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Health or Wealth: Decision Making in Health Insurance

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Abstract

In this thesis we investigate whether health insurance decisions can be explained by loss aversion. We use a model of reference dependent preferences as developed by Kőszegi and Rabin (2006) to show that under loss aversion there are different maximum willingness to pay for private health insurance. We do not endogenise the reference point. Instead we attempt to alter the reference point through framing in a laboratory setting, in a manner which is consistent with the original Tversky and Kahneman (1981) formulation of prospect theory. We find that the framing effect did not result in a difference between the proportion of subjects who purchased private health insurance. We do find that subjects make decisions closer to that of an expected utility maximiser in the treatment which is framed such that the reference point is consistent with having private health insurance, where there is a loss in health and a gain in wealth from giving up the insurance. Our result highlights the importance of framing for governments or policy makers who are attempting to influence individuals behaviour.

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1. Introduction

Throughout the OECD, countries are experiencing continued increases in expenditure for the provision of public health (Potrafke, 2010). Public health expenditure has risen by 3.5 percentage points of GDP between 1970 and 2009 (OECD, 2013). The introduction and continued support of private companies who provide health care has given the choice to individuals of how to receive their health care. Debates about reducing or slowing expenditure increases revolve around the sustainability of taxpayer funded universal health care in the face of rising income inequality and aging populations, as well as the role of the private sector in providing health care. The rise in costs for providing health care has been seen across countries with different combinations of public and private health care, and whose governments intervene in the market in different ways. Common forms of intervention into the market for private health insurance involve a mix of community rating or risk sharing[1], government funded subsidies for private health insurance, and insurance mandates which either imposes a penalty for not purchasing insurance, or forces those with insurance to seek private care (Stavrunova and Yerokhin, 2014). Choices can be influenced by the context in which they are presented (Thaler and Sunstein, 2008). As such it may be possible to increase enrolment in private health insurance through non-monetary mechanisms such as framing. Health insurance take-up can be framed differently depending on expectations. For someone without health insurance, or who expects not to purchase health insurance, the payment required for health insurance premiums is seen as a certain loss, and the gain from purchasing is only an expectation formed about future health outcomes with insurance. For someone who expects to have, or does have health insurance, the scenario is reversed. The saving from giving up health insurance is seen as a certain gain, and the loss is an expectation about future health outcomes without insurance. In a recent policy change, The Affordable Care Act of 2010 introduced a mix of these three policies in the United States. It is not

[1] For example, health insurance premiums in Australia differ state to state - but the price faced for all members of the state are the same

common for governments to use insurance mandates as a means of promoting private health insurance or to reduce the use of publicly financed health care (Stavrunova and Yerokhin, 2014). When they are used they typically do not allow for the individuals to opt out of the mandate, as in Switzerland and the Netherlands (Stavrunova and Yerokhin, 2014).

In Australia, the tax-financed national health insurance scheme called Medicare is funded through the Medicare Levy - a flat tax on total taxable income paid by all tax paying residents of Australia. Recent debate on the role of public and private health care in Australia has focused on the sustainability of Medicare as the government experiences increased health expenditure, and an aging population. Existing policies such as insurance mandates and insurance premium rebates suggest that the government has been attempting to shift the burden of health care from the public to the private sector. The insurance mandate is a penalty for not purchasing private health insurance for those with higher incomes. The penalty is a means tested[2] additional tax, called the Medicare Levy Surcharge, of between 1% and 1.5% of taxable income on all individuals or couples without an 'appropriate' level of health care[3]. The rebate is a means tested[4] subsidy on the price of all private health insurance plans. The rebate decreases with income and increases with age. The efficiency of such 'carrot and stick' approaches to increase private health coverage and provide a solution to rising health care costs is unclear. Proponents of the reforms believe that by encouraging take up of private health insurance that the burden on the publicly funded system, and hence costs are reduced. Despite an increase in the amount of individuals covered by private health insurance (Butler, 2001) there is evidence that the cost of both forgone tax revenue (higher income earners not paying the Medicare Levy Surcharge) and premium rebates is greater than the savings it provides through substitution of health

[2] There are three tiers of the surcharge. Tier 1 (1%) applies for individuals (families) who earn over \$90,000 (\$180,000). Tier 2 (1.25%) applies for individuals (families) who earn over \$105,000 (\$210,000) and no more than \$140,000 (\$280,000). Tier 3 (1.5%) applies for individuals (families) who earn over \$140,000 (\$280,000).

[3] Appropriate refers to hospital cover with an excess of less than \$500 for individuals and \$1000 for couples

[4] For a detailed look at the Medicare Levy Surcharge and insurance rebate see Appendix C

care from public to privately financed institutions. An Australian study by Cheng (2014) suggests, through a simultaneous equation model, that removing the subsidies for private health insurance premiums could yield savings for the public sector due to the relatively low elasticity of demand for private health insurance[5]. Despite the introduction of policies aimed to reduce public health expenditure, the overall share of privately financed health insurance expenditure has decreased (Paolucci et al., 2011), and public expenditure on health care has continued to increase (Australian Institute of Health and Welfare, 2011). This could be due to users purchasing private health insurance but still using the public system, since there is no ban on the use of public hospitals by the privately insured as there is in other countries with insurance mandates. The subsidies for private health insurance may not divert enough people away from the public system to cover their cost, resulting in an increase in public expenditure. In fact, when looking at the coverage of private health insurance over time (see Figure 3) it can be seen that there was a large increase in coverage between 1997 and 2000, when the aforementioned policies were introduced. Between these years the number of Australians covered by health insurance has increased by over 50 per cent. As of 2014, about 50 per cent of Australians are covered by private health insurance. These policies have had some success in increasing demand for private health insurance, but they have not brought about the corresponding expected decrease in public health expenditure.

