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Advantageous selection in private health insurance: The case of Australia

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CHERE WORKING PAPER 2008/2

Version: May 2008

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Acknowledgements:
This paper draws on research funded by a National Health and Medical Research Council Program Grant. We wish to thank participants at presentations at the Australian Health Economics Society Conference, the CAER Health Economics Workshop and an economics seminar at the University of Sydney for their advice and comments. Data from the Australian Bureau of Statistics National Health Survey 2004-05 and Household Expenditure Survey 2003 was provided under the ABS/AVCC CURF agreement.

Abstract

When consumers have private information about risk of suffering a loss, or equivalently, if insurers are prohibited from using observable information on risk in underwriting, theoretical models of insurance predict adverse selection. Yet the most common finding in empirical studies is that of no positive correlation between risk and insurance coverage. This is found for different types of insurance (e.g. car, health, life) and in different countries (e.g. France, US, UK, Israel) suggesting a fundamental relationship involving private information and consumer preferences. In this paper, we investigate the nature of risk selection in the Australian market for private health insurance in which community rated private health insurance complements a universal public health care system. We use National Health Survey data on hospital utilisation and individual characteristics to construct an empirical analogue for the risk variable in the Rothschild and Stiglitz model. Estimating the relationship between insurance and risk semi-parametrically, we find robust evidence of favourable selection. To explore the extent to which underlying risk preferences rather than risk drives the decision to purchase health insurance, we use Household Expenditure Survey data to model decisions to purchase a range of insurance products (health, life, accident, home, car) and to engage in risky behaviours (smoking and various forms of gambling). Correlations between residuals in the model suggest that advantageous selection is driven by risk aversion, which theoretical models do not typically capture.

1. Introduction

A basic prediction of theoretical models of insurance is that when consumers have private information about their risk of suffering a loss - or , equivalently, if insurers are prohibited from using observable information on risk in underwriting - insurance markets will be prone to adverse selection. Market equilibria with adverse selection are characterized by a positive relationship between risk and the level of insurance coverage.[1] In recent years, a number of studies have tested this prediction using data from different types of insurance markets. The results provide little evidence of adverse selection and several studies find exactly the opposite: the level of insurance coverage is negatively related with consumer risk. This is found in health insurance markets in the US (Ettner, 1997; Cardon and Hendel, 2001; Monheit and Vistnes, 2004; Asinski, 2005; Bajari et al, 2006; Fang, Keane and Silverman, 2008), in the UK (Propper, 1989), in Israel (Shmueli, 2001) and in Australia (Doiron, Jones, Savage, 2008. It is also found in the US market for long term care (Finkelstein and McGarry, 2006) and for life insurance (Cawley and Philipson, 1999). Chiappori and Salanie (2000) using data on car insurance in France and find no relationship between the level of coverage and the incidence of claims. In contrast, Finkelstein and Poterba (2002, 2004) do find evidence of adverse selection in the UK market for annuities.

Broadly, there are two possible explanations for the finding that adverse selection is not an issue in insurance markets. One is that the information asymmetries that are central to theoretical models of insurance markets are not empirically important. According to this argument, insurers are able to obtain enough information from consumers to adequately predict their losses and set premiums accordingly. It is conceivable that in some cases, insurers will have better information than consumers concerning expected losses.

The second possible explanation is that there are other factors that positively influence the demand for insurance and are negatively correlated with the risk of suffering a loss. For example, if consumers who are more risk averse are also less likely to suffer a loss - perhaps because they are more inclined to undertake preventive efforts - the positive correlation between risk and insurance coverage due to adverse selection will be attenuated or, perhaps even reversed. The most common

[1] More generally, asymmetric information can lead to both adverse selection and moral hazard, both of which will result in a positive correlation between the level of coverage and ex post losses.

explanation for the counterintuitive result offered in the literature is that of heterogeneity in risk aversion; the degree of risk aversion is negatively correlated with risk class (de Meza and Web, 2001; Jullien et al, 2002; Finkelstein and McGarry, 2006).

In this paper, we investigate the nature of risk selection in the Australian market for private health insurance. Several features of this market make it an important case for understanding the general issue of risk selection in insurance markets and for informing regulatory policy. First, much of the prior research on adverse selection in health insurance markets has used data from the US, which is an outlier among industrialized countries in both the importance of private insurance in financing health care and the link between coverage and employment. Both have important implications for risk selection. In contrast, Australia is more typical of other countries in the way that private health insurance complements a universal public health care system. In particular, the Australian public health system provides universal, free public hospital treatment but private insurance can be purchased for private hospital treatment which, while usually involving out-of-pocket costs, allows choice of medical practitioner and shorter waiting times for some procedures.[2]

A second key feature of the Australian market is that premiums are required to be community rated: for a given contract the same price must be charged to all consumers regardless of age, gender or any other individual characteristics.[3] By prohibiting insurers from basing premiums on readily observable risk factors, community rating essentially introduces a strong form of information asymmetry into the market, which simplifies the interpretation of our results. If the data reject the prediction of adverse selection, the explanation cannot be that information is effectively symmetric in this market. As in other countries, Australian insurers can design policies to attract low or high risks by excluding coverage for specific procedures or types of care or by cost-sharing arrangements, and this could reduce the extent of adverse selection in the insured population. However on the basis of US findings, there is little evidence of cream skimming in the Australian health insurance system.

[2] The Australian system does not allow private insurance for costs associated with out of hospital medical consultations or diagnostic tests.

[3] Community rating was somewhat relaxed by a policy change in 2000, which allowed insurers to charge a uniform premium loading for new entrants aged over 30: the premium for each policy was 2% higher for each year older than 30.

Typically several ex ante indicators of risk conditions (demographics, self assessed health, risk behaviours) are used to model the impact of risk on insurance. This approach makes it difficult to disentangle the drivers of risk. Instead we construct an ex post risk measure, an empirical analogue for the risk variable in the Rothschild and Stiglitz (1976) model. Risk is measured by the predicted probability of a hospital admission in the last 12 months. To allow flexibility in the estimated relationship between insurance and risk, we adopt the semi-parametric approach of Yatchew (1997) controlling for many factors including income, education, country of birth, family type, labour market status and region. Contrary to the conventional wisdom about the impact of community rating on risk selection, but consistent with recent studies by Finkelstein and McGarry (2006) and Fang, Keane and Silverman (2008), we find strong evidence of advantageous selection into private health insurance in Australia. This suggests that underlying risk preferences may drive the findings of advantageous selection in health insurance markets.

To explore this further, we investigate individual decisions to purchase different insurance products for which risks are unlikely to be correlated. We estimate a multivariate probit model of insurance demands (health, sickness, home contents, appliance repairs, life and comprehensive car insurance) and risky behaviours (smoking and various forms of gambling). We find large and significant correlations between residuals in the model which suggests that underlying risk preferences are driving the findings of advantageous selection.

2. Theoretical Background

A natural starting point for considering the issue of risk selection in insurance markets is the seminal paper by Rothschild and Stiglitz (1976). In their model, high and low risk consumers are differentiated by a single parameter, the probability of suffering a loss. When insurers can directly observe each consumer's risk type both types will be offered actuarially fair premiums and will choose to fully insure. When a consumer's risk type is private information, the model predicts adverse selection. In the Rothschild and Stiglitz model, the only feasible equilibrium is a separating equilibrium in which high risks purchase a greater quantity of insurance than low risks. This prediction of a positive correlation between risk and insurance coverage is the focus of much of the empirical literature on risk selection. Theoretical models of insurance in the Rothschild and Stiglitz tradition typically impose a single utility

function across risk classes and this excludes correlation between risk preferences and risk class.

