Hips and hearts: the variation in moral hazard across hospital procedures*

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This version 30 January 2013

Abstract

The separate identification of effects due to incentives, selection and preference heterogeneity in insurance markets is the topic of much debate and recent research. Results on the presence and magnitude of moral hazard vary a lot across markets and studies, but generally, incentive effects are found in the context of health insurance. In this paper, we investigate the presence and variation in moral hazard across health care procedures. The key motivating hypothesis is the expectation of larger causal effects in the case of more discretionary procedures. The empirical approach relies on an extremely rich and extensive data set constructed by linking survey data to administrative data for hospital inpatient medical records. This enables disaggregated analysis of insurance-utilization relationship for elective procedures such as hip replacements and urgent procedures such as coronary artery bypass graft surgeries (CABG). Using this approach we are able to provide credible evidence of large moral hazard effects but for selected uses only.

*This research uses data from the 45 and Up Study which is managed by the Sax Institute in collaboration with major partner Cancer Council New South Wales; and partners the Heart Foundation (NSW Division); NSW Ministry of Health; *beyondblue: the national depression initiative*; Ageing, Disability and Home Care, NSW Family and Community Services; Australian Red Cross Blood Services; and UnitedCare Ageing. This project was undertaken by the University of Technology Sydney and utilised MBS and PBS data supplied by the Department of Human Services. Data linkage for the project was undertaken by the Centre for Health Record Linkage. The project has ethics approval from the NSW Population and Health Services Research Ethics Committee. The study findings are those of the authors and do not necessarily represent the views of the Commonwealth of Australia, represented in this instance by the Department of Health and Ageing and the Department of Human Services. The project is funded by an ARC Discovery Project grant (DP110100729).

1 Introduction

A relationship between health insurance coverage and health care utilization is easy to establish but more difficult to explain. Observing the typical positive correlation could be the result of adverse selection, where people with high expected usage of health services purchase (more) insurance or it could be moral hazard, where those who are insured face lower costs of health care leading to increased utilization of health services. Findings of negative correlations in certain markets has sparked research focussing on a third source of correlation, namely, that of preference heterogeneity; variation in risk aversion, cognitive skills, or bequest motives has been shown to lead to correlation between insurance purchase and outcomes. Institutional factors also play a role. For example, the information available to insurers and the degree with which they can design contracts based on this information vary substantially across markets and areas. In brief, the sign and magnitude of the correlation between insurance and utilization is an empirical matter and disentangling each of these factors is difficult. It is perhaps not surprising to find quite different net effects both in sign and magnitude across markets and institutional environments. In this paper we focus on a different source of variation, that coming from differential incentives faced by consumers.

Our empirical approach starts with the hypothesis that if moral hazard exists, it will appear differentially across diverse health services. Thus, analyses at an aggregate level such as hospital admissions, which is typical in the existing literature, will likely be subject to aggregation biases and hence mask the true situation. Using an extremely rich and extensive dataset we are able to provide credible evidence of variation in moral hazard effects. The data are constructed by linking a survey of older individuals to administrative data for hospital inpatient medical records. The survey is part of the Sax Institute's 45 and Up Study of over 267,000 residents of the state of New South Wales (NSW) in Australia. These data are sufficiently detailed to allow identification of relatively heterogeneous procedures and with the very large number of observations available there are a sufficient number of procedures to allow credible analyses of the insurance-utilization relationships at a highly disaggregated level. The use of specific procedures allows us to address the issue of heterogeneity in the incentive effects of health insurance on hospitalization. In particular surgeries that are elective or non-urgent such as hip replacements are distinguished from non-elective or urgent procedures such as coronary artery bypass graft surgeries (CABG). As elective procedures are more discretionary in nature, the patient will be much more involved in whether to have the procedure or not as well as when to have it.

Selection and preference heterogeneity remain a threat for the identification and estimation of the causal impact of private health insurance on the demand for surgical procedures. One approach would be to exploit the panel nature of the administrative data, which in the case of hospital admissions, is available from 2000 to 2009. However, the survey was collected only once during this period and this is the source of the insurance status of individuals. Even with the availability of insurance information matching the time period corresponding to the administrative data, the lack of variation in the insurance status of older individuals would likely leave the effect unidentified in any analysis controlling for individual fixed effects.

The predominant approach in separating incentive effects from selection in the literature on private health insurance has been the use of instrumental variables. Finding good instruments has been challenging and in many cases, the identifying instrumental variables have not been convincing nor supported by strong empirical evidence. So while many of the instruments that have previously been used are available in our dataset, we do not actively pursue this approach. Instead, our primary approach is to exploit the rich set of controls we have at our disposal, including extensive self-reported health measures obtained from the survey as well as past health care utilizations obtained from the administrative data. Thus, selection effects are dealt with by the use of proxies that form a comprehensive picture of an individual's health status and history thereby minimizing the likelihood of any omitted health effects being a threat to inference. Some support for our approach is provided by Buchmueller et al. (2005) in their survey of the insurance-utilization relationship in health. They do not find large differences in inferences across different econometric methods and they conclude that: "(...) there is a high degree of concordance among the results of studies that use extensive health status controls and demographic variables to control for the nonrandom assignment of insurance status and those using instrumental variables or quasi-experimental regression techniques."

As for the potential confounding effect from preference heterogeneity, we follow most of the literature by using controls representing variation in demographics, socio-economic status, and risk behaviors. It is still possible for heterogeneity in cognitive skills or risk preferences to be impacting on the estimated moral hazard effect, but the robustness of our results to a broad range of specification checks involving controls for preference heterogeneity and the fact that our sample is fairly homogenous to begin with will mitigate this impact.

The empirical results provide strong evidence of moral hazard; insurance has large effects on elective surgeries and the effects are precisely estimated. More specifically, insurance increases the probability of having an elective surgery by 1.26 percentage points, which

corresponds to a 32 percent increase from the mean. The estimated insurance effect on non-elective surgeries is smaller in magnitude and only marginally statistically significant. Once we control for the full set of available health related measures, we find no statistically significant impact of insurance on hospitalizations for non-elective procedures. This can be treated as a falsification test since we argue that the relationship between insurance and utilization should be weaker for the non-elective surgeries than for the elective surgeries.

2 Background

2.1 Literature review

The case for incentive effects in the case of health insurance is arguable since health care may be perceived to be unpleasant and only to be sought in cases of necessity. Nevertheless, it is now generally accepted that health insurance has some causal impact on health care utilization. As stated by Pauly (2006):

"there is one thing we do know: people do not just use medical care based on how sick they are and what doctors order is not just based on their medical training; in both cases, insurance matters."

Studies analyzing the effects of insurance on utilization span many different countries and different institutional environments. Empirical studies generally find positive correlations. However, there have been few large-scale health insurance experiments (the RAND experiment of the mid 1970's and the recent Oregon experiment), and the separation of causal effects has relied in many cases on exclusion restrictions that may be problematic (for example, socio-economic variables affecting utilization only through insurance in studies with coarse information on health). The use of program changes in health insurance as natural experiments have also been widely applied in various contexts. Examples of studies estimating causal effects are: Ettner (1997), Harmon and Nolan (2001), Vera-Hernandez (1999), and Jones et al. (2006). Examples based on natural experiments are: Card et al. (2009), Decker and Remler (2004), McWilliams et al. (2007), Remler and Atherly (2003), Currie and Gruber (1996), Ketcham and Simon (2008), Currie and Fahr (2005), Anderson et al. (2012), Grignon et al. (2008), Hullegie and Klein (2010), and Stabile (2001). Studies using panel data that control for unobserved fixed effects are less common but include the recent work of Bolhaar et al. (2012) for Ireland where they find no evidence of moral hazard.

In their survey, Buchmueller et al. (2005) concentrate on US studies and do not find large differences in inferences about the insurance-utilization relationship across different econometric methods. This suggests that variation in institutional contexts may be driving differences in empirical estimates. One other potential reason for the variation in estimated causal effects is the likely heterogeneity in impacts across types of medical problems and the amount of discretion the patient has. Due to data limitations, existing studies of the causal effects of insurance on health care have used aggregate measures of utilization and so cannot distinguish between the different incentives across types of care. (One exception is the distinction between GP and specialist care; e.g. Jones et al. (2006).) Furthermore, aggregation weights and characteristics of the relevant population are likely to vary across institutional environments in ways that may reinforce the aggregation bias. To our knowledge, this paper is the first to study the variation in incentive effects of health insurance across the different types of hospital care.

Much of the recent empirical literature on insurance markets generally has focused on the presence of asymmetric information and selection effects. Interest in this literature was sparked by findings of advantageous selection in particular insurance markets. See Fang et al. (2008), Cohen and Einav (2007) and Finkelstein and McGarry (2006) for examples and Cohen and Siegelman (2010) for a survey. Heterogeneity in preferences is believed to lead to advantageous selection in certain markets; depending on the context, this heterogeneity in preferences can take the form of variation in risk aversion, cognitive skills or utility of wealth. Certain recent papers have focussed on the separation of the distributions of risk types from preference types and the estimation of correlation in these marginal distributions. This requires more stringent structural assumptions, but the argument is that identification of these distributions is needed for welfare analysis. See Einav and Finkelstein (2011) and Einav et al. (2010) for a discussion of this area. In most of these studies, moral hazard is ignored in order to focus on the identification of the two other sources of correlation between insurance and outcomes. (An exception to this is the paper on health insurance by Cardon and Hendel (2001).)

Previous Australian studies looking at the effects of insurance on utilization have generally found positive effects although the magnitudes vary a lot across studies. This is perhaps not surprising given the variety of identification strategies used. Lu and Savage (2006) and Savage and Wright (2003) consider selection on observables only. Several studies have used instrumental variables to separate causal effects from selection. Examples include Cameron et al. (1988), Cheng and Vahid (2011), Doiron (2012) and Srivastava and Zhao (2008). Most of these studies rely to some extent on exclusion restrictions involving socio-economic or demographic variables and in some cases risk behaviors (smoking).