Another policy introduced in 2000 called Lifetime Health Cover allowed for health insurance companies to discriminate their policies based on age. This policy was introduced separately to the Medicare Levy Surcharge and premium rebates. Lifetime Health Cover applies an additional 2% penalty on premiums for every year spent without appropriate health cover, for those over 30 years of age. For example, if a consumer purchases private health insurance for the first time at age 34, then her insurance premiums will be 8% higher as long as she is still covered. The introduction of this policy was essentially a liberalisation of the health insurance market as previ-

[5] The elasticity of demand reported by Cheng ranged from -0.17 to -0.18.

ously insurance companies were not allowed to discriminate on age. The policy was accompanied by an advertising drive with the theme ‘run for cover’ threatening that without purchasing private health insurance before turning 30, large penalties would apply. This extensive advertising campaign is considered by some authors (Butler, 2001; Ellis and Savage, 2008) to be the driving force of the increase in private health insurance coverage seen since 1997, rather than the ‘carrot and stick’ approach. This was also the cheapest of the three policies for the government to introduce. This indicates that there are opportunities for governments to achieve their goals of increased private health insurance coverage and decreased public health spending by utilising non-monetary incentives[6].

Investigation into decision making and demand for health insurance has typically been conducted under the assumption of perfectly rational utility maximising individuals (Ellis and Savage, 2008; Dor et al., 1987; Puig-Junoy et al., 1998; Cheng, 2014; Rodríguez and Stoyanova, 2004). There is also evidence however, that individuals often make decisions that are not in their best interest, such as not enrolling in available health insurance and not choosing optimal health insurance plans (Rice, 2013). Further there is growing evidence that individuals commit systematic errors when making choices through the use of heuristics to simplify problems as well as biases (Gilovich et al., 2002). Lower than expected take-up of private health insurance has also been noted in countries with parallel public and private health insurance, such as Spain and Australia. Costa-Font and García-Villar (2009) show through an empirical analysis that in Catalonia, demand for private insurance is influenced by risk aversion, as well as behavioural constraints, such as captivity to the public insurer. Departures from expected utility maximisation could have significant effects on insurance take-up, health and welfare outcomes, and long term budget consequences, as it may lead to the design of incentives which are ineffective, and expensive. Un-

[6] ‘Run for cover’ is not strictly a non-monetary incentive. However the advertising drive, rather than the future premium increases is claimed to have led to the increase in cover Ellis and Savage (2008).

derstanding better how people make decisions related to their health and in health insurance markets under uncertainty can be helpful for developing the optimal mix of policy relating to health care. Another factor to consider is whether decisions to purchase health insurance are motivated by wealth and expectations about future prices, or health and expectations about future need for health care, or some mix of the two. There is conflicting evidence on the role of prices in driving this decision. For example there is evidence that many individuals chose to pay an additional 1% to 1.5% of their taxable income as a penalty rather than purchase private health insurance, despite this tax burden being greater than the cost of many private health insurance plans (Stavrunova and Yerokhin, 2014)[7].

Although it is possible that consumers are uninformed, or face large transaction costs in determining their optimal health insurance coverage, we might also consider that the use of models developed largely for determining optimal behaviour in decisions involving monetary outcomes may not explain behaviour in the health domain very well. For instance, when comparing risk preferences over monetary outcomes and health outcomes in an incentivised choice experiment, Bayer and Trogdon (2014, mimeo) found that risk preferences are not related across these two dimensions and that individuals are less risk averse (more risk seeking) in health gambles. Further, preferences over wealth outcomes may not map into preferences over health outcomes with consequences being that incentivising decisions about health outcomes with money may not work as intended. While risk aversion is commonly used to explain preferences over gambles with monetary outcomes, we might also consider other classes of preferences. One such class of preferences is loss aversion as described by prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1991) who showed that individuals are risk averse when making decisions involving

[7] For an indepth discussion on dominated choices in health insurance markets see Sinaiko and Hirth (2011). For example, in choosing employee health plans, many choose to enrol in a plan which is unambiguously worse than another available plan, or do not switch plans when a better plan is made available. These decisions are dominated regardless of an individuals preferences (such as loss aversion or risk aversion).

positive outcomes (gains), and risk seeking when making decisions involving negative outcomes (losses). They expand on standard expected utility maximisation by allowing individuals to assess outcomes by comparing them to a reference point. Another is disappointment aversion (Gul, 1991) which is seen in gambling on sports where a disappointment averse individual will choose only to view the end result rather than receive intermediate updates. Probabilities can be weighted incorrectly in insurance markets, where individuals purchase insurance for events which are very unlikely to happen (Tversky and Kahneman, 1981). Finally preferences can be reference dependent as developed by Kőszegi and Rabin (2006). These preferences build on prospect theory except the reference point is determined by an individual's rational expectations. The rest of this paper will proceed as follows. Section 2 reviews the literature on the use of behavioural economics to explain decisions in health contexts and on manipulating reference points in the lab, as well as Prospect Theory and reference dependent preferences. Section 3 develops a theoretical model of the decision to purchase private health insurance and makes predictions about loss averse decision making. Section 4 describes the experimental setup. Section 5 presents the results. Finally, Section 6 concludes.