The Rothschild-Stiglitz model applies most directly to cases where there is only private insurance and not purchasing coverage is equivalent to self-insuring. In the case of health insurance, this feature fits the US market, where for most non-elderly consumers, private insurance is the only option available. It does not not fit the situation in nearly every other industrialized country, where the public sector is the primary source of health insurance. Olivella and Vera-Hernandez (2006) modify the Rothschild-Stiglitz model to incorporate a public sector that provides partial insurance coverage. They distinguish between two types of private insurance: supplemental, which provides reimbursement for co-payments and services not covered by public insurance, and substitute, which covers the same services as the public program, but provides patients access to more timely care and, perhaps, higher quality. According to their model, the problem of adverse selection is most acute in the latter case. Their model predicts a strong form of separation: high risks will purchase private insurance while low risks will rely entirely on the public system as illustrated in Figure 1.[4]

Figure 1 near here

Different results can arise if individuals differ in their risk preferences. Hemenway (1990) notes that the standard adverse selection prediction can be reversed if individuals who are highly risk avoiding are both more likely to purchase insurance and to take efforts to reduce the risk of experiencing a loss. He gives several examples, such as the case of motorcycle riders. A model assuming that all consumers are equally risk averse would predict that motorcycle riders should be more likely then others to purchase health insurance because they face a greater risk of injury. But, in fact, motorcycle riders are actually less likely to be insured, presumably reflecting a higher than average taste for risk.

In de Meza and Webb (2001) favourable selection can be generated with different risk aversions under imperfect competition. Karagoyozova and Siegelman (2006) allow for flexible correlation between risk aversion and riskiness across a continuum of types and find that an equilibrium with favourable selection requires the insured

[4] Gans and King (2003) modify the Rothschild-Stiglitz model in a similar fashion and obtain comparable results. Finkelstein (2004) provides a good discussion of how the relationship between the coverage offered by public and private insurance can affect risk selection in the private market. Her conclusions are similar to those of Olivella and Vera-Hernandez.

have moderate uncertainty about their own riskiness. Jullien, Salanie and Salanie (2007) develop a model that can imply positive, negative, or (approximately) zero correlation between risk and coverage; a favourable selection requires private risk-aversion and a non-competitive insurance market. Chiappori, Jullien, Salanie et Salanie (2002) develop testable hypotheses in a very general model which requires data on insurance policies and claims.

Another standard assumption in the theoretical literature is that there is a single type of loss against which consumers can insure. In reality, health insurance contracts represent a bundle of reimbursed services. Within certain regulatory constraints, the bundle of services covered and the quality of that coverage is determined by insurers. Frank,Glazer and McGuire (2000) show that when insurers cannot perfectly observe consumer risk types, they have an incentive to engage in service-level rationing: over-providing services that are likely to be used by low risks and skimping on those that tend to be used by high risks. Ellis and McGuire (2007) build on this model by showing how these incentives depend on their predictability (how well the demand for a service can be anticipated) and predictiveness (the extent to which spending on a service is correlated with total spending). They show that when insurers cannot charge risk-based premiums, they have an incentive to under-provide services for which the demand is highly predictable and highly predictive, and over-provide those that score low on both metrics. By altering the mix of services in this way, insurers can counter the tendency toward adverse selection inherent to markets with asymmetric information. Cao and McGuire (2003) find evidence of this type of strategic behaviour by private health maintenance organizations participating in the US Medicare program.

3. Private Health Insurance in Australia

Private health insurance in Australia covers hospital care, including treatment at free-standing same-day facilities and ancillary services, such as dental care, chiropractic treatment and optical services. Private insurance cannot cover outpatient physician services or prescription drugs, which are financed by a universal public insurance program (Medicare) and by direct payments from patients. Government funding for Medicare comes predominantly from general tax revenues although there is a Medicare Levy of 1.5% of taxable income which, in 2003-04, funded 16% federal government health expenditure and 11% of government health expenditure.

Because there are no out-of-pocket costs for treatment of public patients in public hospitals, demand is rationed using waiting lists. As a result, a primary benefit of private hospital insurance is the ability to reduce waiting times by receiving care in a private facility.[5] Private hospitals in Australia tend to be smaller and less comprehensive than public hospitals and tend to focus on elective procedures for which public sector capacity constraints are most severe. For instance, waiting times are particularly long for orthopaedic surgery: in 2004-05 the median time on a public hospital waiting list for knee replacement was 152 days, with roughly one quarter of patients waiting more than a year. In that year, private hospitals performed 70% of all knee replacements. Similarly, private hospitals provide the majority of other procedures with relatively long public hospital waiting lists, such as endoscopy and ophthalmic procedures.[6] It is notable that the types of procedures for which the private sector is the dominant supplier in Australia are ones that score low in terms of Ellis and McGuire's (2007) measures of predictability and predictiveness, and therefore are those likely to attract favourable risks.

Private health insurance contracts must be sold on a community rated basis and no individual can be excluded from the purchase of any offered contract. However, health insurers have flexibility in the way they design their products. Insurers' choices regarding what treatments to cover and how to market different products have implications for risk selection. Some types of care that Ellis and McGuire (2007) find attract high risks, such as hospice and home care, are legislatively excluded from private health cover in Australia. Furthermore, procedures which Australian insurers commonly exclude, such as orthopaedic, ophthalmic and obstetrics procedures attract relatively low risks according to Ellis and McGuire. Most contracts have the option of specified deductibles but no contracts offer coinsurance.

Medical practitioners set their own fees for services to private inpatients. For each item listed on the Medical Benefits Schedule, the government reimburses a fixed amount. For insured patients some part of the gap between the fee and the subsidy is covered by the insurer. In principle, it is possible for patients to face zero gap payments if they choose hospitals and medical providers listed with their insurer.

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[5] Private insurance can also be used in a public hospital to obtain a private room or to ensure one's choice of doctor. However, roughly 80 percent of hospital days reimbursed by private insurance are in private hospitals.

[6] In 2004-05, 74% of same day colonoscopies and 77% of lens procedures were performed privately.

However, providers can choose whether to accept the insurer's payment or to charge a higher fee to the patient on a patient or episode basis. As a result, any private inpatient episode may involve an out-of-pocket gap payment for medical services which can be substantial and unknown prior to admission.

The insurance regulator administers a reinsurance pool which redistributes funds between insurers on the basis of their risk profile determined by the proportion of clients aged over 65 or with hospital stays exceeding 35 days per year.[7] This reduces the incentive to design contracts to select lower risks.

From the introduction of the universal public health system, Medicare, in 1984 there was a steady decline in the proportion of the population with private insurance cover. The decline has been portrayed as an adverse selection death spiral that would impose unsustainable pressures on the public hospital system if it were allowed to continue. (Butler, 1999; Hall et al 1999). To arrest the decline, between 1997 and 2000 the Australian Government introduced a series of incentives for Australians to purchase private health insurance. These policies include an income tax surcharge for uninsured high income individuals and families, a 30% subsidy on health insurance premiums, and selective age-based premium increases for those enrolling after a deadline.

The demand for private insurance has been examined using the ABS National Health Surveys (NHS) undertaken between 1983 and 2001. Prior to the insurance incentives, Schofield et al (1997) find that low income families were most affected by rising premiums but there was also a decline in the proportion of middle income families with private cover. Using the 1989 NHS, Savage and Wright (2003) find a strong association between demand for insurance and income. Barrett and Conlon (2003) test for a change in adverse selection between the NHS surveys of 1989 and 1995. They find adverse selection related to age (a positive age gradient) but mixed results with respect to various measures of health risks.

