \mathbf{x_H}'\beta_\mathbf{H}; \rho_{IH})}; \tag{7}$$

and treatment effects of interest such as:

$$P(Y_P = 1|Y_H = 1, Y_I = 1; \mathbf{x_H}, \mathbf{x_P}, \mathbf{x_I}) - P(Y_P = 1|Y_H = 1, Y_I = 0; \mathbf{x_H}, \mathbf{x_P}, \mathbf{x_I}) \tag{8}$$
$$= \frac{\Phi_3(\mathbf{x_I}'\beta_\mathbf{I}, \mathbf{x_H}'\beta_\mathbf{H}, (\mathbf{x_P}'\beta_\mathbf{P} + \gamma\mathbf{Y_I})); \Sigma)}{\Phi_2(\mathbf{x_I}'\beta_\mathbf{I}, \mathbf{x_H}'\beta_\mathbf{H}; \rho_{IH})} - \frac{\Phi_3(-\mathbf{x_I}'\beta_\mathbf{I}, \mathbf{x_H}'\beta_\mathbf{H}, \mathbf{x_P}'\beta_\mathbf{P}; \Sigma')}{\Phi_2(-\mathbf{x_I}'\beta_\mathbf{I}, \mathbf{x_H}'\beta_\mathbf{H}; -\rho_{IH})}$$

$$\text{where } \Sigma' = \begin{pmatrix} 1 & -\rho_{IH} & -\rho_{IP} \\ -\rho_{IH} & 1 & \rho_{HP} \\ -\rho_{IP} & \rho_{HP} & 1 \end{pmatrix}.$$

The log likelihood for the MVP model with sample selection is

$$\begin{aligned} log(L) = & \sum_{Y_H=1,Y_P=1,Y_I=1} \log \Phi_3[\mathbf{x_H}'\beta_\mathbf{H}, \mathbf{x_P}'\beta_\mathbf{P}, \mathbf{x_I}'\beta_\mathbf{I}; \rho_{HP}, \rho_{HI}, \rho_{PI}] \\ & + \sum_{Y_H=1,Y_P=1,Y_I=0} \log \Phi_3[\mathbf{x_H}'\beta_\mathbf{H}, \mathbf{x_P}'\beta_\mathbf{P}, -\mathbf{x_I}'\beta_\mathbf{I}; \rho_{HP}, -\rho_{HI}, -\rho_{PI}] \\ & + \sum_{Y_H=1,Y_P=0,Y_I=0} \log \Phi_3[\mathbf{x_H}'\beta_\mathbf{H}, -\mathbf{x_P}'\beta_\mathbf{P}, -\mathbf{x_I}'\beta_\mathbf{I}; -\rho_{HP}, -\rho_{HI}, \rho_{PI}] \\ & + \sum_{Y_H=1,Y_P=0,Y_I=1} \log \Phi_3[\mathbf{x_H}'\beta_\mathbf{H}, -\mathbf{x_P}'\beta_\mathbf{P}, \mathbf{x_I}'\beta_\mathbf{I}; -\rho_{HP}, \rho_{HI}, -\rho_{PI}] \\ & + \sum_{Y_H=0,Y_I=1} \log \Phi_2[-\mathbf{x_H}'\beta_\mathbf{H}, \mathbf{x_I}'\beta_\mathbf{I}; -\rho_{HI}] \\ & + \sum_{Y_H=0,Y_I=0} \log \Phi_2[-\mathbf{x_H}'\beta_\mathbf{H}, -\mathbf{x_I}'\beta_\mathbf{I}; \rho_{HI}]. \end{aligned} \tag{9}$$

The system of equations are estimated using Stata codes obtained from David M. Roodman.[8] Marginal effects are then estimated using GAUSS codes. Since the joint and conditional probabilities are highly non linear functions of $\mathbf{x}$, analytical solutions of marginal effects are difficult to obtain. Thus, the marginal effects are calculated using numerical gradients. The standard errors of the marginal effects are then estimated using the delta method.

[8]David's Conditional (recursive) mixed process (cmp) codes estimate multi-equation, conditional recursive mixed process models (Roodman, 2007). It uses the GHK simulator given that estimation requires simulation of cumulative joint normal densities of dimension three or higher. An equation can be dropped for observations for which it is not relevant. In this scenario, Y_P is observed only if $Y_H = 1$. For instance, if an individual does not seek hospital care, then the determinants of private/public health care cannot be modelled.

5 Data

Our data source is the 2004-05 Australian National Health Survey (NHS) which isconducted using a representative sample of the non-institutionalised residential population (ABS, 2006a). This is the fourth in a series of surveys commencing in 1989-90 and is now conducted every three years. One adult and one child aged 0 to 17 years was surveyed from each of the 19 501 private dwellings selected throughout non-sparsely settled areas of Australia and the sample design ensured that individuals were randomly selected within each state and territory (ABS, 2006a). Data were collected using face-to-face interviews and for young adults and children aged less than 18, a parent or guardian was instead interviewed. The survey provides information about the health status of Australians including long term medical conditions they experienced and their self-reported health, their use of various health services and facilities, the health-related aspects of their lifestyle such as their smoking, drinking, eating and exercise habits and patterns, and their private health insurance status. It also provides information on a wide range of demographic and socioeconomic characteristics of individuals and households, including age, marital status, education, main occupation, state of residency and income.