2. Literature Review

2.1. Health decisions and behavioural economics

The use of behavioural economics in modelling decisions in health has received some attention in the literature (Buckley et al., 2012; Baicker et al., 2012) along with some discussion about where behavioural economics can be used in designing better incentives for choosing private health insurance and reducing public health expenditure (Rice, 2013; Volpp et al., 2011; King et al., 2013). An experimental investigation into health insurance decisions has been conducted by Buckley et al. (2012) who use a revealed-choice experiment to investigate willingness to pay for private health insurance under different public-private financing arrangements. They found that with parallel public and private systems in place, the mean willingness to pay for private health insurance was greater than predicted by the model. This is also seen in Barseghyan et al. (2013) by comparison of deductible choice with claim probability, which shows that individuals choose home and auto insurance with a higher deductible than is expected, and could increase expected utility by changing to insurance with a lower deductible. While loss aversion can explain some of this phenomenon, it is also shown that low probability events are either vastly overweighted, or ignored when making the decision to purchase insurance (Tversky and Kahneman, 1992).

Baicker et al. (2012) suggests that health insurance coverage in the United States is lower than expected, given that many of the uninsured have low-cost insurance available to them. The reasons for the low take-up of health insurance are cited as problems understanding costs versus benefits, present bias, misunderstanding of risk, and framing by the individual of health insurance as a certain expense for a non-certain benefit (Baicker et al., 2012). King et al. (2013) discuss the potential impact that behavioural economics could have on redesigning incentives in health care to lower spending growth and have individuals make better decisions. This work in particular focuses on 'nudging' and the role of context in driving decision making. Nudging is the process of influencing decision making by altering 'choice architecture' (Thaler and Sunstein, 2008). This method has been shown to be effective in other policy areas - specifically retirement savings. Switching from opt-out to opt-in lead to an increase in participation rates in the savings program (Madrian and Shea, 2001). One other method to alter choice architecture is through framing of problems. A classic example of the effects that framing can have on decision making is the Asian disease problem first presented by Tversky and Kahneman (1981). This work shows the importance of the framing of decisions and choices. In a laboratory experiment, two groups are presented with the problem 'The US is facing a new disease expected to kill 600 people. Two programs have been proposed to combat the disease' and are asked to choose their preferred program. One group receives the 'positive' frame:

> *Under Program A 200 people will be saved. Under Program B there is a 1/3 probability that 600 are saved and 2/3 probability that no one is saved.*

The second group receives the 'negative' frame:

> *Under Program A 400 people will die. Under Program B there is a 1/3 probability of no one dying and 2/3 probability that 600 will die.*

In the positive frame, 72 per cent choose program A, and in the negative frame, 78 percent choose B. When framed positively, people are risk averse and choose the sure thing over the risky option. Under the opposite framing, despite the consequences being identical, people are risk seeking and choose the risky option over the sure thing. It has been argued that the effect of framing is that it influences the reference point as described by prospect theory. This would allow for the same person to be risk seeking and risk averse over the same choice, depending on how it is described.

2.2. Manipulating reference points

In order to determine if we can induce the reference point to subjects participating in an experiment, we first consider how this has been achieved in other work. There is a considerable body of work on the effect of framing on risky decisions[8]. Two mechanisms are considered for the observed difference in risk preferences between positively and negatively framed identical choices; framing manipulates the reference point, or framing manipulates outcome salience (Kühberger, 1998). Salience refers to the apparent over-weighting of a portion of information to which one's attention has been drawn (Taylor and Thompson, 1982). Empirical studies with direct manipulation of the reference point have not received much attention in the literature however with Abeler et al. (2011); Ericson and Fuster (2011); Gill and Prowse (2012); Banerji and Gupta (2014) the only papers attempting this. Abeler et al. (2011); Gill and Prowse

[8] For a comprehensive review of empirical studies involving framing, see Kühberger (1998).

(2012) use real-effort tasks, Ericson and Fuster (2011) uses an endowment experiment and Banerji and Gupta (2014) uses an auction mechanism.

Abeler et al. (2011) use a real-effort task and in separate treatments alter the rational expectations of subjects about potential earnings in order to alter how much effort subjects put in. In the lab, the reference points are influenced exogenously. The effort task is counting blank squares in a grid, and subjects are paid a fixed rate with 50% probability or a piece rate with 50% probability. Only after the experiment is the payment type made known to the subjects. The manipulation of the reference point is achieved through altering the fixed rate payment. Loss aversion is minimised by solving a number of tasks such that the accumulated piece rate is close to the fixed rate. In treatments with the higher fixed rate, individuals have to solve more tasks and therefore spend more effort to minimise losses. Without reference dependence, individuals would instead set marginal cost of effort to the marginal benefit (which is the piece rate) and the fixed payment should be irrelevant. They find that in the high fixed payment treatment, more effort is put in compared to the low fixed payment treatment. In addition there is a spike in the distribution of effort choice exactly at the effort level which provides the fixed payment amount.

Ericson and Fuster (2011) use an endowment experiment to manipulate reference points. Their method involves endowing subjects with a mug and allowing them with some probability to exchange the mug for a pen. They find that when the probability of exchange is low, subjects are more likely to not exchange if given the opportunity, since they expected to keep it. In a second experiment there is no endowment but the subjects are told that they would receive a mug for free with either 80 percent or 10 percent probability, or could choose between the mug and the money with 10 percent probability. Subjects who were assigned the high probability of receiving the mug valued the mug 20-30% higher than other subjects.