Ellis and Savage (2008) use NHS 2001 to estimate a model of individual decisions to enroll in private health insurance order to understand the effects of the PHI reforms on the age and income distribution of those with private cover over time. They find that the positive impact of income on private coverage was reinforced by

[7] Changes to the reinsurance arrangements were introduced in 2007.

the insurance incentives. There was also a broadening in the age distribution of private health insurance, suggesting a reduction in adverse selection. Using administrative data Butler (2002) examines the changing age composition of the insured pool following the insurance incentives, and observes that the increasing average age of those insured suggests the possible reappearance of an adverse selection dynamic. Lu and Savage (2006) and Dawkins et al (2004) find little evidence that the policies alleviated the burden of public hospitals. Vaithianathan (2004) argues that the subsidy to health insurance was ineffective, despite community rating, because low risks purchased less cover.

Doiron, Jones and Savage (2008) investigate the relationship between ex ante risk and private health insurance using NHS 2001 and find that conditional on age, people with private cover report higher self-assessed health on average than people without. They investigate the factors responsible for favourable selection and find that those who engage in risk-taking behaviours (especially smoking) are simultaneously less likely to be in good health and less likely to buy insurance.

Fiebig, Savage and Viney (2006) provide evidence on the different motivations that people have for buying health insurance using the 2001 NHS. Very few respondents give reasons that are suggestive of adverse selection. Risk aversion/peace of mind is a more common motivation as are financial considerations especially for those who purchased their cover at the time of the insurance incentives.

There is clear evidence that preferences concerning "substitute" private health insurance are likely to be correlated with income. The main benefits of such coverage are the ability to obtain faster access to health care by avoiding public hospital waiting lists, a higher level of service amenities and, perhaps, a higher quality of care. The fact that the demand for these characteristics is likely to be positively related to income combined with a positive relationship between income and health is likely to contribute to advantageous selection.

4. Estimation

Our analysis proceeds in two stages. First, we use data from the NHS 2004-05 to develop an ex post risk measure and estimate the semiparametric relationship between the probability of having private health insurance and predicted risk. Second, we use data from the HES 2003-04 to estimate a multivariate probit model of insurance

demands and risky behaviours. Our focus is on the correlations between residuals in the model.

To develop our risk measure, the probability of hospital admission in the previous 12 months is modelled using a binary probit regression:

$$R_i^* = \delta' X_i + \varepsilon_i \qquad \begin{cases} R_i = 1 \text{ if } R_i^* > 0 \\ R_i = 0 \text{ otherwise} \end{cases} \qquad (1)$$

where *X* includes demographic and socioeconomic variables, health concession card status, self-assessed health status, risk behaviours and long term conditions. We also include insurance status in the model but exclude insurance when predicting risk class.

We estimate the relationship between insurance status and predicted risk using the semi-parametric approach of Yatchew (1997, 1998). The dependent variable I_i is an indicator variable for individual *i*'s insurance status. The conditional mean insurance probability is a linear regression function of a number of controls, z_i and a non-linear function of the predicted risk for individual *i*, $g(\hat{R}_i)$. The form of the function $g(.)$ is unspecified:

$$E\left[I_i \middle| z_i, \hat{R}_i\right] = z_i\beta + g(\hat{R}_i) + \varepsilon_i \qquad (2)$$

The data is ordered by predicted risk and differencing is used to remove the non-parametric effects of risk. We use 10th order differencing with optimal weights to improve the efficiency of the OLS estimator in the parametric regressions. The parameters, β, of the linear component of the model are estimated on the differenced data. The parameters are then applied to the non-differenced data and subtracted from the insurance dummy. The form of the function between the adjusted insurance and the predicted risk is estimated non-parametrically.

$$I_i - z_i\hat{\beta} = z_i(\beta - \hat{\beta}) + g(\hat{R}_i) + \varepsilon_i \cong g(\hat{R}_i) + \varepsilon_i \qquad (3)$$

The approximation in equation (3) holds because $\hat{\beta}$ converges sufficiently quickly to β.

In the second part of the analysis, we estimate a 12 equation multivariate probit model, by the method of maximum simulated likelihood using the GHK simulator.

The model includes six forms of insurance (health, sickness, home contents, appliance repairs, life and comprehensive car insurance), smoking and five forms of gambling: (lotteries, lotto, off-course horse racing, poker machines and other gambling). The explanatory variables include socio-demographics and expenditures on prescriptions and specialist consultations as indicators of health status. We estimate the off-diagonal elements of the error correlations. The simulated likelihood function for the sample as a whole is then maximized using maximum likelihood

5. Data and results

5.1. National Health Survey 2004-05

The 2004-05 NHS is a representative sample of 19,501 private dwellings across Australia. The survey collected information about health status of the population, including long term medical conditions; health–related aspects of people's lifestyle, such as smoking, exercise and alcohol consumption; use of health services such as consultations with doctors and dentists, visits to hospital; and demographic and socio–economic characteristics. Within each selected household a random sub-sample of usual residents was selected for inclusion in the survey comprising one adult (18 years of age and over) and one child aged 0 – 17 years. A total of 25,906 respondent records (19,501 adult records and 6,405 child records) are included in the data set. From the initial adult sample of 19,501 we delete observations corresponding to persons aged less than 20, dependents, and those with missing information for insurance status. Since we study the purchase of health insurance, it is not appropriate to consider children and other dependents as independent observations, however since dependents are covered by family policies we include family type in the controls. The remaining sample consists of 19,012 observations (8,658 males and 10,354 females).

Table 1 near here

In Table 1 we provide the means for the variables used in the risk model. In the estimation, we split the sample by sex to capture the different profile of risk of hospitalisation by males and females. The table confirms that females are more likely to be hospitalised and slightly more likely to be insured. They are less likely to be overweight or obese and less likely to exercise, indulge in risky alcohol consumption or smoke. They are also more likely to have one or more of a variety of major health conditions. Females are more likely to be in lower deciles of household equivalised

income. The choice to use the decile of equivalised household income was driven by its availability in the data. The OECD equivalent scale was used by the ABS to construct the variable.

In the probit model of risk of hospitalisation we include an insurance dummy variable to capture any moral hazard impact of insurance on hospitalisation. Risk is predicted excluding the insurance dummy. We find for both males and females, that risk is significantly higher for those with worse self-assessed health, high Kessler scores, more long term conditions, or with diagnoses of cancer or heart and circulatory conditions. Diabetes increases risk for males and arthritis has a similar impact for females. The only condition with a negative risk impact is high cholesterol for males. The impact of income unit type is distinctly different by sex: single males have higher risk as do females with a partner and children. The only impact of income is to increase risk for males in lower deciles of equivalent income. (The probit results are available on request.)

Table 2 near here

Table 2 presents the means of selected explanatory variables by quintile of predicted risk, split by sex. For males, the predicted probability of hospitalisation rises from 4.8% in the lowest quintile to 30.9% in the highest quintile. The corresponding risks for women are slightly higher but with approximately the same range. The age gradient by risk is more pronounced for males (from 43% in quintile 1 to 63% in quintile 5). For females the gradient is relatively flat at around 50%. Conditions and self assessed health show the expected relationship across risk quintiles while the commonly found negative gradient of hospitalisation with income is evident for both males and females.

The profile of the semiparametric relationship between private health insurance and predicted risk is shown in Figure 2. The risk densities are shown in the lower part of the figure. This shows the impact of risk after controlling for other factors. In the parametric part of the model, we include variables generally found to be associated with insurance (income, income unit type, education, region and country of birth), a variable for ancillary demand (wearing glasses) and two variables to capture risk attitudes (smoking and checking skin for moles). For both males and females we find

that the independent impact of risk on insurance is negative indicating favourable selection into private health insurance.