Doiron (2012) is an exception to this; she looks at the effects of private health insurance on hospital utilization for couples only. The identification strategy relies on the exclusion of partner's health and expectations regarding future children in one's hospital use (conditional on one's health and actual children).

2.2 The Australian institutional environment

Australia has a health care system that is a mix of public and private funding and delivery. Medicare is a universal public insurance system which provides all Australian citizens with free public hospital treatment and subsidized out-of-hospital medical services and pharmaceuticals. In addition to this public insurance, there exists a private health insurance sector. Patients covered by private insurance have access to private hospitals and private treatment in public hospitals. Individuals without private cover can also access private hospitals as self-funded patients. Private patients have choice over their medical provider and typically face shorter waiting times for many procedures. When they are admitted, individuals with private cover choose to use their insurance and be admitted as a private patient or not (remain a public patient). Public patients treated in public hospitals can face long waiting times and forego the choice of medical provider, they are treated by specialists paid by the hospital and do not have access to a private ward. Hospital insurance is duplicate in that it can be used to fund hospital costs that are also provided free-of-charge in the public system. It is also complementary in that it can be used to cover excess medical fees over the legislated Medicare subsidy.

Private health insurance can also be used to cover other procedures and items such as prostheses and ancillary services which include dental care, allied health services, and complementary care. Most individuals who purchase private health insurance buy hospital cover and may or may not purchase cover for ancillary services. Less than 5% of the insured have cover for ancillaries only. In this paper we consider hospital insurance only and if individuals do not have hospital cover they are considered as uninsured.

Two features of the Australian setting help simplify our analysis. First, private health insurance is not tied to employment as it is in the US. This makes the modeling of the demand for insurance easier since accounting for selection into employment and employer-provided insurance cover is not needed. Second, the system is community-rated; insurers cannot refuse to insure or adjust premiums based on individual characteristics including any past usage of medical services. There are two exceptions to this: premiums increase by a fixed amount of two percent per year of age for $30 \leq$ age ≤ 65 for those who purchased private health insurance after 2000, and insurers can impose waiting times of up to a

year for insurance claims involving pre-existing conditions. Community rating implies that providers have limited opportunities to exclude or separate different risk types. Since insurers cannot base provision or features of the insurance contract on personal characteristics, the relationship between observed characteristics of the consumer and the decision to purchase insurance reflects consumer preferences and information rather than insurers' reaction to potential adverse selection. It is worth noting that in such a system, we expect adverse selection to be greater both because of community rating and due to the presence of a universal public insurance system (Vera-Hernandez 1999).

Despite being limited largely to covering private in-hospital treatment and the availability of high-quality free public hospitals, coverage of private health insurance in Australia has been high. A common argument presented by Australian policy makers is that a well-functioning private system is needed for the sustainability of a high-quality public system. Policy initiatives implemented around the year 2000 have created incentives for individuals, especially those with higher incomes to purchase private health insurance. But for the period under study the institutional environment remained stable and no major reforms were implemented. For additional details on the Australian private health insurance system, please see Colombo and Tapay (2003).

3 Empirical strategy

The aim of this paper is to identify the causal effects of private health insurance on the demand for elective and non-elective surgeries. To disentangle these effects from selection and preference heterogeneity, we need to control for the confounding variables that may affect both the demand for private health insurance and the demand for surgeries. The baseline specification of the model is given by:

$$\begin{aligned} s^*_{ijt} &= \alpha PHI_{i,t-1} + X'_{i,t-1}\beta + u_{ijt}, \\ s_{ijt} &= 1[s^*_{ijt} > 0], \end{aligned} \tag{1}$$

where subscript t refers to the time period, j indicates the type of a surgery (elective or non-elective), and i refers to an individual. The variable s^*_{ijt} is the net benefit associated with having a surgery, which is unobserved. Instead, we observe s_{ijt}, that is, whether or not a person has a surgery in period t. This variable takes the value 1 if the net benefit s^*_{ijt} is positive and the value 0 otherwise. We assume that the error term u_{ijt} follows a standard normal distribution and estimate equation (1) by probit regression.

An encounter with the health care system may affect an individual's demand for private health insurance, leading to a simultaneity bias. To account for this possibility, we estimate a prospective model. More specifically, the coefficient α measures the effect of having private health insurance in period t on the probability of having a surgery in the next period. The vector $X_{i,t-1}$ contains three types of variables, measured at the same time as an individual's private health insurance status:

1. health measures,
2. risk preferences (proxied by risk behaviors), and
3. socio-economic and demographic characteristics.

The argument underlying adverse selection in insurance markets is that the demand for insurance is positively correlated with the expected health costs or usage in the next period; this is related to the health state in the next period which in turn is positively related to an individual's health in the current period. Therefore, if one fails to properly control for an individual's health status (and in the absence of excluded instrumental variables), the positive coefficient on the insurance status variable cannot be convincingly interpreted as a causal or moral hazard effect of insurance.

On the other hand, we expect an individual's demand for private health insurance to be positively correlated with his/her level of risk aversion. More risk averse individuals may also invest more in their health and, in turn, be in better health and have lower need for a surgery. Thus, omitting controls for an individual's risk preferences from equation (1) may lead to under-estimation of the insurance effect.

Socio-demographic characteristics such as age, sex, education, and income, are included in the model, as they may be correlated with an individual's risk type, or preference type, or both. Additionally, employment status can act as a proxy for the opportunity costs associated with a surgery, which will be higher for employed people compared to the unemployed and those not in labor force.

Our survey data set contains an extensive list of self-reported health measures. Nevertheless, to check on the sensitivity of our results to potential omitted variables, we include in the regressions past health care utilization, which is obtained from the administrative data. These variables act as additional proxies for an individual's health status.

As mentioned above, we expect to find stronger evidence of moral hazard in the demand for elective surgeries than in the demand for non-elective procedures. For this reason, we estimate equation (1) separately for selected elective and non-elective surgeries. As a sensitivity check, we also estimate the effect of private health insurance on the probability

of having an emergency hospitalization. As in the case of non-elective surgeries, we expect no causal effect of private health insurance on emergency hospitalizations. A patient can receive emergency treatment irrespective of his/her private health insurance status and has limited discretion in the decision regarding his/her admission to hospital in emergency situations.

4 Data

We use a rich dataset constructed by merging survey data with administrative medical records. Access to these data enables us to control for many variables that are usually unobserved. The survey data come from the 45 and Up Study, a survey of over 267,000 individuals 45 years of age or over, who were randomly selected from the residents of New South Wales (NSW), the largest state of Australia. The sampling frame includes all individuals in the target age range who were covered by Medicare, Australia's universal public health insurance program. Medicare covers all Australian citizens and permanent residents. Mail questionnaires were used to collect information from the participants. Recruitment in the study started in early 2006 and the final questionnaires were received in the beginning of 2010, but most of the questionnaires were completed in 2008. Around 18 percent of those sent questionnaires participated and the full sample includes around 10 percent of the eligible population (45 and Up Study Collaborators 2008). The 45 and Up Study provides information about the respondents' socio-demographic characteristics, retirement status, lifestyle, diet, social connections, mental health, physical limitations, medical conditions, surgical procedures, medications, and other health related factors.

The 45 and Up Study data, with the consent of all the participants, are linked to the respondents' medical records. More specifically, we have information on the respondents' hospitalizations, emergency department visits, and the use of medical services and prescription medicines. For this analysis, we mainly use the hospitalization data that come from the NSW Admitted Patient Data Collection and cover all hospital admissions of the sample individuals from 2000 to 2009. Admissions to public and private hospitals and day procedure centers are included in the data. Detailed information is provided on each admission, including information about the hospital, the exact time and date of admission and separation, length of stay, diagnosed conditions and performed procedures.

The NSW Emergency Department Data Collection provides information on all the emergency department visits made by the sample individuals from 1 July 2005 to 31 December 2009. Information on the name of the hospital, exact time and date of the visit, type of

the visit (emergency, planned, return, outpatient, or pre-arranged), triage category, and departure status (whether a person was admitted to hospital, received treatment, left without receiving a treatment, or died), and other details of the visit are available. The Medicare Benefits Schedule (MBS) and Pharmaceutical Benefits Scheme (PBS) datasets provide information about an individual's use of medical services, including general practitioner and specialist visits and diagnostic tests, and prescriptions medicines. At least five years of data are available for all the respondents, starting in September 2005 and ending in August 2010.

The initial sample contained 266,804 individuals. The criteria for the inclusion of observations in the analysis sample are as follows. First, we exclude individuals who were not chosen but volunteered to participate in the 45 and Up Study, as they may introduce selection bias (0.5 percent of the observations). Second, a small number of invalid records, (individuals younger than 45 years of age) are excluded from the sample (22 observations). Third, only individuals interviewed in 2006-2008 are used for the analysis, because we are estimating a prospective model and hospitalization data, which is used to construct the dependent variables, ends in 2009. Thus, 3,604 individuals (1.4 percent) who completed the survey in 2009 and 2010 are excluded. Finally, the analysis sample excludes the observations that have missing data on any of the main variables. Given a large number of controls, this excludes quite a large number of observations (25.9 percent). The only exception is the income variable. To increase the sample size, individuals who refused to report their household income were not excluded from the sample, but a dummy variable for missing income was included in the regressions. The final analysis sample contains 192,638 observations. Most of the sample individuals completed the survey in 2008 (78.8 percent) or 2006 (13.8 percent).