Banerji and Gupta (2014) uses a Becker - DeGroot - Marschak (BDM) auction. "In a BDM auction, a single bidder competes against a random draw or bid from a known distribution; if her bid beats the random draw, she wins the object and pays a price equal to the random draw; if her bid is lower, on the other hand, she loses" (Banerji and Gupta, 2014, p.92). The random distribution that subjects were competing against was $[0, 150]$ in the first treatment and $[0, 200]$ in the second. By altering the distribution that the bidder competed against, they found that bids for a chocolate bar were lower in the first treatment than the second (by about 12 percent). This shows that bidders are loss averse, as the probability of winning the auction when competing against the larger distribution is lower than when competing against the smaller distribution, for the same bid.

Gill and Prowse (2012) analyse reference dependent preferences with a two player sequential real-effort game. Two players are paired, with one designated the first mover, the other the second mover. The game is incentivised by rewarding either the first or second mover a monetary prize, with the probability of winning depending on the differences in effort of both players. The first mover participates in a real-effort task for 2 minutes. At the end of the 2 minutes, the second mover observes how much effort the first mover put in, and then plays the same game. The marginal effort for player 2 which maximises her utility does not depend on the effort exerted by player 1. More importantly, the effort level which maximises utility is also not reference dependent if the reference point is determined exogenously as in Tversky and Kahneman (1991).

2.3. Models of reference dependence and loss aversion

There are two classes of research into reference dependence and loss aversion. They both differ from standard expected utility maximisation, by identifying that people evaluate decisions in terms of gains and losses from a reference point, rather than from a final asset position. One significant difference between them is how the reference point is determined. In the original formulation of prospect theory (Tversky and Kahneman, 1981) which was later expanded to Cumulative Prospect Theory (Tversky and Kahneman, 1992) the reference point is usually defined as the current asset position or status-quo.[9] The second class of preferences are known as reference dependent preferences and allow for the reference point of a decision maker to be determined by their rational expectations about future outcomes (Kőszegi and Rabin, 2006). Each class of preferences will be discussed in further detail in the proceeding sections.

2.3.1. Prospect Theory

Developed in 1981 prospect theory was an attempt to formulate a theory to better explain how decisions are made under uncertainty. It is shown empirically that three aspects of expected utility theory are violated. These are:

1. The utility of a prospect (or choice with uncertainty) is equal to the expected utility of its outcomes.

This assumption is violated through three distinct effects; the certainty effect, the probability effect, and the possibility effect. The certainty effect highlights that in the choice between a gamble and a certain outcome, there is a strong preference for the certain outcome. When the certain outcome is replaced and the problem reformulated, then preferences reverse.[10] The probability effect shows that when evaluating prospects where the probability of 'winning' is large, then the most probable one is chosen. The possibility effect shows that when evaluating prospects where the probability of 'winning' is very small, then the prospect with the highest gain is chosen.

2. Prospects are evaluated based on final asset position.

This is shown through two choice problems where in addition to the choice between two prospects, a bonus is given.[11] In one problem, a small bonus is given and the choice is between two prospects with positive outcomes, and in another problem, a large bonus is given and the choice is between two prospects with negative outcomes. The two choice problems are identical in terms of final states but the observed preferences in the two problems are reversed.

[9] Tversky and Kahneman suggest that the reference point could also be determined by expectations or through how prospects are formulated.

[10] For details see problems 1 and 2 in Tversky and Kahneman (1981).

[11] For details see problems 11 and 12 in Tversky and Kahneman (1981)

3. People are risk averse - that is, the utility function is concave. $(u' > 0, u'' < 0)$

This is only observed in prospects where outcomes are gains. In identical prospects except where outcomes of the prospects are negative, preferences are reversed. That is, in the choice between a sure positive outcome, and a risky prospect which delivers a higher positive outcome with some probability, and zero otherwise, the certain outcome is often preferred - indicating risk aversion. However in the choice between a sure negative outcome and a risky prospect which delivers a more negative outcome with some probability and zero otherwise, the risky prospect is often preferred - indicating risk seeking behaviour. This is termed the reflection effect.

These three violations lead to the development of an alternative theory of decision making under risk. Two stages of decision making are considered; the editing stage which simplifies prospects, and the evaluation stage where the choice of the prospect with the highest value is chosen. Importantly, outcomes are measured in terms of gains and losses from a reference point. The reference point is defined as the 'current asset position' (Kahneman and Tversky, 1979) although it is mentioned that the location of the reference point may be determined by how prospects are formulated, or by expectations of the decision maker. Instead of considering the utility of a choice, they define the value of a prospect.[12] The value of a prospect contains two scaling functions, π, which affects probabilities, and a subjective value function, v, which assigns a value $v(x)$ to an outcome x where the outcome is measured from the reference point as either a gain or a loss. The value function is concave only for the domain above the reference point, unlike the utility function which is concave everywhere. Additionally, the value function is convex below the reference point. This has significant implications for decision making under risk as it implies people take risks to avoid or prevent losses indicating that they are loss averse, while they minimise risk when potential gains are offered. Since gains and losses are measured relative to a reference point, it follows that it is possible to change individuals behaviour when

[12] The explicit formulation of the function which defines the value of a prospect is excluded in this review as we instead use the model formulated by Kőszegi and Rabin (2006).

making decisions under uncertainty, if framing is able to shift the reference point.