Figure 2 near here

One explanation for this result could be the impact of the private health insurance incentives introduced by the government between 1997 and 2000 which encouraged younger, healthier and higher income individuals to purchase insurance. To investigate this we estimate the form of the non-parametric relationship between risk of hospitalisation and private insurance cover in the NHSs of 1989, 2001 and 2004-05. All three show a similar negative relationship, as shown in Figure 3.

Figure 3 near here

To further explore the relationship we use information from the NHS 2004-05 on stated reason for purchasing insurance. Multiple responses are possible and reasons can be classified into four non- mutually exclusive categories (financial, security, choice and health reasons). Table 3 shows that health reasons provide the smallest motivation for insurance purchase for both males and females but, not surprisingly, that those with health reasons have the highest risk of hospitalisation.

Table 3 near here

We re-estimate the semiparametric model separately for each of the four groups. In each case the sample used in the probit model, is the group defined by reason of purchase and the uninsured. Figure 3 shows the impact of risk on insurance for these groups controlling, as before, for other factors impacting in insurance choice. The most distinct result is the adverse selection for the health group. We conclude that the finding of favourable insurance selection overall is because the large majority of people purchasing health insurance are doing so for reasons other than health.

Figure 4 near here

In our estimation, we control for income, age and other observables. What remains are unobservables. For example, if the unobserved factors that make individuals more risk averse lead them to take preventive effort to lower their health risk, we could observe a favourable selection into private health insurance. This is illustrated in Figure 4 for an extreme case where the low risk group are perfectly risk

averse and the high risk group are risk neutral. The setting is a mixed public-private health insurance system.

5.2. Analysis of the Household Expenditure Survey 2003-04

With different forms of insurance, risk of loss is often uncorrelated as, for example, between home contents insurance and health insurance. To explore the role of risk preferences, it is interesting to analyse whether the unobservables that make individuals purchase different forms of insurance are correlated. We investigate this using data on insurance purchases, smoking and gambling behaviours from the Household Expenditure Survey 2003-04. The survey was conducted on a sample of dwellings throughout Australia from July 2003 to June 2004. The 6,957 households excluded non–private dwellings (such as hospitals, institutions, nursing homes, hotels and hostels) and dwellings in collection districts defined as very remote or indigenous communities. Information was collected from all persons aged 15 years and over in the selected household. Personal interviews were conducted and survey participants were also required to record in a diary all their expenditures over a two week period.

Table 4 near here

We select a sample where the household reference person is aged over 19 years. From the expenditure data we create six dummy variables for insurance purchases (positive expenditure), one for smoking (positive expenditure) and five for different forms of gambling (positive or negative expenditures). Table 4 presents data means for the full set of HES variables used in our analysis, for the full sample and separately by private health insurance status. There appears to be a strong association between health insurance purchase and the purchase of other kinds of insurance. For example, while 75% of the sample has home contents insurance, about 90% of those with health insurance also have contents insurance compared with 58% of those without private health cover. There is a very similar relationship for comprehensive car insurance. In contrast, the rate of smoking for households with no private health insurance is almost double that of insured households. There is no relationship between health insurance and gambling behaviours evident in the raw data. Households with private health insurance are more likely to fall in the middle of the age distribution, have higher values of socioeconomic variables and live in cities.

Table 5 near here

Table 5 presents the raw correlations between the indicator variables for risk behaviours. There are high and significant positive correlations between most insurance purchases and smaller significant positive correlations between gambling behaviours. Tobacco consumption forms a link between the two: significant negative correlations with categories of insurance and significant positive correlations with most forms of gambling.

Parameter estimates from the multivariate probit model are presented in Table 6. Expenditures on prescriptions and specialist consultations are included in the health insurance equation as the best available indicators of lower health status. Income positively impacts on all insurance purchases and all forms of gambling except poker machines. Level of wealth increases the probability of purchasing health, life and home contents insurance and lowers the probability of purchasing lotto tickets. Tobacco consumers have lower income and lower wealth.[8]

Table 6 near here

The pattern of residual correlations from the multivariate probit model presented in Table 7 provides insights into the motivations for the behaviours we model. We control for many demographic and socioeconomic characteristics yet a strong pattern of residual correlations remains. We find that unobservable factors generate insurance purchases across a range of insurance products for which the risk of adverse outcomes are unlikely to be correlated. Similarly unobservables that increase the probability of lotto purchases simultaneously increase the likelihood of engaging in other forms of gambling. There are few significant residual correlations between categories of insurance and forms of gambling; in only one case do we find a significant negative correlation (between appliance repair insurance and TAB betting on races). Again the residuals for the tobacco equation have significant negative correlations with most insurance equations and significant positive correlations with the gambling equations. The unobservables that increase the likelihood of smoking reduce insurance purchases and increase involvement in gambling.

[8] We undertake a number of specification tests to establish that the full model is preferred. A test of the 12-equation multivariate probit against 12 individual probit regressions has a LR stat of 1,061, well above the critical test vale. We also test for a block-diagonal specification, comparing the full model to 2 separate 6-equation multivariate probits. The LR stat = 246 and the full model is preferred. We test the full model against a 5 insurance equation and a 7 tobacco and gambling equation. The LR stat = 127 and the full model is preferred.

Table 7 near here

6. Conclusions

In our analysis of the NHS data we find evidence of favourable selection into private health insurance for both males and females. One potential explanation for this is that level of health risk is negatively associated with risk aversion: individuals who are risk averse are more likely to insure and more likely to engage in behaviours that reduce health risk. Models of insurance in the style of Rothschild and Stiglitz (1976) often fail to capture this potential relationship and this contributes to the empirical puzzle of favourable insurance selection.

Because we do not have any direct evidence on individual risk aversion, we attempt to separate risk class and risk preferences using household expenditure data. We estimate a multivariate probit model which includes 6 insurance equations, a tobacco use equation and 5 gambling equations. We find positive and significant correlations between the residuals in the insurance and gambling equations, consistent with a risk preference interpretation for favourable selection. While we find only one significant negative correlation between insurance and gambling, the tobacco equation provides a link between insurance and gambling behaviours: tobacco residuals are negatively correlated with insurance purchase and positively associated with gambling behaviours. Because risks associated with the difference insurance categories are unlikely to be correlated, we interpret our results as providing evidence for the motivating unobservables to be associated with risk preferences. In the Australian setting our results suggest that favourable selection into health insurance is more about risk preferences than selection by insurers. In the absence of data on risk aversion, abstention from tobacco appears to be a reasonable proxy for risk aversion.

Further direct evidence could provide more insights. Individual level data on selected insurance plan, premiums on available plans and claims could be used to test favourable selection using extent of cover (Chiappori, et al 2002, Finkelstein & McGarry, 2003). This is more easily implemented in a setting where there is a strong form of community rating.

There are number of potential policy implications associated with insurance selection. In a Rothschild-Stiglitz separating equilibrium with adverse selection, transfers from low risks to high risks improves welfare. If there is favourable

insurance selection, de Meza & Webb (2001) find that a tax on insurance is welfare improving. Australia provides large premium subsidies for private health insurance (from 30% to 40%). The empirical evidence indicates that these subsidies are directed to higher income individuals with relatively low health risks. Alternative ways of providing subsidies may be welfare improving.