This study focuses on a sample of 14 970 Australian adults aged 18 and over. All three dependent variables in our analysis, hospital utilisation (Y_H), public/private health care utilisation (Y_P) and private health insurance-hospital cover (Y_I) status, are dichotomous variables constructed using various survey questions. Measurement of hospital utilisation is based on whether an individual has had at least one inpatient stay in a hospital[9] and discharged in the 12 months prior to interview. Further details were obtained about the individual's most recent inpatient episode such as whether he or she was admitted as a Medicare or private patient. This information was used to construct the public/private

[9]The survey defines a hospital as an institution which offers residential health care, other than a nursing or convalescent home.

health care utilisation variable Y_P. Note that, questions about hospital utilisation were asked to individuals after enquiring about any recent visits to casualty, outpatients units and hospital, or day clinics, in order to minimise the risk of respondents reporting these visits as hospital admissions.

The survey also collects information on individuals' private health insurance arrangements.[10] Further information on the type of cover (i.e. hospital only, ancillary only, hospital and ancillary) are used to construct the Y_I variable. This variable represented the status of individuals who, at the time of the survey, held a hospital cover irrespective of whether they held any ancillary cover. Household income per equivalent adult are only available for income decile groups. In the study, income is defined as the logarithm of the mean household weekly equivalised income for the decile in which the individual's income is located.

The analysis also includes some variables to calibrate the quality of public andprivate health care. Waiting time, bed density and density of full time equivalent (FTE) medical practitioners in public hospitals are obtained from the Australian Institute of Health and Welfare (AIHW, 2007). While waiting time and FTE medical practitioners are obtained only at state level and have little variation, bed density measured at state level and by remoteness exhibit more variation. Copayments at state level was obtained from PHIAC (PHIAC, 2007a). They represent the average medical gap for insured in-hospital services. Detailed definitions and constructions of all variables used in the analysis are given in Appendix A. Table 2 shows a decomposition of individuals who were admitted to hospitals by selected demographic/health groups and by admission status (i.e. Medicare/private).

[10]Cover provided or arranged through employees was included. However, ambulance only cover and cover arranged under Veteran's Affairs or the government health benefits cars were excluded.

6 Results

Table 3 reports the respective results of the three equations: hospital admission, private/public choice and private health insurance status. The equations are estimated as a system specified in structural forms as in Equation 6. Table 4 reports the marginal effects of the variables along with their standard errors. Note that the marginal effects represent the absolute changes in the respective probabilities in response to a unit change in each individual explanatory variable. For PHI participation and hospital service utilisation, the marginal effects on the marginal probabilities (i.e the unconditional probabilities) are presented while for the private/public health choice equation, we report the marginal effects on the probability of using private/public health care conditional on hospital admission (i.e. $P(Y_P = 1|Y_H = 1; \mathbf{x_P})$. The explanatory variables in the equation includes a number of demographic and socioeconomic characteristics such as age, gender, marital status, household composition, household income, health status, health related lifestyle indicators, the cost of private health care as proxied by copayments and a few indicators of quality of public health care.

To start, the set of correlation coefficients are examined. These coefficients capture the correlation between the unobservable factors via the error terms, after accounting for the observable components. From Table 3, out of the three correlation coefficients, ρ_{IH} and ρ_{HP} are positive and statistically significant at the 5% level. Note that the insignificance of ρ_{IP} might appear counterintuitive at first. However, when the three equations are estimated in a reduced form (not reported in the paper due to space constraint), a large and highly significant correlation is estimated between the private/public choice and private health insurance participation decisions. However, in the structural equation where Y_I is entered directly in Y_P^*, there is no correlation between the structural errors and the error terms in the PHI equation. It appears that after accounting for the direct impact of

PHI on the private/public choice decision, there is very little correlation left between the the error terms via the unobserved factors. Note that ρ_{HP}, the correlation between the hospital admission and the public/private choice equations, captures the selection effect due to partial observability of those who are admitted as public or private patients. With a system approach we do not estimate any 'lambda' parameter as is normally the case in partial observability models entailing two-step estimation (Greene, 2003). To test for selection bias, it requires testing the hypothesis of no effects which results if ρ_{HP} equals zero. A positive and significant ρ_{HP} here indicates selection effect. Lastly, the small yet significant ρ_{IH} indicates some correlation between the error terms of the PHI status and hospital utilisation decisions via unobservable factors and thus justifies the multivariate approach.