4.1 Variables

4.1.1 Dependent variables

The dependent variables used in the estimations of equation (1) are constructed using the hospital admission data. For each admission, the principal procedure performed on the patient is recorded. All surgical procedures performed in Australian hospitals are classified into emergency that need to be performed within 24 hours and elective (planned or booked) that can be postponed for at least 24 hours or more. Patients that need an elective procedure are placed on a waiting list and assigned one of the urgency categories by their doctor. In NSW, the following four categories are used (Baggoley et al. 2011):

1. Admission within 30 days desirable for a condition that *has the potential* to deteriorate quickly to the point that it may become an emergency (urgent);
2. Admission within 90 days desirable for a condition which *is not likely* to deteriorate quickly or become an emergency (semi-urgent);
3. Admission within 365 days acceptable for a condition which is *unlikely* to deteriorate quickly and which has little potential to become an emergency (non-urgent); or
4. Patient is either clinically not ready for admission (staged) and has deferred admission for personal reasons (not ready for care).

As the urgency of the procedure depends on the health condition of the patient, the same procedure may be considered to be non-urgent in one case and semi-urgent or urgent in another case. For example, around 50 percent of the patients admitted for inguinal herniorrhaphy (hernia repair) have been assigned urgency category 3 and the remaining half were assigned category 1 or 2 (Australian Institute of Health and Welfare 2012*b*). The same is true for such procedures as cystoscopy, haemorrhoidectomy, and hysterectomy. Nonetheless, some procedures are usually classified either as urgent, or semi-urgent, or non-urgent. For example, most patients admitted for knee replacement have been assigned urgency category 3 (Australian Institute of Health and Welfare 2012*b*).

We begin with the case of elective procedures. Our definition of an elective surgery includes non-urgent elective procedures (category 3). Among the most common elective surgeries performed in NSW hospitals, the following procedures are usually considered to be non-urgent (the number in the parentheses indicates proportion of patients admitted for a given procedure that have been assigned urgency category 3) (Australian Institute of Health and Welfare 2012*b*):

- septoplasty or nasal surgery (88%),
- total knee replacement (87%),
- myringoplasty or eardrum surgery (86%),
- cataract extraction (85%),
- varicose vein stripping and ligation (79%),
- tonsillectomy or tonsil removal (73%), and
- total hip replacement (71%).

Additionally, we have added excision of skin lesion to the definition of an elective surgery, as it is also a common procedure, which is likely to be non-urgent, that is, fall in category

3 (Australian Institute of Health and Welfare 2012*a*). We construct a binary variable that takes the value of one if an individual had any of these procedures in the *12 months* following the survey date and the value zero otherwise.

It would interesting to look directly at the impact of insurance on waiting times as jumping the queue is one of the usual reasons given for insurance purchase in Australia. Unfortunately, we do not observe when patients were placed on the waiting list. Also, most of the non-urgent procedures (88.9 percent) are performed within 365 days in NSW hospitals (Baggoley et al. 2011). Therefore, a difference in the proportion of people who had an elective surgery within 12 months between the insured and uninsured is not likely to capture differences in waiting times. Nonetheless, as a sensitivity check we also estimated an effect of private health insurance on the probability of having an elective procedure within the next *24 months* from the survey date and found very similar results. In the NSW hospitals, almost all (99.9 percent) of non-urgent surgeries are performed within 24 months from the date a patient is placed on the waiting list (Baggoley et al. 2011). We could only use individuals who completed the survey in 2006 and 2007 for this purpose.

Next, we turn to the description of non-elective procedures. In our analysis, a non-elective procedure refers to an emergency, urgent, or semi-urgent surgery. The most common emergency procedures are appendectomy and coronary angioplasty (Australian Institute of Health and Welfare 2012*a*). Among the most common elective procedures, the following are generally classified as urgent or semi-urgent (the number in parentheses indicates the proportion of patients admitted for a given procedure that have been assigned urgency category 1 or 2) (Australian Institute of Health and Welfare 2012*b*):

- coronary artery bypass graft ($59 + 36 = 95\%$),
- cholecystectomy or removal of the gall bladder($14 + 56 = 70\%$), and
- myringotomy or repair of the perforated drum($13 + 55 = 68\%$)[1].

The constructed binary variable takes the value one if an individual had one of these procedures in the 12 months following the survey date and the value zero otherwise.

We also construct a binary variable that indicates whether or not an individual had an emergency hospitalization within the 12 months following the survey date. A hospitalization is defined to be emergency if a patient was admitted to the hospital via the emergency department (ED). To construct this variable, we merge the hospital admis-

[1]Prostatectomy is also an urgent or semi-urgent procedure in most cases, but it only is performed on men. Therefore, we do not include prostatectomy in the definition of a non-elective procedure.

sion data with emergency department visit data (by personal identification number and date). More specifically, we define a hospitalization to be emergency if a patient made an ED visit on the same day as he/she was admitted to the hospital[2]. If a patient made a planned, return, outpatient, or pre-arranged visit to the ED on the same day as he/she was admitted to the hospital, such hospitalization is not considered to be emergency. We also take into account the possibility that a patient visited the ED on one day and was admitted to the hospital on the next day. Thus we also define a hospitalization to be emergency if a patient had an ED visit on the previous day, provided that the ED record indicates that the patient was subsequently admitted to the hospital and the ED visit was not planned. This adjustment does not affect the results.

Table 1 presents the descriptive statistics of the variables described above. Around 4 percent of the analysis sample (7,526 individuals) had at least one of the above listed elective procedures within the 12 months following the survey date. Some of these individuals had more than one surgery. Therefore, the total number of the procedures is higher (9,235). The most common elective procedure is cataract extraction, closely followed by skin lesion removal. Slightly under 1 percent of the sample had their knee or hip replaced. The other elective procedures are less common. Less than 1 percent of the sample had one of the non-elective surgeries described above within one year of the survey date. There were 1,165 such surgeries performed within a year from the survey date on 1,136 patients. The most common procedure was gall bladder removal, followed by coronary artery bypass graft surgery, and coronary angioplasty. A larger proportion of the sample (6 percent) had an emergency hospital admission. The relatively small incidence of specific procedures highlights the need for large samples in this type of analysis.

4.1.2 Explanatory variables

They key variable of interest is an individual's private health insurance status. People self-report their health insurance status in the 45 and Up Survey. We construct a variable that takes the value one if an individual has private health insurance (with or without ancillary service coverage) and zero otherwise. More than two thirds of the sample (67.35 percent) reported having private health insurance cover. As mentioned in Section 3, the baseline model controls for three types of variables that are expected to affect an individual's demand for an elective and/or non-elective surgery and may also be correlated with

[2]Note that some patients have multiple hospital admissions per day. If a patient visited the ED only once on the same day, only one of these hospital admissions may be emergency. In such cases we over-count emergency hospitalizations. Nonetheless, these cases do not affect our results, as we only analyze the effect of private health insurance on the probability of having an emergency hospitalization, not the number of emergency hospitalizations.

his/her health insurance status. First, we control for socio-economic and demographic characteristics, including sex, age, marital status, remoteness[3], country of birth, ancestry, language, education, income, and employment status. We also include the type of housing, which acts as as a proxy for wealth, and the SEIFA Index of Relative Socio-economic Advantage and Disadvantage, which measures the socio-economic status of the population in an individual's local area[4].

The descriptions and means of the socio-economic and demographic variables are presented in Appendix A Table 7. People who have private health insurance are slightly younger, are more likely to be currently married, live in less remote regions, are more likely to be Australian born, are less likely to speak another language than English at home, have higher level of education, have more wealth as measured by housing type, have higher income, live in wealthier areas (as measured by SEIFA index), and are more likely to be employed than people without private health insurance. These differences are as expected and consistent with the findings in the literature.

Second, we control for a number of self-reported subjective and objective health measures. The subjective measures include self-assessed health status and eyesight. The latter may affect the probability of needing a cataract extraction surgery. As to the objective measures, the 45 and Up Study includes questions on whether an individual has been ever diagnosed with most common chronic conditions and if he/she has been recently treated for certain conditions. Both sets of variables are included as they can have a differential effect on the need for a surgery. The baseline specification also includes a dummy for having a long term illness/disability, a measure of physical functioning (The Medical Outcomes Study - Physical Functioning scale), body mass index, and dummies for taking vitamines/supplements and selected medicines. Some of these variables may indicate a higher need for some of the surgeries. For example, having been diagnosed with arthritis increases the probability of needing a hip or knee replacement. Lower physical functioning scores may also signal a need for knee/hip replacement. Having been previously diagnosed with or recently treated for melanoma or skin cancer is expected to increase the probability of having a skin lesion removal surgery. Other conditions may prevent a person from having such operations. For example, a person who has recently been treated for heart disease, may not be fit for some of the more complicated procedures, such as hip replacement. The participants are also asked about their history of operations, including knee and hip replacements. People who had a previous knee/hip replacement operation may not need to have it done again. On the other hand, prior

[3]Remoteness is measured by the Accessibility/Remoteness Index of Australia Plus (ARIA+). More details on this index are available in Trewin (2001).

[4]For more information on the SEIFA indexes please see Pink (2006).

operation of one knee or hip may indicate health problems and increase the probability of future operations.

The full list, descriptions, and means of the subjective and objective health measures are provided Appendix A Table 8 (panel A). Individuals with private health insurance rate their health as better than individuals without insurance, which is consistent with the findings of the literature (Doiron et al. 2008). Moreover, insured individuals also seem to be generally healthier in terms of the objective measures of health than the uninsured. Individuals who have health insurance are less likely to have been diagnosed with and/or recently treated for such chronic conditions as diabetes, Parkinson's disease, and depression. People with private health insurance also have less physical activity limitations, lower BMI, and are less likely to be disabled than people without health insurance. The insured are less likely to take selected medications, but more likely to consume vitamins and supplements than the uninsured. Vitamin and supplement consumption may be associated with higher risk aversion rather than with health problems. More importantly, the health problems that may be associated with a higher need for some of the elective or non-elective surgeries are negatively correlated with the probability of having private health insurance. Insured individuals are less likely to have been diagnosed and/or treated for heart disease, high blood pressure, stroke, blood clot, high cholesterol, osteoarthritis, and osteoporosis in the last month than uninsured individuals. The only exception is skin health problems. Insured individuals are more likely to have been diagnosed with skin cancer and had skin cancer removal operation in the past. All in all, there seems to be advantageous selection on both subjective and objective health. But these relationships are just correlations. We investigate this issue further in the next section.