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Table 1: National Health Survey 2004-05 variable means by sex

	Males	Females		Males	Females
hospital admission	0.152	0.191	**BMI<16**	0.001	0.003
insured	0.458	0.461	**BMI 16 to <17**	0.001	0.006
concession card	0.321	0.448	**BMI 17 to <18.5**	0.005	0.026
age 19 to 24	0.071	0.068	**BMI 18.5 to <20**	0.023	0.060
age 25 to 29	0.078	0.077	**BMI 20 to <25**	0.318	0.376
age 30 to 34	0.103	0.097	**BMI 25 to <30**	0.407	0.248
age 35 to 39	0.104	0.105	**BMI 30 to <40**	0.172	0.148
age 40 to 44	0.112	0.103	**BMI 40 or more**	0.012	0.016
age 45 to 49	0.103	0.094	**BMI missing**	0.061	0.117
age 50 to 54	0.090	0.084	**Exercise high**	0.075	0.036
age 55 to 59	0.087	0.082	**Exercise moderate**	0.251	0.228
age 60 to 64	0.075	0.067	**Exercise low**	0.333	0.391
age 65 to 69	0.056	0.056	**Sedentary (very low exercise)**	0.004	0.007
age 70 to 74	0.047	0.057	**Sedentary (no exercise)**	0.336	0.337
age 75 to 79	0.037	0.050	**Exercise missing**	0.000	0.000
age 80 to 84	0.021	0.039	**Alcohol high risk**	0.083	0.032
age 85 or more	0.015	0.022	**Alcohol other**	0.876	0.854
Couple with dependents	0.266	0.240	**No alcohol**	0.041	0.114
Couple only	0.356	0.295	**Current smoker**	0.268	0.207
One parent with dependents	0.023	0.104	**Ex-smoker**	0.375	0.274
One person	0.355	0.360	**Never smoked**	0.357	0.518
Income decile na	0.017	0.038	**At least one smoker**	0.318	0.278
Income decile 1	0.030	0.076	**SAH excellent**	0.178	0.195
Income decile 2	0.068	0.082	**SAH very good**	0.334	0.349
Income decile 3	0.098	0.142	**SAH good**	0.299	0.276
Income decile 4	0.067	0.122	**SAH fair**	0.136	0.125
Income decile 5	0.068	0.114	**SAH poor**	0.053	0.055
Income decile 6	0.083	0.093	**Arthritis**	0.284	0.320
Income decile 7	0.083	0.068	**Asthma**	0.173	0.216
Income decile 8	0.113	0.073	**High cholesterol**	0.049	0.038
Income decile 9	0.156	0.071	**Any heart condition**	0.337	0.436
Income decile 10	0.146	0.040	**Diabetes**	0.064	0.066
Income decile not stated	0.024	0.016	**Osteoporosis**	0.014	0.079
Income decile not known	0.047	0.064	**Cancer**	0.148	0.167
Foreign born	0.274	0.261	**Kessler < 20**	0.845	0.791
Language not English	0.067	0.066	**Kessler 20 to 24**	0.086	0.113
Major city	0.618	0.640	**Kessler 25 to 29**	0.036	0.050
Employed	0.702	0.528	**Kessler 30 or more**	0.033	0.046
			No conditions	0.124	0.087
			Conditions=1	0.185	0.153
			Conditions=2	0.184	0.166
			Conditions=3	0.146	0.145
			Conditions=4	0.112	0.119
			Conditions=5	0.249	0.330

Table 2: Means of selected NHS explanatory variables by sex and quintile of predicted risk

	Males					Females				
	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Predicted risk %	4.8	7.4	10.5	16.1	30.9	6.8	10.9	14.6	19.9	32.5
average age	43.3	42.5	45.7	53.0	63.8	50.6	48.9	50.2	52.1	54.1
% employed	93.0	89.3	83.5	61.3	23.9	84.0	67.9	53.1	38.5	20.4
% major city	70.0	65.0	63.3	58.4	52.5	69.9	67.5	63.6	60.8	58.0
% not english	9.0	6.2	5.2	5.7	7.3	7.7	8.2	5.7	6.0	5.6
% smoker	30.3	32.9	34.6	33.7	27.8	25.0	26.1	26.0	29.0	33.1
% arthritis	6.9	11.7	23.3	37.5	62.2	12.2	20.2	31.2	41.2	54.9
% asthma	7.4	14.5	18.6	22.3	23.5	13.6	18.2	20.5	23.8	32.1
% cancer	0.3	3.6	8.9	19.2	41.7	4.3	8.0	14.0	21.2	36.1
% high cholesterol	8.6	5.1	4.5	3.8	2.3	6.4	4.5	3.3	3.2	1.3
% any heart condition	9.1	16.3	28.5	44.5	69.7	20.1	31.3	44.1	54.7	67.6
% diabetes	0.1	0.6	1.8	5.7	23.6	2.2	3.7	5.8	8.6	12.7
% osteoporosis	0.0	0.2	0.6	1.3	4.9	2.9	4.3	5.5	10.3	16.5
SAH excellent	44.6	24.8	12.9	5.5	1.0	41.1	25.5	15.9	10.6	4.3
SAH very good	49.4	51.4	39.1	21.6	5.8	43.3	44.4	41.2	31.0	14.7
SAH good	5.7	22.6	41.9	50.3	29.0	14.8	27.0	35.3	36.9	24.1
SAH fair	0.2	1.2	6.1	21.7	38.6	0.8	3.1	7.3	20.6	31.0
SAH poor	0.0	0.0	0.0	1.0	25.5	0.0	0.1	0.3	1.0	25.9
Income decile 1	1.7	2.4	2.8	3.5	4.7	2.6	4.6	8.5	9.6	12.7
Income decile 2	0.7	2.8	4.2	8.6	18.0	3.6	5.9	8.4	10.2	13.0
Income decile 3	0.6	2.6	4.4	12.0	29.1	3.5	9.1	13.6	18.5	26.5
Income decile 4	2.4	3.6	5.7	8.7	13.1	4.7	8.3	12.5	16.2	19.6
Income decile 5	5.2	6.5	7.6	7.9	6.9	12.7	13.8	10.8	11.5	7.8
Income decile 6	5.4	9.4	9.9	10.3	6.8	13.0	11.7	9.5	7.1	5.0
Income decile 7	8.1	10.5	10.2	8.4	4.2	7.3	9.0	8.2	6.4	3.2
Income decile 8	10.9	15.8	14.9	10.3	4.6	16.6	8.8	6.6	2.5	1.7
Income decile 9	26.8	19.1	16.8	10.7	4.5	14.5	9.1	6.1	4.3	1.4
Income decile 10	24.0	18.8	15.5	12.0	2.7	6.2	5.7	3.9	3.1	1.1
Income not stated	14.2	8.6	8.0	7.7	5.6	15.4	13.9	12.1	10.6	8.0

Table 3: Reason for insurance purchase and risk of hospitalisation by sex

	Reason for insurance purchase		Risk of hospitalisation	
	Males %	**Females %**	**Males %**	**Females %**
Financial	0.154	0.148	0.106	0.136
Security	0.267	0.261	0.122	0.149
Choice	0.185	0.210	0.126	0.150
Health	0.059	0.072	0.170	0.178

Table 4: Household Expenditure Survey 2003-04 variable means for whole sample and by health insurance status