2.3.2. Kőszegi and Rabin reference dependent references

The model for reference dependent preferences in Kőszegi and Rabin (2006) builds on the work of prospect theory developed by Tversky and Kahneman (1981). From prospect theory it is asserted that losses are always worse than gains - or utility is convex in losses, and concave in gains. The point to which losses and gains are measured is termed the reference point. In prospect theory, the reference point is the status-quo. Kőszegi and Rabin (2006) extend this by allowing the reference point to be formed endogenously based on the beliefs an individual has about their own future behaviour. That is, when considering a decision in the future, which contains an uncertain element, an individual develops a plan of their action for each realisation of the uncertain element. Then when the decision is made and the uncertainty is resolved, their action is consistent with the plan. As such the reference point is consistent with expectation and decisions are consistent with beliefs. This is termed a personal equilibrium.[13] The concept of preferred personal equilibrium is also defined, where given more than one personal equilibrium, the one with the highest utility is selected.

The model for reference dependent utility as described by Kőszegi and Rabin (2006) is explained below. The utility over a riskless outcome is denoted $u(c \mid r)$ where c is consumption and r is a reference level of consumption. This utility is comprised of two components. The first is utility from consumption only, and the second is a gain-loss utility. As such the overall utility is defined as:

$$u(c \mid r) \equiv m(c) + n(c \mid r)$$

Consumption utility and gain-loss utility are both additively separable such that gain-

[13] An example given in the paper to highlight the personal equilibrium concept considers expectations and preferences. If a person expects to buy shoes for a given price she will prefer to buy them. If she expects not to buy shoes for a given price, she will prefer not to buy them. These are both personal equilibria.

loss utility is determined separately in all dimensions. Kőzegi and Rabin preferences also include loss aversion. This arises through the gain-loss utility portion of the utility function. Gain-loss utility is defined as:

$$n(c \mid r) \equiv \mu\left(m(c) - m(r)\right)$$

The function $\mu(\cdot)$ satisfies properties of prospect theory as developed by Tversky and Kahneman (1981). That is, $\mu(\cdot)$ is continuous, and twice differentiable everywhere except $\mu(x) = 0$, strictly increasing, and is convex in gains, and concave in losses. For simplicity, Koszegi and Rabin assume linear value functions such that $\mu''(x) = 0$. This gives the following formulation:

$$\mu(x) = \begin{cases} \eta x & \text{if } x > 0 \\ \eta \lambda x & \text{if } x \leq 0 \end{cases}$$

where $\eta \geq 0$ is the weight an individual places on gain-loss utility and $\lambda > 1$ measures the degree of loss aversion. Koszegi and Rabin preferences collapse to expected utility maximisation when $\eta = 0$.

3. Modelling health insurance decisions

In what follows we develop a model of the decision to purchase private health insurance under the assumption that buyers exhibit loss aversion. In doing so, we use the simple formulation of gain-loss utility as developed by Kőszegi and Rabin (2006) and shown in Section 2.3.2. We do not use the notion of a personal equilibrium in that we do not allow potential buyers to form their own reference point, but instead use the original formulation of prospect theory where the exogenous reference point can be influenced by framing.

We model the decision to purchase private health insurance as a means of accessing better health care. We consider two kinds of health care. The first kind is public health care which is adequate for any kind of treatment. The second kind is private health care which can only be accessed when covered by private health insurance. Private health care is better than public health care for all health statuses but is more expensive. A consumer faces a simple choice; to purchase private health insurance for access to private health care at a cost of p or to utilise public health care for free. Outcomes are determined by decision, and by health status which is determined randomly. We will refer to a function H which maps health status, h, and insurance decision a into a health outcome. Here, $a = 1$ represents purchasing insurance and $a = 0$ represents not purchasing insurance. Health status is a measure of health. We treat health as a random variable with $h \in \left[\underline{h}, \overline{h}\right]$ where $\underline{h}$ is the worst health status, and $\overline{h}$ is considered perfect health. Health states are distributed by the function $f(h)$. The health outcome from purchasing private health insurance is denoted as $H(h, a = 1)$ and from not purchasing health insurance as $H(h, a = 0)$. We make some assumptions about the differences in quality of private and public health care in order to determine the shape of this health ouctome function over its domain.

3.1. Assumptions

In determining how health status maps into health outcomes for those who utilise private health care (those who decide to purchase insurance) and those who utilise public health care, we need to consider the difference between private health care and public health care. In both cases, the health outcome function depends on insurance cover and health status. The health outcome function requires several properties which capture the effect of private health care on an individuals outcomes. The key property here is that the difference between the outcome, when covered by private health insurance and when not covered, is increasing as health status decreases. We motivate this by first considering the gap in outcomes when an individual is in perfect health. We assume that if an individual is in perfect health then they require no treatment. As such the outcome with private health insurance is equal to the outcome without private health insurance.[14] To further motivate these assumptions, we now consider an individual who is in the worst health state. Private health insurance offers the benefits of the choice of doctor or specialist for any procedures or consultation. This allows for individuals to choose those who are highly specialised for their treatment. Additionally, waiting times are reduced or eliminated for patients who utilise private health care. Other benefits include a private room, and discounted access to ancillary health services which are not covered by Medicare (such as dental and orthodontic services). The ability to choose the best doctor or surgeon for procedures combined with reduced waiting times in receiving health care and supplementary health care (such as rehabilitation following surgery) offers greatly improved health outcomes when an individual is in poor health. As such we will develop a health outcome function where the difference between private health care and public health care is decreasing as health status increases. A simple linear model which obeys the assumptions described below will fulfil these general properties. We consider first a simplified linear model of health outcomes as presented below:

$$H_1 \equiv H(h, a = 1) = \alpha_1 + \beta_1 h$$

$$H_0 \equiv H(h, a = 0) = \alpha_0 + \beta_0 h$$

We make the following assumptions about $H(\cdot)$:

A.1 $\boldsymbol{\beta_1, \beta_0 > 0}$

This means that health outcomes are increasing in health status for those who are privately insured and those who are not. We would expect that for any two consumers, whether receiving treatment through private care or public care would always be better off with a better health status.