Most of the explanatory variables have the expected signs. Age is a significant determinant of in all three equations.[11] The probability of purchase of private health insurance is found to increase with age with a slight drop-off for the 70+ age group. This is suggestive of a higher probability of PHI purchase as individuals get older and less likely to stay healthy (see Propper, 1993; Hopkins and Kidd, 1996). In contrast, the probability of hospital admission has a U-shaped distribution with age[12] while the chances of using private care increases progressively as individuals get older. Younger and healthier individuals with no private insurance are more likely to opt for public care while the insured older ones are more likely to use private health care. In terms of gender, females are slightly more likely to purchase insurance, get hospitalised and use private hospital treatment than males. This may be explained by a higher demand for medical services among women

[11] Cameron et al. (1988) and Savage and Wright (2003) obtained similar findings when modelling insurance decision for Australia.

[12] Note that the lowest probability of hospital admission relates to the 60-69 age group after controlling for factors such as long-term conditions mostly associated with older individuals. On the other hand, the highest probability of hospital admission in the under-30s age group relates to higher accident risks and pregnancies in this particular cohort.

during their reproductive years (see Sindelar, 1982). Married individuals are also more likely to get insured and use private health care than their single counterparts. Note that age, gender and marital status may also affect individuals' risk vulnerability and therefore influence their insurance purchase decision.

PHI purchase and use of private hospital care are also associated with individuals' occupations. Labourers (the base category) have the lowest chances of purchasing PHI and opting for private hospital care than individuals in any other occupation. In particular, labourers are 20 per cent less likely to choose private hospital treatment than those in professional occupations. The insurance decision as well as health care utilisation appears to be highly associated with education. Education is likely to increase individuals' awareness of health care services and the benefits of purchasing a private health insurance. The marginal effects of education indicates that degree holders are more likely to get insured and also more likely to use private health care than someone who has completed less than secondary education.

Higher household income is associated with an increased probability of purchasing private health insurance and an increased probability of private health care utilisation. In particular, those in the tenth income decile have 53 per cent higher chances of purchasing private health insurance and 46 per cent higher chances of seeking private care that those with income below the poverty line. [13] However, there does not appear to be any distinct pattern between income and hospital admission. The issue of equity with regard to health care accessibility has been examined by several studies (Goddard and Smith, 2001; van Doorslaer et al., 2000; Gerdtham, 1997) and is a key feature in policy debates about the private and public health sectors in Australia. Colombo and Tapay (2003) argued that private cover may create incentives for differentiated access and treatment according to

[13]The base case here is the third income decile. Considering a Henderson Poverty Line of AUD 353 used in international comparison of poverty, this roughly represents the segment of the population below the poverty line.

insurance status in Australia because doctors and public hospitals treat both public and private insurees but they are better paid when treating private patients. Moreover while access to health service is based on medical need, the way waiting lists are managed - whether centralised by the hospital or whether they are solely managed by the doctor - can potentially affect discretion over who is ultimately admitted.[14] Tax incentives have also been a significant stimulus for purchasing private health insurance.[15] A flat Medicare levy with a progressive income taxation system encourages those on higher incomes to purchase private insurance irrespective of whether they would use private sector facilities.

Individuals' valuation of their health states is a potential predictor of health care utilisation. Those who are in good health are less likely to access health care services. In the same vein, those who expect themselves to be in good health have little to gain from insurance while those who are in poor health are more likely to purchase health insurance. The results of the hospital utilisation equation support this hypothesis indicating that the less healthy individuals are, the more likely they are to get admitted into hospitals. However, we obtain a positive relationship between individuals' self-assessed health and the probability of purchasing health insurance or seeking private health care. This could be explained by the argument raised by Wright (2007) that private hospitals provide incentives to treat short stay patients. Since they cannot observe patient type they attract specialists who are more income driven and choose to treat a high proportion of short stay patients. It is very likely that these short stay patients are in general 'healthy' individuals. The positive relationship between self-assessed health and insurance purchase is therefore counter intuitive to the hypothesis of moral hazard and adverse selection into insurance

[14]When admitting private patients, public hospitals receive payment by the insurance fund and do not have to use resources from the state budget. Some hospitals charge doctors for using hospital facilities for their private patients which is an added source of revenue for hospitals. Thus, hospitals often encourage patients to be admitted as private patients, for example by offering a waive-off on their out-of-pocket expenditure (Colombo and Tapay, 2003).

[15]Fiebig et al. (2006) have shown that financial incentives is an increasingly important factor in the insurance decision in Australia, in particular in the aftermath of the 1999-2000 policy changes.

of those who are most likely to need health care. However, such finding is not unusual and has been obtained in several previous studies (Harmon and Nolan, 2001; Doiron et al., 2008; Barrett and Conlon, 2003; Ettner, 1997).[16] We also include in the model some more objective measures of health status in terms of long-term conditions such as arthritis, cancer, heart disease, diabetes, asthma and osteoporosis. While only a couple of these health indicators seem to be related to the choice of private health care or insurance purchase, most of them are positively and significantly correlated with hospital utilisation. In other words, medical need is an important determinant of hospital utilisation but not the choice between public and private care.