	All	No health insurance	Health insurance		All	No health insurance	Health insurance
Health	0.529			**Owner without a mortgage**	0.350	0.285	0.408
Sick	0.115	0.068	0.158	**Owner with a mortgage**	0.365	0.286	0.436
Life	0.180	0.114	0.239	**Renter**	0.259	0.400	0.134
Contents	0.746	0.582	0.892	**Other**	0.025	0.029	0.022
Car	0.714	0.584	0.830	**age1924**	0.031	0.053	0.011
Appliance	0.052	0.040	0.062	**age2529**	0.069	0.085	0.054
Tobacco	0.237	0.315	0.167	**age3034**	0.105	0.118	0.093
Lottery	0.050	0.041	0.058	**age3539**	0.126	0.132	0.121
Lotto	0.307	0.271	0.338	**age4044**	0.120	0.114	0.126
TAB	0.029	0.022	0.034	**age4549**	0.093	0.078	0.108
Pokey	0.058	0.061	0.055	**age5054**	0.089	0.073	0.103
Other	0.139	0.122	0.155	**age5559**	0.086	0.069	0.100
income	1.049	0.765	1.303	**age6064**	0.072	0.062	0.082
wealth	4.766	2.473	6.813	**age6569**	0.059	0.053	0.065
cob Australia	0.739	0.715	0.761	**age7074**	0.054	0.058	0.051
cob english speaking	0.114	0.119	0.110	**age7579**	0.053	0.056	0.050
cob other	0.147	0.166	0.129	**age80plus**	0.042	0.050	0.036
0 earners	0.329	0.424	0.244	**nsw**	0.248	0.246	0.250
1 earner	0.341	0.349	0.334	**vic**	0.214	0.223	0.206
2 earners	0.330	0.226	0.422	**qld**	0.131	0.142	0.121
Single	0.296	0.358	0.240	**sa**	0.127	0.124	0.129
Couple	0.335	0.256	0.405	**wa**	0.103	0.100	0.107
Couple with dependents	0.293	0.258	0.324	**tas**	0.083	0.076	0.090
Sole person with dependents	0.076	0.127	0.030	**act-nt**	0.094	0.089	0.098
Number of dependents	0.737	0.777	0.702	**area na (act/nt)**	0.094	0.089	0.098
Male head	0.599	0.557	0.637	**capital city**	0.611	0.574	0.643
				rest of state	0.296	0.336	0.260

Table 5: Raw correlations of risk behaviours (bold indicates significant at 5% level)

	health	sick	life	contents	car	appliance	tobacco	lottery	lotto	tabrac	pokey	gambling
health	1											
sick	**0.141**	1										
life	**0.162**	**0.133**	1									
contents	**0.356**	**0.134**	0.131	1								
car	**0.272**	**0.083**	**0.122**	**0.372**	1							
appliance	**0.048**	**0.047**	**0.047**	**0.060**	**0.048**	1						
tobacco	**-0.174**	-0.010	**-0.057**	**-0.177**	**-0.123**	-0.007	1					
lottery	**0.039**	**0.027**	0.003	**0.042**	**0.050**	**-0.028**	-0.015	1				
lotto	**0.072**	**0.037**	**0.035**	**0.122**	**0.102**	0.016	**0.035**	**0.117**	1			
tabrac	**0.036**	0.007	-0.009	**0.025**	0.018	-0.016	**0.040**	0.009	**0.110**	1		
pokey	-0.013	-0.012	0.014	0.016	0.024	-0.007	**0.068**	**0.087**	**0.131**	**0.088**	1	
gambling	**0.047**	**0.032**	**0.046**	**0.086**	**0.079**	0.005	-0.005	**0.067**	**0.164**	**0.095**	**0.186**	1

Table 6: Estimates from the multivariate probit model (bold indicates significant at 5% level)

	Health	Sick	Life	Contents	Car	Appliance	Tobacco	Lottery	Lotto	TAB	Pokey	Other
income	**0.685**	**0.281**	**0.133**	**0.424**	**0.303**	**0.251**	**-0.204**	**0.375**	**0.131**	**0.439**	0.206	**0.158**
income squared	**-0.052**	**-0.019**	-0.009	**-0.036**	**-0.025**	-0.041	**0.014**	**-0.087**	**-0.029**	**-0.101**	-0.069	**-0.015**
wealth	**0.050**	0.006	**0.006**	**0.016**	-0.001	0.001	**-0.013**	0.007	**-0.025**	-0.009	-0.011	-0.001
prescriptions	0.048											
specialists	**0.273**											
cob english	**-0.139**	-0.057	0.040	-0.067	-0.091	0.105	-0.015	0.089	-0.062	-0.072	0.022	-0.081
cob other	**-0.181**	-0.125	**-0.227**	**-0.439**	**-0.203**	-0.119	**-0.190**	-0.040	**-0.260**	**-0.424**	**-0.467**	**-0.391**
1 earner	**0.416**	**0.450**	**0.288**	**0.239**	**0.431**	-0.003	**-0.184**	0.084	**0.149**	0.167	-0.041	0.091
2 earners	**0.359**	**0.467**	**0.440**	**0.227**	**0.285**	-0.034	-0.133	-0.079	**0.170**	0.194	0.073	0.104
mortgage	-0.083	**0.221**	**0.187**	-0.008	**-0.247**	-0.010	**0.195**	0.109	0.010	-0.061	-0.026	-0.052
renter	**-0.538**	-0.079	-0.021	**-1.359**	**-0.782**	**-0.222**	**0.415**	0.076	-0.111	-0.123	-0.030	-0.124
other tenure	-0.142	0.017	**0.405**	**-1.197**	**-0.398**	0.012	0.210	0.076	-0.030	-0.141	-0.138	-0.102
couple	0.059	0.028	**0.411**	**0.418**	**0.635**	**0.246**	0.063	**0.219**	**0.354**	-0.098	0.085	**0.229**
coupleplus	0.045	0.079	**0.370**	**0.442**	**0.777**	0.113	0.037	0.162	**0.219**	-0.033	-0.162	**0.311**
sole	**-0.336**	-0.179	0.159	0.203	**0.347**	0.095	0.058	0.262	0.134	-0.464	-0.162	-0.029
dependants	**-0.119**	0.051	**0.081**	-0.051	**-0.098**	0.073	-0.016	-0.045	-0.002	-0.058	0.010	0.003
male	**-0.103**	-0.041	0.012	**-0.206**	-0.073	-0.088	**0.127**	**0.169**	**0.103**	**0.324**	0.053	-0.024
age2529	**0.364**	0.375	0.266	0.240	0.119	-0.083	0.152	-0.333	0.154	0.031	-0.195	-0.206
age3034	**0.429**	**0.388**	**0.586**	**0.459**	0.176	**-0.364**	0.068	0.090	**0.415**	0.110	**-0.396**	0.077
age3539	**0.548**	**0.423**	**0.826**	**0.396**	0.045	**-0.345**	0.094	0.001	**0.685**	0.367	-0.035	0.153
age4044	**0.543**	**0.477**	**0.908**	**0.425**	0.055	**-0.344**	-0.018	0.150	**0.685**	0.157	-0.197	0.196
age4549	**0.604**	**0.439**	**0.945**	**0.407**	0.085	**-0.497**	0.037	0.313	**0.889**	0.193	-0.188	0.279
age5054	**0.598**	**0.505**	**1.133**	**0.264**	0.099	**-0.399**	0.146	0.417	**0.932**	0.102	-0.105	**0.400**
age5559	**0.688**	**0.429**	**0.935**	**0.650**	**0.280**	**-0.405**	-0.077	0.412	**1.075**	0.107	-0.072	**0.426**
age6064	**0.729**	0.340	**0.864**	**0.593**	0.235	**-0.714**	-0.171	0.478	**1.141**	0.353	0.096	**0.591**
age6569	**0.921**	**0.667**	**0.883**	**0.653**	**0.398**	**-0.651**	**-0.538**	**0.553**	**1.206**	0.276	0.124	**0.608**
age7074	**0.797**	0.400	**0.796**	**0.793**	**0.425**	**-0.635**	**-0.834**	**0.643**	**1.111**	0.016	-0.255	**0.706**
age7579	**0.875**	**0.556**	**0.745**	**0.859**	0.129	**-1.156**	**-0.972**	**0.563**	**0.977**	0.359	-0.099	**0.551**
age80plus	**0.734**	0.230	**0.655**	**0.687**	-0.236	**-1.345**	**-1.473**	**0.645**	**0.704**	0.142	-0.307	**0.544**
vic	-0.057	**-0.155**	**-0.181**	**0.223**	-0.045	**-0.273**	0.019	**-0.830**	0.097	0.066	**-0.170**	-0.053
qld	-0.045	0.037	0.126	**0.305**	-0.033	0.134	-0.087	**-0.529**	**0.294**	0.043	-0.048	0.038
sa	**0.143**	0.120	-0.081	**0.449**	**0.157**	**-0.354**	-0.031	-0.088	-0.010	-0.040	0.075	-0.099
wa	**0.135**	0.036	-0.027	**0.234**	0.069	-0.169	0.005	**-0.857**	**0.445**	0.064	-4.424	-0.055
tas	**0.220**	0.026	-0.078	**0.462**	-0.067	**-0.269**	0.115	**-0.661**	-0.010	0.065	**-0.279**	0.022
act-nt	**0.212**	0.094	**0.197**	**-0.210**	0.055	-0.018	-0.086	**0.471**	0.099	0.251	0.069	0.033
capital city	**0.235**	**0.217**	**0.301**	**-0.171**	-0.095	-0.074	0.001	**0.681**	0.106	0.294	0.094	**0.213**
constant	**-1.523**	**-2.539**	**-2.767**	0.088	-0.025	**-1.355**	**-0.479**	**-2.723**	**-1.776**	**-2.774**	**-1.421**	**-1.738**