Additionally, we include variables that may increase a risk of developing a condition requiring one of the above described surgeries. More specifically we control for an individual's skin color, which may be associated with the demand for the skin lesion removal procedure, and family history of the diseases that may affect the need for some of the surgeries. These diseases include melanoma, arthritis, osteoporosis, and hip fracture. Panel B of Table 8 provides the means of these variables. The distribution of skin color among the insured is similar to the distribution among the uninsured. However, there are some differences in the family history variables between the two groups. Insured individuals are less likely to have a sibling or parent diagnosed with arthritis, which is consistent with the lower prevalence of arthritis among the insured. Interestingly, an individual is more likely to have insurance if his/her parent has had melanoma, osteoporosis, or hip fracture, but is less likely to be insured, if his/her sibling has had any of these conditions.

Finally, we add variables that act as proxies for an individual's risk attitudes. These variables include lifestyle factors, that is, alcohol consumption and smoking. Panel C of Table 8 shows that people who have health insurance are less likely to smoke either now or ever, but they consume more alcohol than people who do not have private health insurance. The latter finding may be explained by the mixed findings on the benefits and risks of alcohol consumption. Additionally, dummies for having had a prostate/breast cancer test and bowel cancer test are included in the baseline specification. It is expected that more risk averse individuals may be more likely to have been tested than less risk averse individuals. The proportion of people who have been tested for any of the cancers is, indeed, higher among the insured than among the uninsured.

As part of the sensitivity analysis, we include additional variables to the baseline specification. These variables may affect an individual's need for a surgery or prevent him/her from having it, or act as proxies for an individual's risk attitudes, or both. More specifically, we control for the self-rated quality of life, memory, and teeth; a dummy for having hearing loss; the number of teeth left; the number of falls in the past 12 months; a dummy for having a broken bone in the past 12 months; the number of times an individual is troubled by leaking urine; mental health measures (The Kessler Psychological Distress Scale (K10), whether emotional problems interfere with a person's daily activities, and family history of Alzheimer's); exercise; the number of hours spent outdoors; exposure to someone else's smoking; diet; time use; and social connections[5].

As a further check on potential selection effects we include past health care utilization measures obtained from an individual's medical records, which are expected to serve as additional proxies for an individual's health status. We first investigate whether the results are robust to including an individual's hospitalizations in the past five years. More specifically, we add binary variables that indicate whether or not an individual went to hospital in period $t-s, s=1,\ldots,5$. Hospital admissions for an elective (non-elective) surgery and other hospitalizations are included separately. Then, we control for an individual's emergency visits in the past two years. Finally, we include an individual's total health care expenditure in the past calendar year in the regression. The total health care expenditure includes the expenditure on hospitalizations, emergency department visits, doctor visits, diagnostic tests, and prescription medicines. More information on how this variable is constructed is provided in Ellis et al. (2012).

[5]These variables are not expected to be a major source of selection bias, which is largely confirmed by the results. Moreover, some of the additional controls have many missing values. For these reasons, they are not included in the baseline specification.

5 Results

All tables in this section report probit average partial effects of private health insurance and other variables. Standard errors are estimated using the delta method (by Stata's `margins` command). Due to the large sample size, we are conservative in testing the statistical significance of the parameter estimates. A variable is considered to be statistically significant if its associated coefficient estimate has a p-value of 0.05 or lower (equivalently, its z-statistic is 1.96 or higher).

5.1 Insurance effects on elective and non-elective surgeries

Table 2 presents the estimated effects of private health insurance and other variables on the probabilities of having an elective and non-elective surgery. Controlling for the base set of covariates, private health insurance increases the probability of having an elective surgery within the next 12 months by 1.26 percentage points, which is a 32.2 percent increase from the mean. This effect is highly statistically significant. The effect of private health insurance compares to the effects of a 7 year increase in age, having been recently treated for arthritis, and having had a hip or knee replacement operation in the past. This finding is interpreted as evidence of substantial moral hazard in the case of elective surgeries.

To investigate whether the results are driven by particular procedures, Table 3 presents the effects of private health insurance on the selected individual surgeries (excision of a skin lesion, cataract extraction, hip replacement and knee replacement)[6]. The results show that private health insurance significantly increases the probability of all of these surgeries. Relative to the mean, private health insurance has the largest effect on the demand for knee replacement surgery (46.8 percent), closely followed by skin lesion removal (44.7 percent), and hip replacement (40.6 percent). Private health insurance has a smaller effect on the demand for cataract extraction surgery (20.8 percent), suggesting that moral hazard may be less important in this case. This is perhaps not surprising, given relatively lower price of the cataract surgery, and thus, a smaller difference between the price and the co-payment compared to such procedures as knee and hip replacement. The fit of the model also varies across procedures. The knee replacement model has the best fit.

[6]The numbers of tonsil removal, varicose vein, ear drum, and nasal surgeries are too small to estimate the models for these procedures separately.

As expected, we find that private health insurance has a substantially smaller effect on the probability of undergoing a non-elective surgery. It is estimated that health insurance cover increases this probability by 0.09 percentage points, which is a 15.25 percent increase from the mean, but this effect is only marginally statistically significant. The numbers of non-elective surgeries are too small to estimate the effects of health insurance cover on individual surgeries. Furthermore, we find no evidence of positive effect of private health insurance on emergency hospitalizations. To the contrary, health insurance is found to decrease the probability of being admitted to a hospital via emergency department by 0.66 percentage points (11 percent of the mean). This effect, however, becomes smaller in magnitude and statistically insignificant once the additional controls are added to the model. Overall, the baseline results suggest that the positive insurance effect on elective surgeries is unlikely to be driven by any remaining adverse selection. Otherwise, we would expect to find similar insurance effects across different types of hospitalizations.

5.2 Other variables

Given that this is the first study to look at the demand for particular surgeries, we also provide and discuss the coefficients of other variables. Most of the covariates affect the demand for elective and non-elective surgeries differently.

As expected, the probability of having both types of surgery increases with age. Males and native born individuals are more likely to have an elective surgery, but gender and ethnicity do not have any effects on the probability of a non-elective surgery. Surprisingly, education does not have any effect on either elective or non-elective surgery, once other variables are held constant. Living in a house or apartment, which may indicate higher wealth, is positively associated with the probability of having an elective surgery. The probability of a non-elective surgery is lower for people living in a house on farm, which may be explained by health care access or lifestyle factors. In the case of elective surgeries, the socio-economic status of the population in an individual's local area has a significant effect; individuals from more affluent areas are more likely to get an elective surgery. Holding socio-economic status of the local area fixed, household income does not have a significant effect on the probability of an elective surgery, which may be due to high correlation between the two measures. The probability of a non-elective surgery is not affected either by household income or local area socio-economic status.

As expected, holding objective health measures fixed, individuals who rate their general health worse are more likely to have a non-elective surgery. On the other hand, the probability of an elective surgery is negatively affected by worse self-rated health. It may

be that people in poor health (or their doctor) consider themselves to be unfit for such a major surgery as knee or hip replacement, which often requires general anesthesia and has a long recovery period. Worse self-assessed eyesight has an expected positive effect on the probability of having an elective surgery, mainly driven by the demand for a cataract extraction procedure.

The objective health measures mainly have expected effects. The probability of having an elective surgery is higher for individuals who have previously been diagnosed with skin cancer or melanoma, treated for cancer or arthritis, had a skin cancer operation, knee replacement, or hip replacement, or have activity limitations (as shown by the negative coefficient on the physical functioning scale). Taking vitamins, supplements, or medicines and having higher BMI is also positively associated with the probability of an elective surgery. On the other hand, it seems that some health conditions may deter a patient from having an elective surgery. Having been diagnosed with asthma or hay fever, recently treated for osteoporosis or heart attack, and having a long-term illness or disability reduces the likelihood of undergoing an elective surgery. As expected, individuals with very light skin and melanoma history in the family, are more likely to have an elective surgery. Turning to the non-elective surgeries, the probability of having such a surgery in the following 12 months is higher for individuals who have been recently treated for heart attack. Taking medications increases the likelihood of a non-elective surgery, but consumption of vitamins and/or supplements decreases this probability. Individuals who had gallbladder removed in the past have lower chance of a non-elective surgery in the following 12 months. This result is likely to be driven by a negative effect of this variable on the probability of a gallbladder removal operation, given that this surgery can only be performed once.

As to the risk behaviors, people who had a prostate/breast cancer test and people who do not smoke are more likely to have an elective surgery, suggesting that risk aversion may, in fact, be positively associated with the demand for elective procedures. The only risk behavior that is found to significantly affect the probability of an urgent surgery is alcohol consumption. An increase in alcohol consumption is, in fact, found to decrease this probability, which is consistent with the findings in the medical literature that moderate alcohol consumption has a protective effect on coronary heart disease (Brien et al. 2011).

It is also of interest to investigate whether there is adverse selection in private health insurance based on the subjective and objective health measures that affect the demand for elective and non-elective surgeries. For this purpose, we add the control variables in the two regressions one group at a time. The results for the elective surgeries are presented in panel A of Table 4. Starting with the model with no controls (except for the

time effects) and adding the socio-economic and demographic characteristics increases the estimated coefficient on the private health insurance variable substantially. This increase is almost fully accounted for by the inclusion of age, as age significantly affects both the probability of insurance and the probability of an elective surgery, and the two effects are of the opposite signs. Adding the subjective health measures further increases the average partial effect of private health insurance, but including the objective health measures slightly decreases this effect. The inclusion of other health risks and risk attitude variables practically does not change the estimated effect of health insurance. Thus, it seems that in terms of the health measures associated with the demand for the selected elective procedures, there is advantageous selection on subjective health and adverse selection on objective health. The first finding is driven by individuals with worse self-rated eyesight being less likely to have private health insurance, but having higher demand for an elective surgery. The second result is largely due to the past skin, knee, and hip problems being positively associated with both the probability of having private health insurance and the probability of undergoing an elective surgery within the next 12 months.