Health related lifestyle factors such as heavy smoking, drinking at high risk levels, lack of exercise and being obese are all negatively related to insurance decision. Where these variables indicate poor health, a positive relationship would be expected with the private insurance purchase decision. However, if such factors indicate risk attitudes towards health, a decision-maker with such characteristics is less likely to indulge in a risk-averse behaviour such as private health insurance participation.

Given that health care utilisation or the decision to purchase insurance is often determined at the level of household rather than at an individual level, household characteristics play an important role in such decisions. The presence of dependant kids is likely to be a significant stimulus for getting insured from both the risk averseness and financial point of view. The positive and significant coefficient on this indicator supports the hypothesis. On the other hand, single parents are found to be less likely to purchase PHI. Their decision to purchase insurance may be potentially constrained by their financial situations.

Cost of insurance and cost of access to private hospitals are potential determinants of

[16]Doiron et al. (2008) and Barrett and Conlon (2003) associated the positive relationship between self-assessed health and insurance purchase to individuals' risk averse traits. The risk averse individuals with lower risk behaviours will have a better health and are also more likely to purchase private health insurance.

the insurance decision and the choice between public and private hospital care. While there is no information available on health insurance premium either in the NHS or from any other source, average state-level copayments are used as a measure of the cost of private care. As expected, the effect of this variable on both the insurance decision and the probability of using private care is negative and statistically significant. The availability of concession cards, on the other hand, increases the probability of hospital use but decreases the probability of insurance purchase and private hospital care.

The effect of the quality of public health care has been identified as an important determinant of insurance decision in previous studies (Goddard and Smith, 2001; Propper, 2000). A common measure of public hospital care is waiting list and queuing. Although not included in the final specification, the model is estimated with two different measures of waiting list at state level: average waiting time (i.e. days waited at 50th percentile) and the proportion of individuals who waited for more than a year for elective surgery. The effect of waiting time on the insurance decision is found to be insignificant but the percentage waiting for more than a year is positively and significantly related to PHI purchase. However, given that the Australian waiting list data at state level are known to be inconsistent with regard to their collection and presentation (Hopkins and Kidd, 1996; AIHW, 2007), instead we have tried using bed density and full-time equivalent (FTE) medical practitioners in public hospitals as alternate measures of quality of public care. We assume that both the measures of supply of health services are likely to reflect the effect of public hospital waiting list/time. The effects of these variables are found to be negative (although mostly insignificant) with respect to both insurance purchase and private health care service utilisation.[17] However, the density of FTE medical officers is not included in the final specification because a lack of variation in the variable tends to affect the

[17]Using physicians per bed in private hospitals as a proxy for accessibility, citetfabbri02 found it to be negatively correlated with public hospital utilisation.

robustness of the results.

Hopkins and Kidd (1996) controlled for the interstate differences in quality and services available in the public sector using state indicators. They found significant differences between New South Wales (NSW) and states such as Australian Capital Territory (ACT), Victoria (VIC) and Queensland (QLD). They argued that the lower propensity to purchase PHI in QLD is due to a positive attitude towards public sector health care since before Medicare, the QLD population had access to free shared-ward accommodation with treatment by hospital doctors. The difference with regard to ACT which had the lowest private bed density was explained by the variation in the provision of services while the difference with respect to VIC was not very clear. Controlling for quality difference across various states using state-level indicators, we obtain similar findings to Hopkins and Kidd (1996).[18]

Finally, the large and positive effect of private insurance status on private health care utilisation indicates that private insurance is the most important determinant of private health care utilisation. In particular, those with private hospital cover are almost 76% more likely to seek private health care than use public health services. Note that this represents the direct ('structural') effect of PHI on the public/private choice decision. The total effect ('structural' effect + effect via the unobservable characteristics) is estimated using the multivariate aspect of the model and involves a significant increase in computing complexity. They are presented in the next section.

[18]Because of multicollinearity with other state-level variables, the effects of the state indicators are estimated by excluding other state-level variables from the model. However, the state-level indicators have been excluded in the final specification.

7 Predictions

The key advantage of estimating a multivariate probit model is that it allows to predict joint and conditional probabilities using correlation via the unobserved characteristics. Such information will not be available if a univariate approach is used. For instance, it allows us to estimate the effect of private insurance participation on the probability of visiting hospital or on the probability of seeking private care taking into account the effects of any unobserved individual characteristics. Table 5 reports a few unconditional, conditional probabilities and treatment effects at the mean of explanatory variables along with their standard errors. From panel A we find that while a typical person has 16.5 per cent chances of visiting a hospital, he has slightly higher (18.3%) chances of doing so if he has a private health insurance.