Table 7: Residual correlations from the multivariate probit model (bold indicates significant at 5% level)

	health	sick	life	contents	car	appliance	tobacco	lottery	lotto	tabrac	pokey	gambling
health	1											
sick	**0.125**	1										
life	**0.142**	**0.103**	1									
contents	**0.310**	**0.142**	**0.083**	1								
car	**0.194**	0.053	**0.093**	**0.330**	1							
appliance	**0.076**	**0.100**	0.070	**0.108**	0.072	1						
tobacco	**-0.182**	-0.019	**-0.107**	**-0.177**	**-0.159**	-0.019	1					
lottery	0.037	0.038	-0.012	0.039	**0.078**	-0.078	0.023	1				
lotto	0.041	0.041	0.017	**0.112**	**0.075**	0.048	**0.091**	**0.177**	1			
tabrac	0.054	-0.034	-0.055	-0.009	-0.023	**-0.106**	**0.133**	0.017	**0.289**	1		
pokey	-0.024	0.004	0.038	0.020	0.057	-0.057	**0.195**	**0.168**	**0.320**	**0.206**	1	
gambling	0.010	0.051	0.032	0.053	**0.085**	-0.004	**0.083**	**0.091**	**0.254**	**0.207**	**0.319**	1

Figure 1. Olivella and Vera Hernandez: adverse selection in a mixed public-private health insurance system

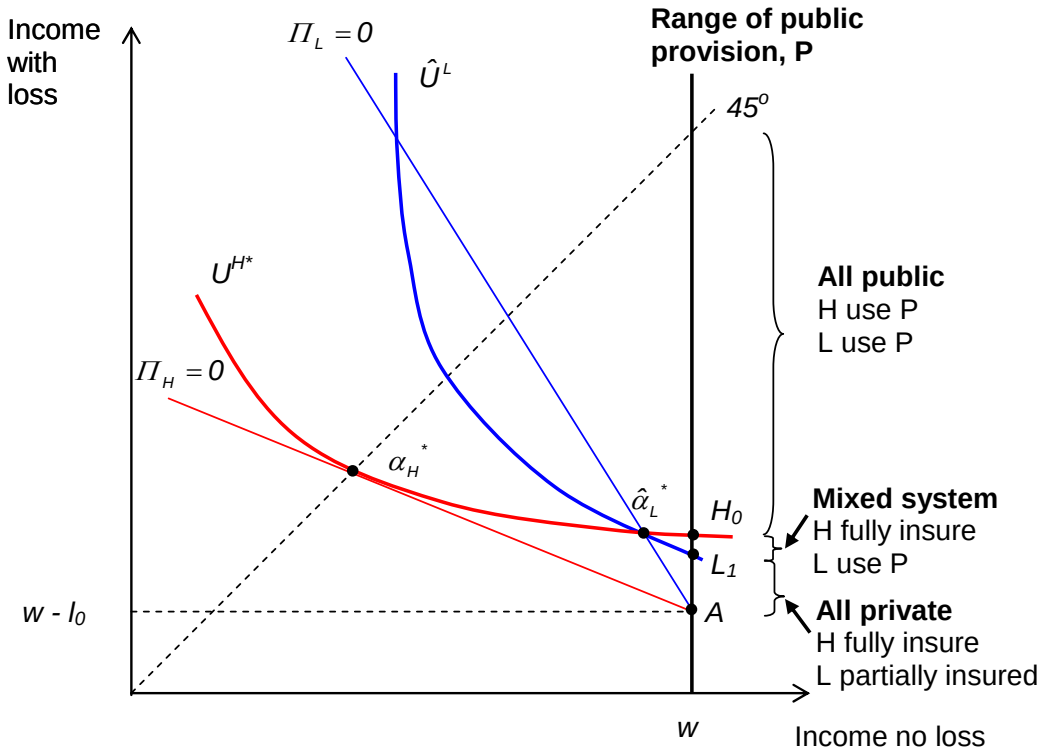
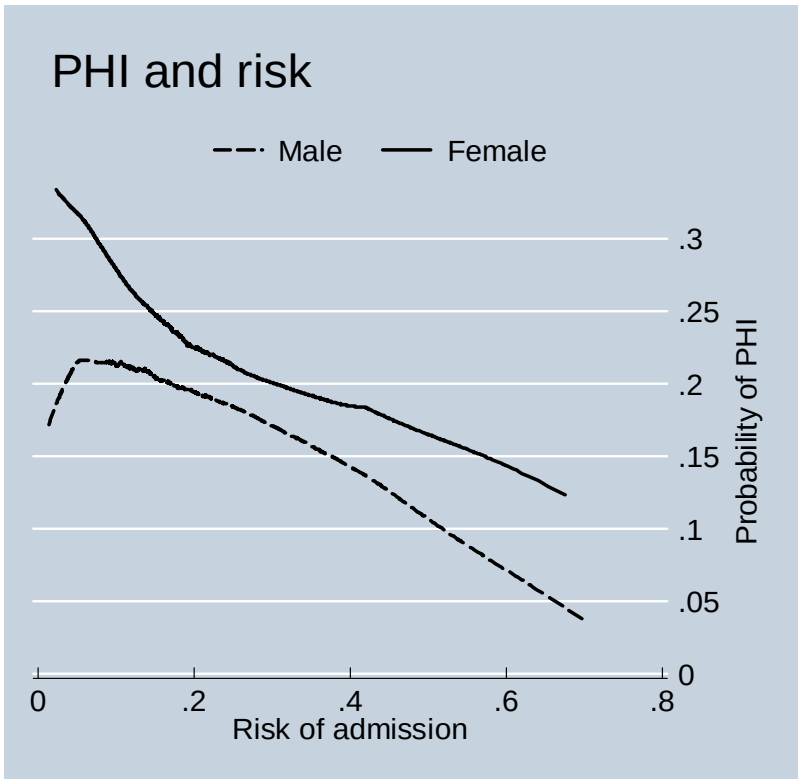


Figure 2. Semiparametric relationship between probability of private health insurance and predicted risk and densities of risk by sex