Different patterns are observed in the case of the non-elective surgeries, as shown by the results reported in panel B of Table 4. Adding the socio-economic and demographic characteristics changes the estimated effect of private health insurance from negative to positive, but the insurance effect is not statistically significant in either of the models. It seems, however, that it is not as important to control for age as to include other characteristics such as gender, education, housing, household income, and employment status to the regression of non-elective procedures. Additionally, the results suggest that there may be advantageous selection based on both subjective and objective health measures that are related to the probability of a non-elective procedure. More specifically, such measures as worse self-assessed health, heart attack history, lower physical activity level, and not taking vitamins or supplements are positively associated with a higher probability of having an urgent surgery, but are negatively correlated with the demand for private health insurance. Finally, it seems that controlling for risk behaviors, especially for alcohol consumption, is important in the case of non-elective surgeries.

5.3 Sensitivity analysis

Next, we present results of regressions that include the additional control variables described in Subsection 4.1.2. Due to missing values for these variables, the sample sizes are smaller in these estimations than in the main analysis. For this reason, we also present

estimates of the baseline model for each of the sub-samples. Column (1) of Table 5 presents the estimated effects of private health insurance in the models with the full set of controls available in the survey data. The estimates of the models that control for an individual's hospitalizations in the past five years are reported in column (2). The results presented in column (3) show how the estimated effects of private health insurance are affected by the inclusion of the binary variables that indicate whether or not an individual visited the emergency department in the past two years. The number of included lags is smaller than for hospitalizations, because the emergency data cover a shorter time period. Finally, column (4) controls for an individual's total health care expenditure in the past calendar year[7].

Panel A of Table 5 presents the results for elective surgeries. The inclusion of the additional survey variables, past hospitalizations, and total health care expenditure decreases the estimated effect of private health insurance on the probability of an elective surgery only slightly. This effect remains statistically and economically significant. The estimated effect of private health insurance is also not affected by the inclusion of the past emergency department visits. If anything, the estimate of the insurance effect becomes slightly larger compared to the baseline once these variables are included. Across different model specifications, the average partial effect of health insurance varies from 0.2813 to 0.3350 relative to the mean.

The results of the sensitivity analysis further support the hypothesis that private health insurance does not affect the probability of a non-urgent surgery significantly. These results are reported in panel B of Table 6. Including past hospitalization reduces the magnitude and statistical significance of the estimated effect of private health insurance (column 2). This effect is not statistically significant at any conventional significance levels. Adding the other survey controls, emergency department visits, and total health care expenditure to the model, increases the estimate of the insurance effect slightly, but it remains statistically insignificant as in the baseline model. Depending on the specification, the average partial effect of health insurance ranges from 0.0536 to 0.1373 relative to the mean.

It is also of interest to investigate how past health care utilization affects the probability of having an elective or non-elective surgery in the current period. Table 6 presents these results. Both the probability of an elective surgery and non-elective surgery is higher for individuals who previously had such an operation, but the effects of past operations

[7]In this analysis, a time period t does not correspond to a calendar year. The period t starts the day after the survey completion date and lasts for 12 months. The health expenditures were calculated, however, by calendar year.

are only significant in the case of elective surgeries (panel A). Individuals who had an elective surgery in the past 12 months are much more likely to have such surgery in the following 12 months comparing to individuals who did not have an elective surgery. The effect of past elective surgeries monotonically declines with time. The results of additional estimations show that these results are largely driven by skin lesion removal surgeries. The estimates presented in panel B show that other health problems, as indicated by past hospitalizations for other purposes besides elective (non-elective) procedures, are also positively correlated with the probability of an elective (non-elective) procedure. In the case of elective procedures, this relationship remains economically and statistically significant even after 5 years. We also find positive associations between past emergency department visits and total health care expenditure and the probabilities of elective and non-elective surgeries (panels C and D).

6 Conclusion

Using a unique data set we have examined the relationship between insurance status and health care utilization at a disaggregated level. By comparing results for particular elective surgeries with those from non-elective surgeries and by exploiting a comprehensive set of controls for an individual's health and past health care utilization we are able to provide evidence that a small average incentive effect (due to the use of aggregate data) can mask a large variability. Specifically, in the case of elective surgeries, we find incentive effects of over 30% while for urgent procedures, there is no evidence of any moral hazard.

These results must be placed in the context of a mixed private-public system. In a different system where urgent services are not available without private insurance, we would expect perhaps less variation in the incentive effects but we would still expect more discretionary services to also involve greater moral hazard. The Australian system is also characterized by community-rating so that insurers are not able to design contracts that price insurance according to risk type. This feature would be expected to lead to more extensive selection problems in private health insurance. However, our extensive dataset and sensitivity analysis suggests that we have dealt with selection on risk types in a satisfactory basis. Finally our data refer to an older population (45 years of age or more) but it is this older subpopulation that consumes the majority of health services and will be the major source of future growth in health expenditures making research of the type presented here even more important in terms of understanding the impact of incentives on the use of health services.

References

45 and Up Study Collaborators (2008), 'Cohort profile: the 45 and up study', *International journal of epidemiology* **37**(5), 941–947.

Anderson, M., Dobkin, C. and Gross, T. (2012), 'The effect of health insurance coverage on the use of medical services', *American Economic Journal: Economic Policy* **4**(1), 1–27.

Australian Institute of Health and Welfare (2012*a*), 'Australia's hospitals 2010-11 at a glance'. Health services series no. 44.

Australian Institute of Health and Welfare (2012*b*), 'National definitions for elective surgery urgency categories'. Submission information paper.

Baggoley, C., Owler, B., Grigg, M., Wellington, H., Monaghan, M. and Hartley-Jones, J. (2011), 'Expert panel review of elective surgery and emergency access targets under the national partnership agreement on improving public hospital services'. Report to the Council of Australian Governments.

Bolhaar, J., Lindeboom, M. and van der Klaauw, B. (2012), 'A dynamic analysis of the demand for health insurance and health care', *European Economic Review* **56**(4), 669–690.

Brien, S. E., Ronksley, P. E., Turner, B. J., Mukamal, K. J. and Ghali, W. A. (2011), 'Effect of alcohol consumption on biological markers associated with risk of coronary heart disease: systematic review and meta-analysis of interventional studies', *BMJ* **342**.

Buchmueller, T. C., Grumbach, K., Kronick, R. and Kahn, J. G. (2005), 'The effect of health insurance on medical care utilization and implications for insurance expansion: A review of the literature', *Medical Care Research and Review* **62**(1), 3–30.

Cameron, A. C., Trivedi, P. K., Milne, F. and Piggott, J. (1988), 'A microeconometric model of the demand for health care and health insurance in Australia', *The Review of Economic Studies* **55**(1), 85–106.

Card, D., Dobkin, C. and Maestas, N. (2009), 'Does medicare save lives?', *The Quarterly Journal of Economics* **124**(2), 597–636.

Cardon, J. H. and Hendel, I. (2001), 'Asymmetric information in health insurance: Evidence from the national medical expenditure survey', *The RAND Journal of Economics* **32**(3), 408–427.

Cheng, T. C. and Vahid, F. (2011), 'Demand for hospital care and private health insurance in a mixed public-private system: Empirical evidence using a simultaneous equation modeling approach'. Melbourne Institute Working Paper No. 22/11.

Cohen, A. and Einav, L. (2007), 'Estimating risk preferences from deductible choice', *The American Economic Review* **97**(3), 745–788.

Cohen, A. and Siegelman, P. (2010), 'Testing for adverse selection in insurance markets', *Journal of Risk and Insurance* **77**(1), 39–84.

Colombo, F. and Tapay, N. (2003), 'Private health insurance in Australia: a case study'. OECD health working papers No. 8.

Currie, J. and Fahr, J. (2005), 'Medicaid managed care: effects on children's medicaid coverage and utilization', *Journal of Public Economics* **89**(1), 85–108.

Currie, J. and Gruber, J. (1996), 'Health insurance eligibility, utilization of medical care, and child health', *The Quarterly Journal of Economics* **111**(2), 431–466.

Decker, S. L. and Remler, D. K. (2004), 'How much might universal health insurance reduce socioeconomic disparities in health? A comparison of the US and Canada'. National Bureau of Economic Research Working Paper No. 10715.

Doiron, D. (2012), 'Using partner's information to identify the causal effects of insurance on utilization'. Mimeo, University of New South Wales.

Doiron, D., Jones, G. and Savage, E. (2008), 'Healthy, wealthy and insured? The role of self-assessed health in the demand for private health insurance', *Health Economics* **17**(3), 317–334.

Einav, L. and Finkelstein, A. (2011), 'Selection in insurance markets: Theory and empirics in pictures', *Journal of Economic Perspectives* **25**(1), 115–138.

Einav, L., Finkelstein, A. and Levin, J. (2010), 'Beyond testing: Empirical models of insurance markets', *Annual Review of Economics* **2**(1), 311–336.

Ellis, R. P., Fiebig, D. G., Johar, M., Jones, G. and Savage, E. (2012), 'Explaining health care expenditure variation: larger-sample evidence using linked survey and health administrative data'. UTS Business School Economics Discipline Group Working paper No.1.

Ettner, S. L. (1997), 'Adverse selection and the purchase of Medigap insurance by the elderly', *Journal of Health Economics* **16**(5), 543–562.

Fang, H., Keane, M. P. and Silverman, D. (2008), 'Sources of advantageous selection: Evidence from the Medigap insurance market', *Journal of Political Economy* **116**(2), 303–350.

Finkelstein, A. and McGarry, K. (2006), 'Multiple dimensions of private information: Evidence from the long-term care insurance market', *American Economic Review* **96**(4), 938–958.