Panel B of the table reports some treatment effects of PHI status. For instance, the chances of using private care increases from 7.5 per cent for a person who does not have a PHI to 77.4 per cent if he/she has a PHI resulting in a PHI treatment effect of 69.8 per cent which is statistically significant at the 5 per cent level. Lastly, we estimate the public/private choice equation using a univariate probit model treating PHI participation as an exogenous variable. The effect of PHI using the univariate approach is reported in column 1 of Panel C and compared to the 'structural' (partial) effect and the treatment (total) effect estimated using the multivariate approach. In this case, there does not appear to be much of a difference between the 'exogenous' effect and the treatment effect given low correlation between the PHI and public/private choice equations. However, in other instances where large and significant correlations have been estimated, these differences have been quite significant (see Zhang et al., 2007).

8 Conclusion

This paper has investigated the factors that influence individuals' utilisation of public and private hospital care in the Australian's health system which is characterised by a mix of public and private but where all residents are entitled to free hospital treatment. We estimate a recursive trivariate probit system model with partial observability that allows for endogeneity of private insurance participation and potential selection bias as we only observe individuals' public/private choices for those who have visited a hospital in the past 12 months. Relative to the prevailing two-step estimation for sample selection or endogenous treatment, our full information maximum likelihood (FIML) approach is both consistent and efficient.

A series of reforms have been implemented in Australia in recent years in order to increase private insurance participation to relieve the overburdened public health system. While the reforms have expanded private coverage, a significant proportion of the privately insured still opt for public treatment in hospitals. This paper has identified private health insurance status and income as important determinants of private hospital care utilisation. An individual with a private hospital cover has nearly 70 per cent higher chance to opt for private treatment in a hospital and a person within the tenth income decile group has 46 per cent higher probability to seek private hospital care than someone who falls in the third or lower income decile groups. To some extent other factors such as perceived quality of care in the public sector and cost of access have also been found to have some impact on the use of private hospital care.

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9 Appendix A: Definition of Variables

Table 1: Definition of Dependent and Explanatory Variables

Hospital utilisation, Y_H: 1 if had at least one inpatient hospital stay in the last 12 months, 0 otherwise;	
Public/private status, Y_P: 1 if admitted as a private patient, 0 if admitted as a public patient, at most recent admission;	
PHI status, Y_I: 1 if currently covered by private hospital insurance, 0 otherwise.	
Age:	**age30less** 1 for age group 18-29 years, 0 otherwise (ref category); **age30** 1 for age group 30-39 years, 0 otherwise; **age40** 1 for age group 40-49 years, 0 otherwise; **age50** 1 for age group 50-59 years, 0 otherwise; **age60** 1 for age group 60-69 years, 0 otherwise; **age70plus** 1 for age group 70 years and over, 0 otherwise.
Geographic location:	**majcity** 1 if living in a major city, 0 otherwise; **inregn** 1 if living in inner regional areas, 0 otherwise; **othereg** 1 if living in other regions, 0 otherwise (ref. category).
Main occupation:	**workft** 1 if employed full-time, 0 otherwise; **workpt** 1 if employed part-time,, 0 otherwise; **studyft** 1 if studying full-time,, 0 otherwise; **unemp** 1 if unemployed and looking for job, 0 otherwise; **NLF** 1 if not in labour force, 0 otherwise (ref. category).
Area of Occupation:	**admin** 1 for managers and administrators, 0 otherwise; **prof** 1 for professionals, 0 otherwise; **ass prof** 1 for associate professionals, 0 otherwise; **traders** 1 for tradesperson and related workers, 0 otherwise; **clerical** 1 for advanced clerical and service workers, 0 otherwise; **sales** 1 for intermediate clerical, sales and service workers, 0 otherwise (ref. category); **production** 1 for intermediate production and transport workers, 0 otherwise; **service** 1 for elementary clerical, sales and service workers, 0 otherwise; **labourer** 1 for labourers and related workers, 0 otherwise.
Educational attainment:	**degree** 1 if highest qualification is a tertiary degree, 0 otherwise; **tafe** 1 if highest qualification is a non-tertiary diploma or trade certificate, 0 otherwise; **year12** 1 if highest qualification is year 12, 0 otherwise; **lessyr12** 1 for no qualification, if still at school or highest qualification is less than year 12, 0 otherwise (ref. category).
Income:	**incdech3** 1 if household income falls in first to third income decile, 0 otherwise (ref. category); **incdech4** 1 if it falls in fourth decile, 0 otherwise; **incdech5** 1 if it falls in fifth decile, 0 otherwise; **incdech6** 1 if it falls in sixth decile, 0 otherwise; **incdech7** 1 if it falls in seventh decile, 0 otherwise; **incdech8** 1 if it falls in eighth decile, 0 otherwise; **incdech9** 1 if it falls in ninth decile, 0 otherwise; **incdech10** 1 if it falls in tenth decile, 0 otherwise.