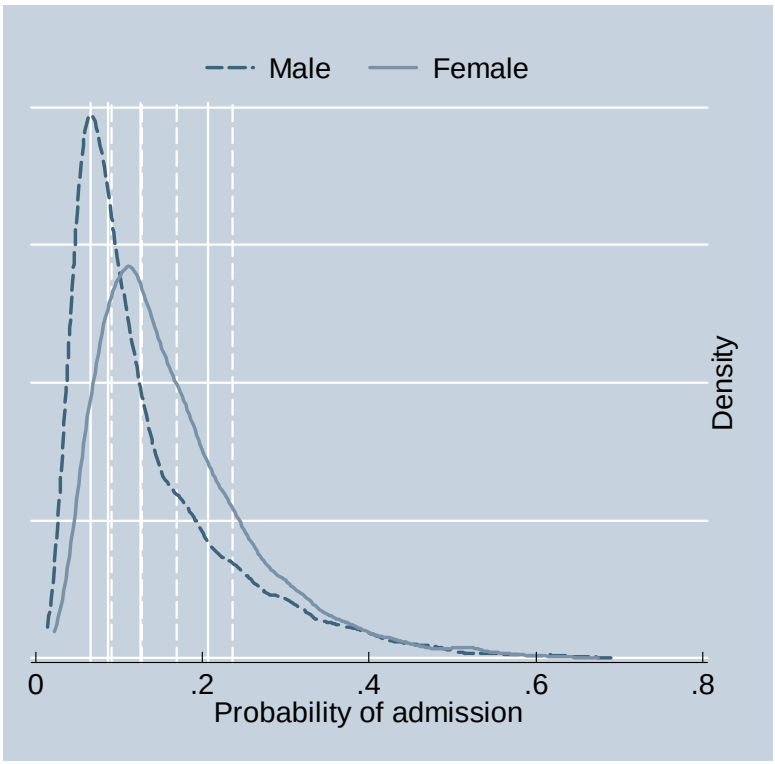


Figure 3. Nonparametric relationship between probability of private health insurance and predicted risk, NHS 1989, 2001, 2004-05

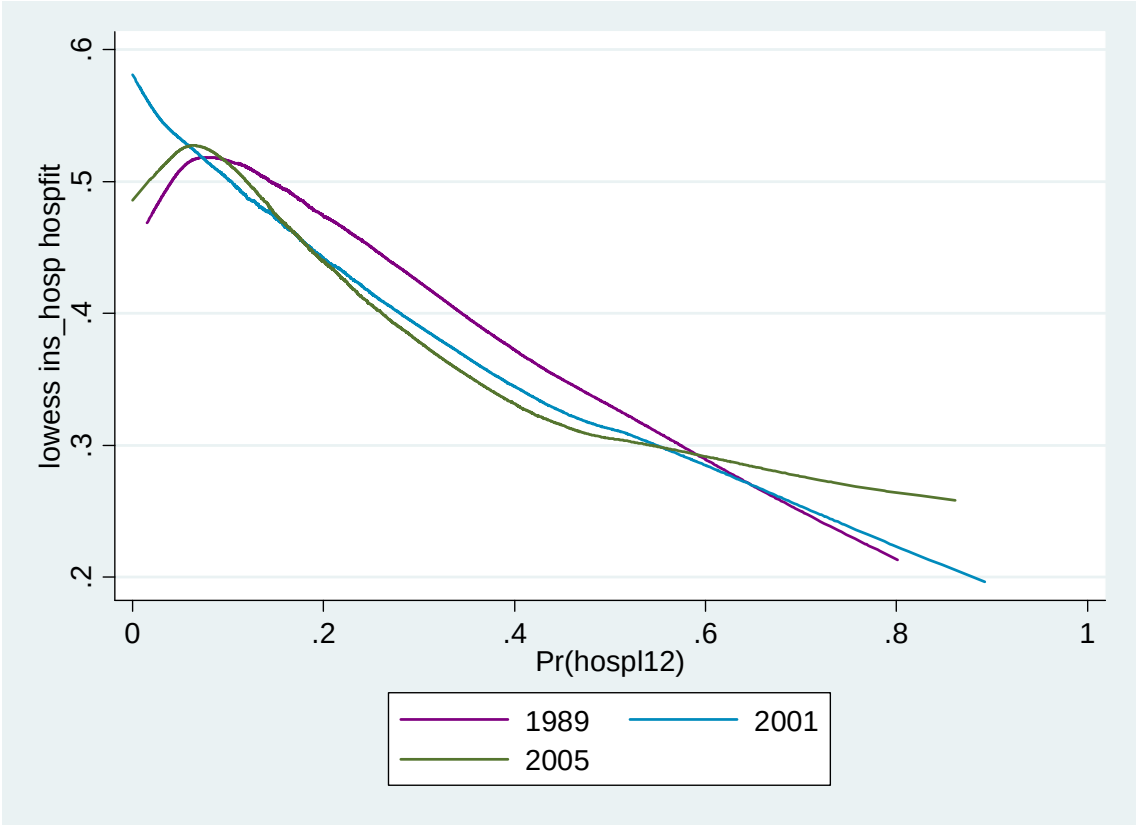


Figure 4. Semi-parametric relationship between probability of private health insurance and predicted risk by reason for buying insurance

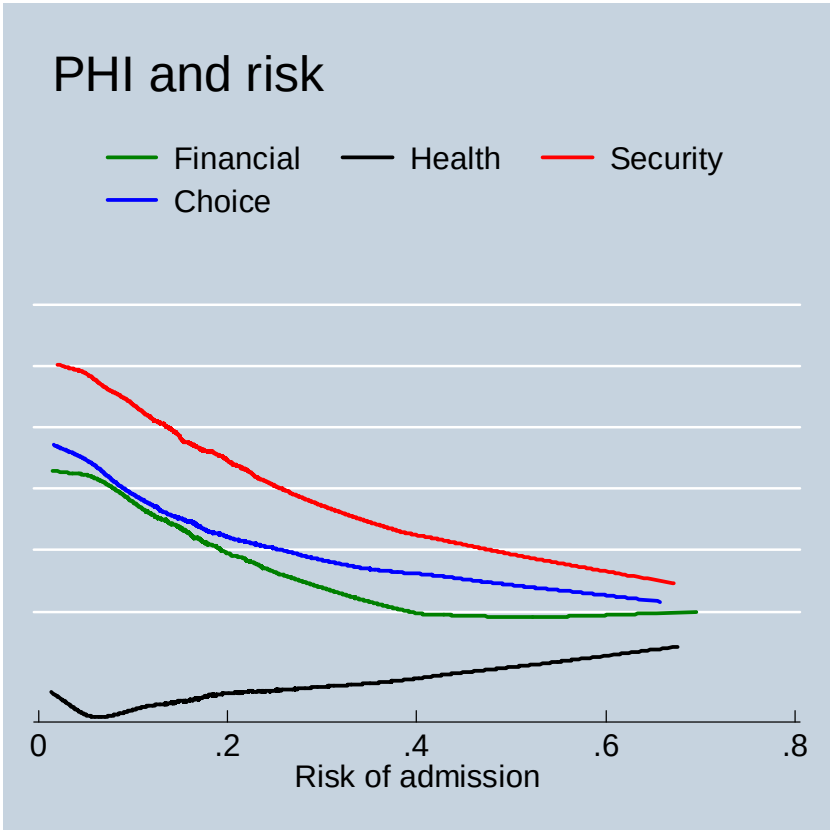


Figure 5. Correlation between risk class and risk preferences (low risk types more risk averse) generates favourable selection into private insurance