Grignon, M., Perronnin, M. and Lavis, J. N. (2008), 'Does free complementary health insurance help the poor to access health care? Evidence from France', *Health Economics* **17**(2), 203–219.

Harmon, C. and Nolan, B. (2001), 'Health insurance and health services utilization in Ireland', *Health Economics* **10**(2), 135–145.

Hullegie, P. and Klein, T. J. (2010), 'The effect of private health insurance on medical care utilization and self-assessed health in Germany', *Health Economics* **19**(9), 1048–1062.

Jones, A. M., Koolman, X. and Doorslaer, E. v. (2006), 'The impact of having supplementary private health insurance on the use of specialists', *Annals of Economics and Statistics / Annales d'Economie et de Statistique* (83/84), 251–275.

Ketcham, J. D. and Simon, K. (2008), 'Medicare part D's effects on elderly drug costs and utilization'. National Bureau of Economic Research Working Paper No. 14326.

Lu, M. and Savage, E. (2006), Do financial incentives for supplementary private health insurance reduce pressure on the public system? Evidence from Australia. CHERE working paper 2006/11.

McWilliams, J. M., Meara, E., Zaslavsky, A. M. and Ayanian, J. Z. (2007), 'Health of previously uninsured adults after acquiring medicare coverage', *JAMA: The Journal of the American Medical Association* **298**(24), 2886–2894.

Pauly, M. V. (2006), 'Adverse selection and moral hazard: Implications for health insurance markets'. Oberlin College Health Economics Conference paper, September 8-10.

Pink, B. (2006), 'Socio-economic indexes for areas (SEIFA)'. Technical paper. Australian Bureu of Statistics.

Remler, D. K. and Atherly, A. J. (2003), 'Health status and heterogeneity of cost-sharing responsiveness: how do sick people respond to cost-sharing?', *Health Economics* **12**(4), 269–280.

Savage, E. and Wright, D. J. (2003), 'Moral hazard and adverse selection in Australian private hospitals: 1989-1990', *Journal of Health Economics* **22**(3), 331–359.

Srivastava, P. and Zhao, X. (2008), 'Impact of private health insurance on the choice of public versus private hospital services'. HEDG Working Paper 08/17.

Stabile, M. (2001), 'Private insurance subsidies and public health care markets: Evidence from Canada', *The Canadian Journal of Economics / Revue canadienne d'Economique* **34**(4), 921–942.

Trewin, D. (2001), 'ABS views on remoteness'. Information paper. Australian Bureu of Statistics.

Vera-Hernandez, A. M. (1999), 'Duplicate coverage and demand for health care. The case of Catalonia', *Health Economics* **8**(7), 579–598.

Table 1: Description and means of the dependent variables

Variable	Description	Mean
A. Elective surgeries		
s_nurg_365d	=1 if had non-urgent elective surgery in the next 12 months	0.0391
p_eye_365d_y	=1 if had cataract surgery in the next 12 months	0.0178
p_skin_365d_y	=1 if had skin lesion removal in the next 12 months	0.0123
p_knee_365d_y	=1 if had knee replacement in the next 12 months	0.0047
p_hip_365d_y	=1 if had hip replacement in the next 12 months	0.0032
p_vvein_365d_y	=1 if had varicose vein surgery in the next 12 months	0.0010
p_nose_365d_y	=1 if had nasal surgery in the next 12 months	0.0008
p_tons_365d_y	=1 if had tonsillectomy in the next 12 months	0.0001
p_ear_365d_y	=1 if had ear drum surgery in the next 12 months	0.0001
B. Non-elective surgeries		
s_urg_365d	=1 if had emergency or urgent elective surgery in the next 12 months	0.0059
p_gallbl_365d_y	=1 if had gall bladder removal in the next 12 months	0.0033
p_cabg_365d_y	=1 if had coronary artery bypass graft surgery in the next 12 months	0.0012
p_ptca_365d_y	=1 if had coronary angioplasty in the next 12 months	0.0007
p_append_365d_y	=1 if had appendectomy in the next 12 months	0.0005
p_perfear_365d_y	=1 if had perforated ear drum repair in the next 12 months	0.0003
C. Emergency hospitalizations		
ed_snd_365d_y	=1 if was admitted to hospital via ED in the next 12 months	0.0600
Observations		192,638

Table 2: Effects of private health insurance on the demand for elective and non-elective surgeries, average partial effects

	Elective surgeries		Non-elective surgeries	
	APE	Stand. error	APE	Stand. error
Insurance	0.0126***	(0.0010)	0.0009*	(0.0004)
male	0.0046***	(0.0012)	0.0006	(0.0005)
age	0.0017***	(0.0001)	0.0001*	(0.0000)
ms_single	−0.0018	(0.0020)	−0.0005	(0.0008)
ms_partner	−0.0049*	(0.0021)	−0.0007	(0.0008)
ms_widowed	−0.0002	(0.0015)	−0.0015**	(0.0006)
ms_divorced	−0.0012	(0.0017)	0.0007	(0.0007)
ms_separated	−0.0025	(0.0028)	−0.0006	(0.0010)
childrennum	−0.0001	(0.0003)	0.0001	(0.0001)
ARIA_plus_mean	−0.0006	(0.0003)	−0.0001	(0.0001)
CofO_Au	0.0061**	(0.0021)	0.0009	(0.0008)
CofO_es	0.0022	(0.0026)	0.0017	(0.0011)
ancesAust	−0.0007	(0.0012)	0.0006	(0.0005)
ancesEnglish	−0.0017	(0.0010)	0.0000	(0.0004)
ancesIrish	0.0005	(0.0012)	0.0004	(0.0005)
ancesScot	0.0002	(0.0013)	−0.0007	(0.0005)
ancesEuro	−0.0022	(0.0016)	0.0002	(0.0007)
ancesOth	−0.0061***	(0.0015)	0.0002	(0.0007)
otherlanghomeyn	−0.0023	(0.0022)	0.0005	(0.0009)
highestqual_1	−0.0002	(0.0017)	0.0011	(0.0008)
highestqual_2	0.0005	(0.0014)	0.0008	(0.0006)
highestqual_3	−0.0027	(0.0017)	0.0001	(0.0007)
highestqual_4	0.0012	(0.0017)	0.0011	(0.0007)
highestqual_5	0.0001	(0.0014)	0.0003	(0.0006)
currenthousing_2	0.0020	(0.0014)	−0.0002	(0.0006)
currenthousing_3	0.0002	(0.0018)	−0.0017**	(0.0006)
currenthousing_o	−0.0064***	(0.0017)	−0.0009	(0.0008)
income_1	0.0059	(0.0042)	−0.0018	(0.0013)
income_2	−0.0024	(0.0025)	0.0007	(0.0011)
income_3	0.0010	(0.0019)	0.0000	(0.0008)
income_4	0.0006	(0.0019)	0.0008	(0.0008)
income_5	−0.0033	(0.0018)	0.0013	(0.0009)
income_6	−0.0029	(0.0019)	0.0003	(0.0008)
income_7	0.0001	(0.0018)	−0.0002	(0.0007)
income_miss	−0.0001	(0.0016)	−0.0002	(0.0006)
seifa_1	−0.0057*	(0.0029)	−0.0003	(0.0012)
seifa_2	−0.0066***	(0.0020)	0.0001	(0.0009)
seifa_3	−0.0030	(0.0020)	−0.0006	(0.0008)
seifa_4	−0.0063***	(0.0017)	−0.0006	(0.0007)
seifa_5	−0.0047**	(0.0017)	0.0006	(0.0008)
seifa_6	−0.0060***	(0.0014)	0.0000	(0.0006)
seifa_7	−0.0056***	(0.0015)	−0.0002	(0.0007)
seifa_8	−0.0072***	(0.0015)	0.0010	(0.0008)
seifa_9	−0.0035*	(0.0017)	−0.0003	(0.0007)
workfulltime	−0.0017	(0.0019)	−0.0000	(0.0007)
workparttime	−0.0021	(0.0019)	−0.0007	(0.0007)

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	Elective surgeries		Non-elective surgeries	
	APE	Stand. error	APE	Stand. error
workfullyretired	0.0015	(0.0017)	0.0006	(0.0007)
workpartretired	−0.0018	(0.0020)	0.0010	(0.0009)
workdisabledsick	−0.0047	(0.0024)	0.0001	(0.0010)
workselfemployed	−0.0023	(0.0018)	0.0001	(0.0007)
workunpaid	−0.0014	(0.0018)	−0.0002	(0.0007)
workstudyonly	−0.0001	(0.0042)	−0.0005	(0.0015)
workhomefamily	0.0001	(0.0016)	0.0011	(0.0007)
workunemployed	−0.0057	(0.0031)	−0.0006	(0.0012)
workother	0.0021	(0.0038)	0.0007	(0.0016)
ratehealth_vg	0.0003	(0.0015)	0.0014*	(0.0007)
ratehealth_g	−0.0012	(0.0017)	0.0025**	(0.0008)
ratehealth_f	−0.0060**	(0.0019)	0.0033**	(0.0012)
ratehealth_p	−0.0096***	(0.0028)	0.0076**	(0.0027)
ratevision_vg	0.0028	(0.0017)	−0.0005	(0.0006)
ratevision_g	0.0101***	(0.0018)	−0.0007	(0.0006)
ratevision_f	0.0324***	(0.0028)	−0.0003	(0.0007)
ratevision_p	0.0511***	(0.0053)	−0.0027**	(0.0009)
skin	0.0085***	(0.0014)	−0.0002	(0.0006)
melan	0.0072***	(0.0019)	−0.0002	(0.0008)
prostbr	0.0003	(0.0017)	0.0004	(0.0008)
otherca	0.0011	(0.0016)	0.0007	(0.0007)
hrt	0.0003	(0.0015)	0.0011	(0.0007)
highbld	0.0009	(0.0013)	0.0005	(0.0005)
stroke	0.0002	(0.0021)	0.0007	(0.0010)
diabet	0.0019	(0.0015)	0.0002	(0.0006)
bldclot	0.0011	(0.0020)	0.0012	(0.0009)
asthmhayf	−0.0030**	(0.0011)	−0.0003	(0.0005)
Parkin	0.0029	(0.0048)	−0.0028	(0.0015)
trtcancer	0.0101***	(0.0027)	−0.0002	(0.0010)
trthrtattack	−0.0048*	(0.0022)	0.0057***	(0.0015)
trtothheart	−0.0032	(0.0022)	0.0015	(0.0010)
trthighbld	−0.0003	(0.0014)	−0.0001	(0.0006)
trthighchol	−0.0020	(0.0012)	0.0002	(0.0005)
trtbloodclott	−0.0014	(0.0028)	−0.0014	(0.0010)
trtasthma	0.0007	(0.0022)	0.0002	(0.0009)
trtarthritis	0.0159***	(0.0018)	−0.0004	(0.0006)
trtthyroid	−0.0023	(0.0018)	−0.0003	(0.0008)
trtosteop	−0.0041*	(0.0016)	−0.0011	(0.0007)
trtdepranx	0.0001	(0.0016)	0.0004	(0.0007)
mospf	−0.0004***	(0.0000)	−0.0000	(0.0000)
disabled	−0.0104***	(0.0016)	−0.0017*	(0.0007)
multisuppl	0.0018*	(0.0009)	−0.0007*	(0.0004)
medicines	0.0044***	(0.0011)	0.0016***	(0.0004)
bmi	0.0002*	(0.0001)	0.0001***	(0.0000)
opskin	0.0047**	(0.0014)	0.0000	(0.0006)
opreprod	0.0037***	(0.0009)	0.0004	(0.0004)
opkneereplac	0.0139***	(0.0021)	−0.0003	(0.0008)
ophipreplac	0.0133***	(0.0023)	0.0000	(0.0010)
opgallb	0.0011	(0.0014)	−0.0022***	(0.0005)