Other demographic Variables:

male 1 for male, and 0 otherwise; **married** 1 if married or *de facto,* and 0 otherwise; **profeng** 1 if proficient in english and 0 otherwise; **depchild** 1 if there are dependent child/children in the household; **sinpar** 1 if coming from a single parent household, 0 otherwise.

Self reported health status:

excelh 1 for excellent health, 0 otherwise; **vgoodh** 1 for very good health, 0 otherwise; **goodh** 1 for good health, 0 otherwise; **poorh** 1 for poor health, 0 otherwise (reference category).

Long term Medical Conditions:

arthritis 1 if currently has rheumatoid or osteo-arthritis, 0 otherwise; **cancer** 1 if currently has skin, colon/rectum/bowel, breast, prostate, lymphoma cancer or cancer of the female reproductive organ, 0 otherwise; **heart** 1 if currently suffering from any heart and circulatory condition, 0 otherwise; **diabetes** 1 if currently has any type of diabetes except for high sugar levels (HSL), 0 otherwise; **asthma** 1 if currently has asthma, 0 otherwise; **osteo** 1 if currently suffering from osteoporosis, 0 otherwise.

Lifestyle factors:

smokedly 1 for regular daily smoker, 0 otherwise; **alchrisk** 1 for high risk drinker, i.e. daily average consumption of more than 75 ml for male and more than 50 ml for female, 0 otherwise; **overwt** 1 for those who are overweight, i.e. with a BMI of more than 25, 0 otherwise; **noexcise** 1 for those who do very low level or no exercise, 0 otherwise.

Cost/quality of hospital variables:

copay average gap payment for in-hospital medical services, at state level; **bed** beds available per 1000 population in public hospitals, at state level and by remoteness; **ftemo** full-time equivalent salaried medical practitioners per 100,000 population available in public hospitals, at state level; **waitime** days waited at 50th percentile for elective surgery in public hospitals, at state level; **waitlist** proportion of individuals who waited for more than a year for elective surgery in public hospitals, at state level.

Table 2: Type of Admission by Demographic/Health Groups

At last admission in hospital:	Medicare Patient	Private Patient
Age group		
30 or less	78.2	23.3
30-39	61.4	38.6
40-49	57.0	43.0
50-59	51.2	48.8
60-69	51.4	48.6
70-79	59.6	40.4
80-89	52.9	47.1
Education		
Degree	40.3	59.7
TAFE	60.7	39.3
Year 12	60.6	39.4
Lessyr12	69.9	30.1
Employment		
workft	47.3	52.7
workpt	53.0	47.0
Studyft	67.1	32.9
Unemp	80.9	19.1
NLF	65.8	34.2
Specific Health Conditions		
Athritis	58.1	41.9
Cancer	58.3	41.7
Heart	59.4	40.6
Diabetes	66.0	34.0
Osteoporosis	52.8	47.2
Asthma	65.9	34.1
Household Income		
1st Decile	82.5	17.5
2nd Decile	79.7	20.3
3rd Decile	65.0	35.0
4th Decile	59.9	40.1
5th Decile	57.8	42.2
6th Decile	52.0	48.0
7th Decile	51.8	48.2
8th Decile	44.4	55.6
9th Decile	36.5	63.5
10th Decile	26.8	73.2
Other demographic/geographic variables		
Male	60.8	39.2
Married	49.6	50.4
Remoteness		
Major City	55.7	44.3
Inner Regional	62.2	37.8
Outer Regional	65.6	34.4