A.2 Private health care is weakly better for all health states

$$\alpha_0 + \beta_0 h \leq \alpha_1 + \beta_1 h$$

[14] Note that we are only considering the health outcomes from having private health insurance. That is we are discounting the additional cost of private health insurance.

Private health care provides better outcomes than public health care. Private health care is only weakly better because if we consider a perfect health status, there is no difference between the health outcomes for having private or public health care since treatment is unnecessary.

A.3 **The relative benefits of private health care are greater when health states are worse**

$\beta_0 > \beta_1$ such that $H(h, a = 0)$ increases faster in health status than $H(h, a = 1)$. To illustrate this, suppose an individual has the worst possible health status of $\underline{h}$. Public health care would provide sufficient treatment to restore their health. However private health insurance provides access to better services such as the choice of doctor and a private room such that $H(\underline{h}, a = 0) < H(\underline{h}, a = 1)$. The benefit that these extra services provide is assumed to be greatest when health status is worse.

A.4 **No healthcare is necessary when in the best health state**

With perfect health, there is no difference in health outcomes between private and public health care. Perfect health implies that there is no need to seek health care, whether private or public. As such the health outcome from not being treated with private health care or with public health care must be the same.

$$\alpha_1 + \beta_1 \overline{h} = \alpha_0 + \beta_0 \overline{h}$$

3.2. Decision of an expected value maximiser

For the time being assume that subjects are risk-neutral. The price of insurance is p. Further assume without loss of generality that the health outcome functions defined above are measured in money equivalents so that we can incorporate the price of insurance into the health outcome function. We can then define the expected health outcome for a risk neutral consumer who purchases private health insurance as:

$$\mathbb{E}H(h, a = 1) = \sum_{\underline{h}}^{\overline{h}} f(h) \left[\alpha_1 + \beta_1 h\right] - p \tag{1}$$

and who does not purchase private health insurance as:

$$\mathbb{E}H(h, a = 0) = \sum_{\underline{h}}^{\overline{h}} f(h) \left[\alpha_0 + \beta_0 h\right] \tag{2}$$

An individual who is maximising expected value will choose to purchase private health insurance if:

$$\sum_{\underline{h}}^{\overline{h}} f(h) \left[\alpha_1 + \beta_1 h\right] - p \geq \sum_{\underline{h}}^{\overline{h}} f(h) \left[\alpha_0 + \beta_0 h\right]$$

As such we can see that there is a price p for which individuals who are expected value maximisers will always purchase private health insurance, and will never purchase private health insurance. That is an expected value maximiser will choose to buy private health insurance by following the decision rule:

$$\text{Buy} = \begin{cases} 1 & \text{if } p < \sum_{\underline{h}}^{\overline{h}} f(h) \left[\alpha_1 - \alpha_0 + (\beta_1 - \beta_0) h\right] \\ 0 & \text{if } p > \sum_{\underline{h}}^{\overline{h}} f(h) \left[\alpha_1 - \alpha_0 + (\beta_1 - \beta_0) h\right] \end{cases} \tag{3}$$

3.3. Decision of a loss-averse individual

Since we are interested in determining the impact of loss aversion on the decision to purchase insurance, h is the health status at the point of consumption of health care in order to capture the differences in health outcomes from, for example, not having insurance and getting sick and not having insurance and being healthy. We can expand on this model to incorporate reference dependent preferences in to the health outcomes. Suppose individuals consume over two dimensions of health outcomes and wealth, such that $m(c) = c_1 + c_2$ where c_1 is health outcomes, and c_2 is wealth. Health outcomes are determined by health and insurance status. Future health status is unknown to individuals. We use the linear formulation of $\mu(x)$ as in Section 2.3.2. Outcomes for individuals are determined by both health state, and health insurance decision. This model incorporates two possible reference points. They are defined as

$R_1 \equiv \{a : a = 1\}$ which is the expectation of having private health insurance, and $R_0 \equiv \{a : a = 0\}$ the expectation of not having private health insurance. We compare the prices for which individuals will buy private health insurance under both reference points. We are using the formulation of reference dependence and gain-loss utility from Kőszegi and Rabin (2006). We do not use their notion of personal equilibrium to endogenise the reference point. Instead we assume the reference point is something that may be able to be influenced by a government or health insurance company through marketing, advertising, or information campaigns.