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	Elective surgeries		Non-elective surgeries	
	APE	Stand. error	APE	Stand. error
opheart	0.0020	(0.0019)	0.0011	(0.0008)
skincol_1	0.0032*	(0.0015)	−0.0004	(0.0005)
skincol_2	0.0019	(0.0011)	−0.0006	(0.0004)
skincol_o	−0.0021	(0.0029)	0.0010	(0.0011)
fhmelanomabrosis	0.0052*	(0.0023)	−0.0001	(0.0009)
fhmelanomamofa	0.0022	(0.0020)	−0.0005	(0.0007)
fharthritisbrosis	0.0036	(0.0020)	−0.0002	(0.0008)
fharthritismofa	−0.0008	(0.0011)	−0.0002	(0.0005)
fhosteobrosis	−0.0018	(0.0024)	−0.0007	(0.0010)
fhosteomofa	0.0001	(0.0014)	−0.0006	(0.0005)
fhhipfracbrosis	−0.0024	(0.0034)	−0.0007	(0.0015)
fhhipfracmofa	−0.0001	(0.0015)	−0.0006	(0.0006)
alcdrinksperweek	0.0001	(0.0001)	−0.0001***	(0.0000)
smokestat_1	−0.0044*	(0.0020)	0.0012	(0.0008)
smokestat_2	0.0030**	(0.0010)	0.0003	(0.0004)
psamammoyn	0.0026*	(0.0013)	0.0002	(0.0005)
bowelscreenyn	0.0016	(0.0009)	0.0006	(0.0004)
2007	0.0015	(0.0019)	−0.0005	(0.0009)
2008	0.0013	(0.0012)	−0.0025***	(0.0006)
Sample size	192,638		192,638	
Pseudo R-squared	0.1038		0.0361	
Mean of dep var	0.0391		0.0059	

Symbols *, **, and *** denote statistical significance at the 5%, 1%, and 0.1% level, respectively.

Table 3: Effects of health insurance on individual procedures, average partial effects

	(1) Any	(2) Cataract	(3) Skin lesion	(4) Knee	(5) Hip
Insurance	0.0126***	0.0037***	0.0055***	0.0022***	0.0013***
	(0.0010)	(0.0007)	(0.0006)	(0.0003)	(0.0003)
Sample size	192,638	192,638	192,638	192,638	192,638
Pseudo R-squared	0.1038	0.1624	0.0924	0.1957	0.1752
Mean of dep var	0.0391	0.0178	0.0123	0.0047	0.0032
Change from mean	0.3223	0.2079	0.4472	0.4681	0.4063

Notes: Standard errors in parentheses. All regressions control for the variables listed in Tables 7 and 8. Symbol *** denotes statistical significance at the 0.1% level.

Table 4: Selection on observables, average partial effects

Add...	(1) No controls	(2) Socio-dem. charact.	(3) Subj. health measures	(4) Obj. health measures	(5) Health risks	(6) Risk attitudes
A. Elective surgeries.						
Insurance	0.0040***	0.0120***	0.0136***	0.0128***	0.0128***	0.0126***
	(0.0009)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
Pseudo R-squared	0.0006	0.0788	0.0875	0.1030	0.1033	0.1038
Mean of dep var	0.0391	0.0391	0.0391	0.0391	0.0391	0.0391
Change from mean	0.1023	0.3069	0.3478	0.3274	0.3274	0.3223
B. Non-elective surgeries.						
Insurance	−0.0004	0.0006	0.0007	0.0008*	0.0008*	0.0009*
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Pseudo R-squared	0.0027	0.0160	0.0223	0.0331	0.0337	0.0361
Mean of dep var	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059
Change from mean	−0.0678	0.1017	0.1186	0.1356	0.1356	0.1525
Sample size	192,638	192,638	192,638	192,638	192,638	192,638

Notes: Standard errors in parentheses. All regressions include time effects. Symbols * and *** denote statistical significance at the 5% and 0.1% level, respectively.

Table 5: Sensitivity of results to adding other covariates, average partial effects

	(1)		(2)		(3)		(4)	
Add...	Base	Oth vars	Base	Hosp hist	Base	ED hist	Base	Tot HC exp hist
A. Elective surgeries.								
Insurance	0.0105***	0.0097***	0.0126***	0.0110***	0.0129***	0.0131***	0.0129***	0.0127***
	(0.0016)	(0.0016)	(0.0010)	(0.0010)	(0.0011)	(0.0011)	(0.0011)	(0.0011)
Pseudo R-squared	0.1056	0.1125	0.1038	0.1182	0.1016	0.1020	0.1016	0.1021
Mean of dep var	0.0311	0.0311	0.0391	0.0391	0.0391	0.0391	0.0391	0.0391
Change from mean	0.3376	0.3119	0.3223	0.2813	0.3299	0.3350	0.3299	0.3248
B. Non-elective surgeries.								
Insurance	0.0006	0.0007	0.0009*	0.0005	0.0003	0.0004	0.0003	0.0003
	(0.0007)	(0.0007)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Pseudo R-squared	0.0527	0.0685	0.0361	0.0425	0.0337	0.0370	0.0337	0.0346
Mean of dep var	0.0051	0.0051	0.0059	0.0059	0.0056	0.0056	0.0056	0.0056
Change from mean	0.1176	0.1373	0.1525	0.0847	0.0536	0.0714	0.0536	0.0536
Sample size	64,136	64,136	192,638	192,638	165,928	165,928	165,980	165,980

Notes: Standard errors in parentheses. All regressions control for the variables listed in Tables 7 and 8. Symbols * and *** denote statistical significance at the 5% and 0.1% level, respectively.

Table 6: Effects of past health care utilization, average partial effects

	(1) Elective	(2) Non-elective
A. Elective (non-elective) surgeries		
t-1	0.0525***	0.0028
	(0.0028)	(0.0020)
t-2	0.0118***	0.0050*
	(0.0021)	(0.0023)
t-3	0.0062**	0.0022
	(0.0021)	(0.0020)
t-4	0.0037	0.0002
	(0.0022)	(0.0017)
t-5	0.0000	0.0000
	(0.0021)	(0.0017)
B. Other hospitalizations		
t-1	0.0073***	0.0029***
	(0.0011)	(0.0005)
t-2	0.0076***	0.0006
	(0.0011)	(0.0004)
t-3	0.0032**	0.0010*
	(0.0011)	(0.0005)
t-4	0.0038***	0.0008
	(0.0011)	(0.0005)
t-5	0.0042***	0.0008
	(0.0011)	(0.0005)
C. Emergency department visits		
t-1	0.0049***	0.0029***
	(0.0014)	(0.0006)
t-2	0.0039**	0.0014*
	(0.0015)	(0.0006)
D. Total health care expenditure		
t-1	0.0003***	0.0001***
	(0.0000)	(0.0000)
Sample size	192638	192638

Notes: Standard errors in parentheses. All regressions control for the insurance status and variables listed in Tables 7 and 8. Symbols * and *** denote statistical significance at the 5% and 0.1% level, respectively.