Table 3: Results of Structural Model: Coefficients

	Y_I		Y_H		Y_P	
Y_I						
age30	0.206	(0.042)**	-0.114	(0.045)**	1.946	(0.508)**
age40	0.485	(0.043)**	-0.232	(0.046)**	0.295	(0.135)**
age50	0.793	(0.047)**	-0.282	(0.050)**	0.166	(0.151)
age60	1.139	(0.056)**	-0.291	(0.055)**	0.399	(0.192)**
age70+	1.101	(0.061)**	-0.210	(0.058)**	0.730	(0.261)**
male	-0.068	(0.027)**	-0.098	(0.028)**	0.862	(0.257)**
married	0.225	(0.028)**	0.059	(0.027)**	-0.156	(0.079)**
profeng	0.358	(0.081)**	0.162	(0.087)*	0.190	(0.087)**
depkid	0.153	(0.036)**			0.238	(0.239)
sinpar	-0.155	(0.064)**			0.019	(0.111)
majcity	0.137	(0.038)**	-0.021	(0.036)	0.005	(0.178)
inregn	0.123	(0.041)**	0.023	(0.042)	-0.162	(0.108)
workft	-0.341	(0.064)**	-0.331	(0.045)**	-0.076	(0.116)
workpt	-0.288	(0.063)**	-0.144	(0.044)**	-0.248	(0.221)
workstud	-0.179	(0.112)	-0.157	(0.117)	-0.331	(0.220)
studyft	0.456	(0.080)**	-0.315	(0.087)**	-0.153	(0.295)
unemp	-0.207	(0.101)**	-0.273	(0.090)**	-0.438	(0.287)
prof	0.440	(0.057)**			0.009	(0.323)
trades	0.231	(0.066)**			0.322	(0.198)
clerk	0.593	(0.097)**			0.155	(0.219)
intsales	0.318	(0.061)**			0.465	(0.329)
prodtran	0.151	(0.071)**			0.487	(0.212)**
elsales	0.124	(0.071)*			0.225	(0.238)
degree	0.317	(0.042)**	0.042	(0.043)	0.216	(0.234)
tafe	0.098	(0.035)**	0.099	(0.036)**	0.225	(0.121)**
year12	0.218	(0.034)**	0.026	(0.035)	0.153	(0.099)
incdech4	0.357	(0.046)**	0.004	(0.051)	0.240	(0.101)**
incdech5	0.385	(0.047)**	0.138	(0.052)**	0.292	(0.146)**
incdech6	0.519	(0.049)**	0.133	(0.056)**	0.352	(0.143)**
incdech7	0.621	(0.050)**	0.113	(0.057)**	0.285	(0.167)
incdech8	0.787	(0.051)**	0.093	(0.060)	0.337	(0.178)*
incdech9	0.978	(0.053)**	0.176	(0.059)**	0.281	(0.208)
incdech10	1.340	(0.055)**	0.193	(0.060)**	0.434	(0.221)**
concess	-0.487	(0.040)**	0.105	(0.043)**	0.457	(0.267)*
excelh	0.239	(0.063)**	-0.730	(0.061)**	0.040	(0.144)
vgoodh	0.229	(0.059)**	-0.647	(0.055)**		
goodh	0.146	(0.057)**	-0.448	(0.051)**		
athritis	0.014	(0.032)	0.073	(0.031)**		

Continued ...

Table 3: (Continued)

	Y_I		Y_H		Y_P	
cancer	0.096	(0.075)	0.491	(0.069)**		
heart	0.062	(0.029)**	0.151	(0.030)**		
diabetes	-0.035	(0.054)	0.198	(0.050)**		
asthma	0.023	(0.040)	0.041	(0.038)		
osteo	0.157	(0.055)**	0.072	(0.056)		
smokedly	-0.394	(0.031)**				
alchirsk	-0.141	(0.062)**				
overwt	-0.025	(0.025)				
noexcise	-0.081	(0.025)**				
copay	-0.006	(0.001)**			-0.003	(0.004)
bed	0.020	(0.022)			-0.146	(0.065)**
Constant	-1.770	(0.140)**	-0.461	(0.116)**	-2.486	(0.405)**
ρ_{IH}	0.081	(0.018)**				
ρ_{IP}	0.050	(0.277)				
ρ_{HP}	0.484	(0.137)**				

Standard errors are given in parentheses. *significant at 10% level;
**significant at 5% level.

Table 4: Results of Structural Model: Marginal Effects

	Y_I		Y_H		$Y_P \vert Y_H = 1$	
Y_I					0.756	(0.071)**
age30	0.081	(0.017)**	-0.028	(0.011)**	0.142	(0.030)**
age40	0.191	(0.017)**	-0.058	(0.012)**	0.200	(0.031)**
age50	0.313	(0.018)**	-0.070	(0.012)**	0.348	(0.033)**
age60	0.449	(0.022)**	-0.072	(0.014)**	0.525	(0.040)**
age70+	0.434	(0.024)**	-0.052	(0.015)**	0.538	(0.038)**
male	-0.027	(0.011)**	-0.024	(0.007)**	-0.046	(0.019)**
married	0.089	(0.011)**	0.015	(0.007)**	0.102	(0.019)**
profeng	0.141	(0.032)**	0.040	(0.022)*	0.139	(0.051)**
depkid	0.060	(0.014)**			0.047	(0.026)*
sinpar	-0.061	(0.025)**			-0.042	(0.043)
majcity	0.054	(0.013)**	-0.005	(0.009)	0.001	(0.022)
inregn	0.048	(0.015)**	0.006	(0.011)	0.013	(0.026)
workft	-0.134	(0.025)**	-0.082	(0.011)**	-0.117	(0.048)**
workpt	-0.113	(0.025)**	-0.036	(0.011)**	-0.144	(0.052)**
workstud	-0.071	(0.044)*	-0.039	(0.029)	-0.069	(0.112)
studyft	0.180	(0.032)**	-0.078	(0.022)**	0.055	(0.078)
unemp	-0.082	(0.040)**	-0.068	(0.023)**	-0.025	(0.056)
prof	0.173	(0.022)**			0.200	(0.043)**
trades	0.091	(0.026)**			0.101	(0.052)**
clerk	0.234	(0.038)**			0.277	(0.093)**
intsales	0.125	(0.024)**			0.206	(0.049)**
prodtran	0.059	(0.028)**			0.096	(0.059)
elsales	0.049	(0.028)*			0.087	(0.056)
degree	0.125	(0.017)**	0.011	(0.011)	0.138	(0.028)**
tafe	0.039	(0.014)**	0.025	(0.009)**	0.053	(0.024)**
year12	0.086	(0.013)**	0.006	(0.009)	0.116	(0.023)**
incdech4	0.141	(0.018)**	0.001	(0.013)**	0.169	(0.035)**
incdech5	0.152	(0.018)**	0.034	(0.013)**	0.177	(0.031)**
incdech6	0.205	(0.020)**	0.033	(0.014)**	0.198	(0.037)**
incdech7	0.245	(0.020)**	0.028	(0.014)**	0.241	(0.035)**
incdech8	0.310	(0.020)**	0.023	(0.015)	0.275	(0.038)**
incdech9	0.386	(0.021)**	0.044	(0.015)**	0.356	(0.039)**
incdech10	0.528	(0.022)**	0.048	(0.015)**	0.460	(0.043)**
concess	-0.192	(0.016)**	0.026	(0.011)**	-0.137	(0.032)**
excelh	0.094	(0.025)**	-0.181	(0.015)**	0.148	(0.036)**
vgoodh	0.090	(0.023)**	-0.161	(0.014)**	0.136	(0.032)**
goodh	0.058	(0.022)**	-0.111	(0.013)**	0.091	(0.025)**