3.3.1. Expect to have private health insurance

Following the formulation of reference dependent preferences by Kőszegi and Rabin (2006) we need to consider both the consumption utility $m(c)$ and the gain-loss utility $n(c \mid r)$ of choices. Expected consumption utility from purchasing private health insurance is shown in Equation (1). Under expectations to purchase private health insurance, the gain loss utility from purchasing private health insurance is 0 since there is no difference between the expected outcome and the actual outcome. The reference dependent utility for purchasing private health insurance under R_1 is simply the expected utility of purchasing private health insurance:

$$\mathbb{E}H(h, a = 1, R_1) = \sum_{\underline{h}}^{\overline{h}} f(h)\left[\alpha_1 + \beta_1 h\right] - p$$

Expected consumption utility from not purchasing private health insurance is shown in Equation (2). The gain-loss utility from not purchasing is made up of two components. The first is the gain by not having to pay the price of insurance as expected. The second is the loss from the worse expected health outcomes. The reference dependent utility for not purchasing private health insurance under R_1 is therefore:

$$\mathbb{E}H(h, a = 0, R_1) = \sum_{\underline{h}}^{\overline{h}} f(h)\left[\alpha_0 + \beta_0 h\right] + \eta p + \eta\lambda \sum_{\underline{h}}^{\overline{h}} f(h)\left[\alpha_0 + \beta_0 h - \alpha_1 - \beta_1 h\right]$$

Individuals compare the expected utility of purchasing private health insurance with the expected, reference dependent utility from not purchasing private health insurance to determine prices for which they are better off purchasing:

$$\sum_{\underline{h}}^{\overline{h}} f(h)\left[\alpha_1+\beta_1 h\right]-p \geq \sum_{\underline{h}}^{\overline{h}} f(h)\left[\alpha_0+\beta_0 h\right]+\eta p+\eta\lambda \sum_{\underline{h}}^{\overline{h}} f(h)\left[\alpha_0+\beta_0 h-\alpha_1-\beta_1 h\right]$$

Solving this inequality, individuals should purchase private health insurance, under expectations to purchase, when:

$$p \leq \left(\frac{1+\eta\lambda}{1+\eta}\right) f(h) \sum_{\underline{h}}^{\overline{h}}\left[\alpha_1+\beta_1 h-\alpha_0-\beta_0 h\right] \tag{4}$$

Finally we define $\hat{p_1} \equiv \left(\frac{1+\eta\lambda}{1+\eta}\right) f(h) \sum_{\underline{h}}^{\overline{h}}\left[\alpha_1+\beta_1 h-\alpha_0-\beta_0 h\right]$ as the maximum willingness to pay for private health insurance under R_1 which is the expectation to have private health insurance.

3.3.2. Expect not to have private health care

Under expectations not to purchase private health insurance, there is no gain-loss utility when the expected outcome and the realised outcome are the same. As such the expected utility of not purchasing private health insurance under R_0 is just the consumption utility of not purchasing private health insurance:

$$\mathbb{E}H(h, a=0)=\sum_{\underline{h}}^{\overline{h}} f(h)\left[\alpha_0+\beta_0 h\right]$$

Expected consumption utility from purchasing private health insurance is shown in Equation (1). The gain-loss utility from purchasing is made up of two components. The first is the loss by having to pay the price of insurance. The second is the gain from the better expected health outcomes. The expected, reference dependent utility for purchasing private health insurance under R_0 is therefore:

$$\mathbb{E}H(h, a=1, R_0) = \sum_{\underline{h}}^{\overline{h}} f(h)\left[\alpha_1 + \beta_1 h\right] - p - \eta\lambda p + \eta \sum_{\underline{h}}^{\overline{h}} f(h)\left[\alpha_0 + \beta_0 h - \alpha_1 - \beta_1 h\right]$$

Individuals compare the expected utility of purchasing private health insurance with the expected, reference dependent utility from not purchasing private health insurance to determine prices for which they are better off purchasing:

$$\sum_{\underline{h}}^{\overline{h}} f(h)\left[\alpha_1 + \beta_1 h\right] - p - \eta\lambda p + \eta \sum_{\underline{h}}^{\overline{h}} f(h)\left[\alpha_0 + \beta_0 h - \alpha_1 - \beta_1 h\right] \geq \sum_{\underline{h}}^{\overline{h}} f(h)\left[\alpha_0 + \beta_0 h\right]$$

Solving this inequality, individuals should purchase private health insurance, under expectations to not purchase private health insurance when:

$$p \leq \left(\frac{1+\eta}{1+\eta\lambda}\right) f(h) \sum_{\underline{h}}^{\overline{h}} \left[\alpha_1 + \beta_1 h - \alpha_0 - \beta_0 h\right] \tag{5}$$

As above we define $\hat{p_0} \equiv \left(\frac{1+\eta}{1+\eta\lambda}\right) f(h) \sum_{\underline{h}}^{\overline{h}} \left[\alpha_1 + \beta_1 h - \alpha_0 - \beta_0 h\right]$ as the maximum willingness to pay for private health insurance under R_0. So individuals choose to purchase private health insurance provided the price is no greater than the loss in expected health outcomes from not having private insurance. With reference dependence, this is scaled by the terms $\frac{1+\eta\lambda}{1+\eta}$ and $\frac{1+\eta}{1+\eta\lambda}$. We assume, following Kőszegi and Rabin (2006) that $\lambda > 1$ and $\eta \geq 0$ and ignore the special case where $\eta = 0$.[15] Therefore $\frac{1+\eta\lambda}{1+\eta} > 1$ and conversely $\frac{1+\eta}{1+\eta\lambda} < 1$. This leads to the hypothesis:

$$\hat{p_1} > \hat{p_0}$$

Proposition 1. *An individual who is loss averse with reference dependent preferences has a higher maximum willingness to pay for private health insurance when she has a reference point consistent with expectations to purchase private health insurance than*

[15] Allowing $\eta = 0$ reduces this problem to standard expected utility maximisation without reference dependence.

when her reference point is consistent with expectations not to purchase private health insurance.