A Additional tables

Table 7: Description and means of socio-economic and demographic characteristics

Variable	Description	No PHI	PHI	z-stat
male	=1 if male	0.470	0.475	-2.13
age	Age in years	63.317	61.051	41.83
ms_single	=1 if single	0.081	0.048	26.45
ms_married[a]	=1 if married	0.594	0.768	-76.06
ms_partner	=1 if living with partner	0.065	0.052	11.63
ms_widowed	=1 if widowed	0.112	0.057	38.81
ms_divorced	=1 if divorced	0.117	0.058	41.05
ms_separated	=1 if separated	0.042	0.021	23.99
childrennum	Number of children	2.545	2.353	26.12
ARIA_plus_mean	Accessibility/Remoteness Index, 0(accessible)-15(remote)	1.493	1.093	47.19
CofO_Au	=1 if born in Australia	0.722	0.779	-26.90
CofO_es	=1 if born in English speaking country	0.146	0.121	14.63
CofO_nes[a]	=1 if born in non-English speaking country	0.132	0.099	20.62
ancesAust	=1 if has Australian ancestry	0.499	0.526	-11.26
ancesEnglish	=1 if has English ancestry	0.432	0.429	1.52
ancesIrish	=1 if has Irish ancestry	0.165	0.167	-1.23
ancesScot	=1 if has Scottish ancestry	0.146	0.151	-3.19
ancesEuro	=1 if has other European ancestry	0.120	0.110	6.34
ancesOth	=1 if has other ancestry	0.151	0.127	14.10
otherlanghomeyn	=1 if speaks other language than English at home	0.107	0.075	21.95
highestqual_1	=1 if doesn't have any qualifications	0.182	0.059	73.32
highestqual_2	=1 if has school/intermediate certificate	0.259	0.193	32.13
highestqual_3	=1 if has higher school certificate	0.103	0.100	2.04
highestqual_4	=1 if has trade/apprenticeship	0.139	0.094	27.81
highestqual_5	=1 if has certificate/diploma	0.191	0.236	-23.08
highestqual_6[a]	=1 if has university degree	0.127	0.318	-103.07
currenthousing_1[a]	=1 if lives in a house	0.728	0.802	-35.07
currenthousing_2	=1 if lives in a flat	0.131	0.090	25.93
currenthousing_3	=1 if lives in a house on farm	0.079	0.080	-0.75
currenthousing_o	=1 if lives in other housing	0.062	0.028	31.66
income_1	=1 if HH income is less then $5000 per year	0.023	0.009	22.39
income_2	=1 if HH income is $5000-$9999 per year	0.072	0.016	51.72
income_3	=1 if HH income is $10000-$19999 per year	0.259	0.070	100.20
income_4	=1 if HH income is $20000-$29999 per year	0.135	0.078	36.57
income_5	=1 if HH income is $30000-$39999 per year	0.086	0.081	3.61
income_6	=1 if HH income is $40000-$49999 per year	0.070	0.080	-7.88
income_7	=1 if HH income is $50000-$69999 per year	0.083	0.128	-31.78
income_8[a]	=1 if HH income is $70000 or more per year	0.089	0.357	-153.62
income_miss	=1 if refused to answer	0.184	0.182	1.52
seifa_1	=1 if in 1st decile of SEIFA Index of rel soc-econ adv/disadv	0.037	0.015	26.53
seifa_2	=1 if in 2nd decile of SEIFA Index of rel soc-econ adv/disadv	0.107	0.054	38.06
seifa_3	=1 if in 3th decile of SEIFA Index of rel soc-econ adv/disadv	0.085	0.055	23.08
seifa_4	=1 if in 4th decile of SEIFA Index of rel soc-econ adv/disadv	0.141	0.089	32.37
seifa_5	=1 if in 5th decile of SEIFA Index of rel soc-econ adv/disadv	0.105	0.080	17.54
seifa_6	=1 if in 6th decile of SEIFA Index of rel soc-econ adv/disadv	0.170	0.141	16.34
seifa_7	=1 if in 7th decile of SEIFA Index of rel soc-econ adv/disadv	0.121	0.121	-0.35

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Variable	Description	No PHI	PHI	z-stat
seifa_8	=1 if in 8th decile of SEIFA Index of rel soc-econ adv/disadv	0.084	0.093	-6.35
seifa_9	=1 if in 9th decile of SEIFA Index of rel soc-econ adv/disadv	0.061	0.094	-26.34
seifa_10[a]	=1 if in 10th decile of SEIFA Index of rel soc-econ adv/disadv	0.089	0.257	-101.12
workfulltime	=1 if in full time paid work	0.172	0.301	-65.42
workparttime	=1 if in part time paid work	0.131	0.144	-7.85
workfullyretired	=1 if completely retired or pension	0.442	0.326	48.84
workpartretired	=1 if partially retired	0.040	0.069	-28.10
workdisabledsick	=1 if disabled or sick	0.080	0.018	54.21
workselfemployed	=1 if self-employed	0.096	0.149	-34.75
workunpaid	= 1 if doing unpaid work	0.062	0.060	1.64
workstudyonly	=1 if studying	0.020	0.014	9.10
workhomefamily	=1 if looking after home or family	0.103	0.103	-0.60
workunemployed	=1 if unemployed	0.041	0.014	31.62
workother	=1 if work status is other	0.021	0.012	14.03
Observations		192,638		

Notes: [a] indicates omitted category in the regressions.
The last column presents z-statistics for the equality of means test.

Table 8: Description and means of health and risk attitude measures

Variable	Description	No PHI	PHI	z-stat
A. Health measures.				
ratehealth_exc[a]	=1 if self-rated health is excellent	0.117	0.185	-40.78
ratehealth_vg	=1 if self-rated health is very good	0.320	0.414	-40.49
ratehealth_g	=1 if self-rated health is good	0.359	0.311	21.21
ratehealth_f	=1 if self-rated health is fair	0.167	0.080	51.98
ratehealth_p	=1 if self-rated health is poor	0.037	0.011	32.50
ratevision_exc[a]	=1 if self-rated vision is excellent	0.083	0.131	-33.13
ratevision_vg	=1 if self-rated vision is very good	0.269	0.364	-43.08
ratevision_g	=1 if self-rated vision is good	0.427	0.386	17.40
ratevision_f	=1 if self-rated vision is fair	0.182	0.105	43.74
ratevision_p	=1 if self-rated vision is poor	0.038	0.014	29.67
skin	=1 if diagnosed with skin cancer	0.247	0.274	-12.50
melan	=1 if diagnosed with melanoma	0.058	0.054	3.28
prostbr	=1 if diagnosed with prostate/breast cancer	0.057	0.057	0.03
otherca	=1 if diagnosed with other cancer	0.073	0.058	12.67
hrt	=1 if diagnosed with heart disease	0.142	0.105	22.41
highbld	=1 if diagnosed with high blood pressure	0.387	0.343	18.95
stroke	=1 if diagnosed with stroke	0.043	0.021	23.42
diabet	=1 if diagnosed with diabetes	0.114	0.070	30.45
bldclot	=1 if diagnosed with blood clot	0.053	0.041	11.73
asthmhayf	=1 if diagnosed with asthma/hay fever	0.213	0.226	-6.80
Parkin	=1 if diagnosed with Parkinson's disease	0.007	0.005	4.85
trtcancer	=1 if treated for cancer in the last month	0.032	0.025	8.85
trthrtattack	=1 if treated for heart attack in the last month	0.037	0.017	23.57
trtothheart	=1 if treated for other heart disease in the last month	0.033	0.024	11.30
trthighbld	=1 if treated for high blood pressure in the last month	0.272	0.229	20.20
trthighchol	=1 if treated for high cholesterol in the last month	0.166	0.149	9.52
trtbloodclott	=1 if treated for blood clotting problems in the last month	0.023	0.015	11.87
trtasthma	=1 if treated for asthma in the last month	0.057	0.041	14.73
trtarthritis	=1 if treated for osteoarthritis in the last month	0.097	0.066	22.27
trtthyroid	=1 if treated for thyroid problems in the last month	0.053	0.047	6.26
trtosteop	=1 if treated for osteoporosis in the last month	0.063	0.050	11.29
trtdepranx	=1 if treated for depression/anxiety in the last month	0.108	0.070	26.70
mospf	Physical Functioning scale, 0(low)-100(high)	76.771	86.643	-80.24
disabled	=1 if has a long-term illness/disability	0.090	0.032	46.81
multisuppl	=1 if has taken vitamins/supplements in the past 4 weeks	0.456	0.521	-26.92
medicines	=1 if has taken selected medicines in the past 4 weeks	0.654	0.620	14.75
bmi	Body mass index	27.382	26.929	17.01
opskin	=1 if had skin cancer removal operation	0.262	0.283	-10.08
opreprod	=1 if had reproductive organ operation	0.411	0.421	-4.03
opkneereplac	=1 if had knee replacement operation	0.041	0.037	3.44
ophipreplac	=1 if had hip replacement operation	0.030	0.030	-0.07
opgallb	=1 if had gall bladder removal operation	0.114	0.092	14.56
opheart	=1 if had heart or coronary bypass surgery	0.069	0.052	15.09
B. Health risks.				
skincol_1	=1 if skin color is very fair	0.155	0.159	-2.14
skincol_2	=1 if skin color is fair	0.559	0.558	0.56
skincol_3[a]	=1 if skin color is light olive	0.246	0.255	-4.37
skincol_o	=1 if skin color is dark olive/brown/black	0.040	0.028	12.87

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Variable	Description	No PHI	PHI	z-stat
fhmelanomabrosis	=1 if brother/sister had melanoma	0.038	0.036	2.75
fhmelanomamofa	=1 if mother/father had melanoma	0.060	0.068	-7.02
fharthritisbrosis	=1 if brother/sister had arthritis	0.058	0.037	19.71
fharthritismofa	=1 if mother/father had arthritis	0.197	0.184	6.72
fhosteobrosis	=1 if brother/sister had osteoporosis	0.031	0.023	9.82
fhosteomofa	=1 if mother/father had osteoporosis	0.117	0.143	-15.67
fhhipfracbrosis	=1 if brother/sister had hip fracture	0.015	0.009	10.71
fhhipfracmofa	=1 if mother/father had hip fracture	0.084	0.094	-7.28
C. Risk attitudes.				
alcdrinksperweek	Number of alcoholic drinks per week	6.685	7.449	-15.36
smokestat_1	= 1 if smokes now	0.119	0.045	52.52
smokestat_2	=1 if smoked before, not now	0.395	0.343	21.96
smokestat_3[a]	=1 if never smoked	0.486	0.612	-52.32
psamammoyn	=1 if had PSA test/mammogram	0.767	0.838	-36.40
bowelscreenyn	=1 if had bowel cancer test	0.434	0.545	-46.00
Observations		192,638		

Notes: [a] indicates omitted category in the regressions.
The last column presents z-statistics for the equality of means test.