Continued ...

Table 4: (Continued)

	Y_I		Y_H		$Y_P \vert Y_H = 1$	
athritis	0.005	(0.013)	0.018	(0.008)**	-0.004	(0.012)
cancer	0.038	(0.030)	0.122	(0.017)**	-0.028	(0.047)
heart	0.025	(0.012)*	0.037	(0.008)**	0.000	(0.012)
diabetes	-0.014	(0.021)	0.049	(0.013)**	-0.032	(0.026)
asthma	0.009	(0.016)	0.010	(0.010)	0.002	(0.015)
osteo	0.062	(0.022)**	0.018	(0.014)	0.035	(0.020)*
smokedly	-0.155	(0.012)**			-0.109	(0.019)**
alchirsk	-0.055	(0.024)**			-0.039	(0.036)
overwt	-0.010	(0.010)			-0.007	(0.007)
noexcise	-0.032	(0.010)**			-0.022	(0.009)**
copay	-0.003	(0.000)**			-0.002	(0.001)**
bed	0.008	(0.007)			-0.030	(0.013)**

Standard errors are given in parentheses. *significant at 10% level;
**significant at 5% level.

Table 5: Predicted Probabilities and Treatment Effects

	Panel A	
	$\tilde{P}(.)$	
$P(Y_I = 1\|\overline{\mathbf{x}})$	0.439	(0.005)**
$P(Y_H = 1\|\overline{\mathbf{x}})$	0.165	(0.003)**
$P(Y_P = 1\|Y_H = 1, \overline{\mathbf{x}})$	0.416	(0.028)**
$P(Y_P = 0\|Y_H = 1, \overline{\mathbf{x}})$	0.584	(0.028)**
$P(Y_H = 1\|Y_I = 1, \overline{\mathbf{x}})$	0.183	(0.005)**
$P(Y_H = 1\|Y_I = 0, \overline{\mathbf{x}})$	0.151	(0.004)**
$P(Y_P = 0\|Y_H = 1, Y_I = 1, \overline{\mathbf{x}})$	0.226	(0.040)**
$P(Y_P = 0\|Y_H = 1, Y_I = 0, \overline{\mathbf{x}})$	0.925	(0.041)**
$P(Y_P = 1\|Y_H = 1, Y_I = 1, \overline{\mathbf{x}})$	0.774	(0.040)**
$P(Y_P = 1\|Y_H = 1, Y_I = 0, \overline{\mathbf{x}})$	0.075	(0.041)*

	Panel B					
					Treatment effect	
	$\tilde{P}(.\|Y_I = 1)$		$\tilde{P}(.\|Y_I = 0)$		$\tilde{P}(.\|Y_I = 1) - \tilde{P}(.\|Y_I = 0)$	
$P(Y_H = 1\|\overline{\mathbf{x}})$	0.183	(0.005)**	0.151	(0.004)**	0.032	(0.007)**
$P(Y_P = 1\|Y_H = 1, \overline{\mathbf{x}})$	0.774	(0.040)**	0.075	(0.041)*	0.698	(0.060)**
$P(Y_P = 0\|Y_H = 1, \overline{\mathbf{x}})$	0.226	(0.029)**	0.925	(0.041)**	-0.698	(0.060)**

	Panel C					
	UVP		MVP		MVP	
	Exogenous Effect		Structural Effect		Treatment effect	
$P(Y_P = 1\|Y_H = 1, Y_I = 1, \overline{\mathbf{x}})$	0.690	(0.017)**	0.756	(0.060)**	0.698	(0.071)**

Standard errors are given in parentheses. *significant at 10% level; **significant at 5% level.