3.4. Discussion

If individuals are loss averse and framing can influence their reference point, then it is possible to nudge people to buy more private health insurance by describing the benefits and losses of private health insurance as if they already had health insurance (where forgoing private health insurance has a gain of the price and a loss of worse future health outcomes) and if they did not have private health insurance (where buying private health insurance has a loss of the price paid and a gain of better health outcomes)

3.5. Risk Averse Consumer

It is necessary to show that our result from a simple linear model of health outcomes also applies when individuals are risk averse. We introduce a utility function $U(\cdot)$ which is concave such that $U'(\cdot) > 0$ and $U''(\cdot) < 0$. In order to simplify equations, the expected consumption utility from purchasing private health insurance will be referred to as H_1. For not purchasing private health insurance, the expected consumption utility will be referred to as H_0. These correspond to Equations (1) and (2). Further we assume that utility is quasilinear in incomes such that $U(H_1 - p) = U(H_1) - p$. Under the reference point R_1 the utility from purchasing private health insurance is the consumption utility of private health insurance:

$$\sum_{\underline{h}}^{\overline{h}} f(h)U(H_1(h)) - p$$

The utility from not purchase health insurance under R_1 is the consumption utility of not having private health insurance and the gain-loss utility from not purchasing:

$$\sum_{\underline{h}}^{\overline{h}} f(h)U(H_0(h)) + \eta\lambda \left[\sum_{\underline{h}}^{\overline{h}} f(h)U(H_0(h)) - \sum_{\underline{h}}^{\overline{h}} f(h)U(H_1(h)) \right] + \eta p$$

Following the reasoning from Section 3.3 a risk averse individual under the reference point R_1 will purchase private health insurance if:

$$p \leq \left(\frac{1+\eta\lambda}{1+\eta} \right) \left[\sum_{\underline{h}}^{\overline{h}} f(h)U(H_0(h)) - \sum_{\underline{h}}^{\overline{h}} f(h)U(H_1(h)) \right] \tag{6}$$

For a consumer under the reference point R_0 the utility from not purchasing private health insurance is the consumption utility of public health care:

$$\sum_{\underline{h}}^{\overline{h}} f(h)U(H_0(h))$$

and the utility from purchasing private health insurance is the consumption utility of having private health insurance and the gain-loss utility from purchasing:

$$\sum_{\underline{h}}^{\overline{h}} f(h)U(H_1) - p + \eta \left[\sum_{\underline{h}}^{\overline{h}} f(h)U(H_0(h)) - \sum_{\underline{h}}^{\overline{h}} f(h)U(H_1(h)) \right] - \eta\lambda p$$

Therefore a risk averse individual under the reference point R_0 will purchase private health insurance if:

$$p \leq \left(\frac{1+\eta}{1+\eta\lambda} \right) \left[\sum_{\underline{h}}^{\overline{h}} f(h)U(H_0(h)) - \sum_{\underline{h}}^{\overline{h}} f(h)U(H_1(h)) \right] \tag{7}$$

4. Experimental design

In order to test our proposition, we require the use of a laboratory setting to induce preferences of individuals who have different expectations about purchasing private health insurance. This is necessary because no data set exists which allows us to identify the effect.

4.1. Experimental Procedure

We conducted six sessions with 3 sessions for each treatment. Overall, 132 subjects participated in the experiment. Each experiment took approximately ten minutes and so was conducted at the end of an unrelated experiment. Subjects were recruited through the Online Recruitment System for Economic Experiments, ORSEE (Greiner, 2004). This ensures that the subjects invited to participate in the experiment had not previously attended. The experiment was conducted in the Adelaide University Experimental Economics lab (ADLAB) and was programmed using zTree (Fischbacher, 2007). A between-subject design was used to ensure that each subject participated only in one treatment. Within each treatment subjects were asked to make 16 decisions about purchasing private health insurance. This was a one shot game. Subjects were shown 16 prices from 0 to 300 and asked to decide whether they would purchase private health insurance for that price. Our method for influencing the expectations about private health insurance was through framing the decisions differently in the two treatments. We call our treatments R_0 and R_1 which coincide with the reference points described in Section 3.3. Before the experiment began subjects were given written instructions explaining the payoff functions for private health insurance and for not having private health insurance, and shown a table describing payoffs for different health statuses. In treatment R_0 the payoffs shown were 'Gain in Wellbeing from purchasing private health insurance' and 'Cost of Private Health insurance' and in treatment R_1 the payoffs shown were 'Loss in Wellbeing from not purchasing Health Insurance' and 'Saving from not purchasing Health Insurance'. By presenting the information in such a way, the instructions coincide with the reference points we attempt to induce. That is, treatment R_0 is consistent with the reference point being expectation not to have private health insurance, and treatment R_1 is consistent with the reference point being the expectation to have private health insurance. The written instructions which were given to the subjects are available in the Appendix.

4.2. Treatments

As explained above, our method of influencing the reference point of subjects is through the written instructions they receive. If the subjects are loss averse and have reference dependent preferences, this should influence the cut-off price for which they will purchase private health insurance. Subjects are compared across all treatments and the decision task is identical in both treatments. That is, subjects are asked to make the same decisions with the same payoff functions in both treatments. The framing in both treatments occurs by showing a table indicating what the gains and losses are for each health status. Both of these tables are shown below in Table 1.

Health Status Drawn	Gain in Wellbeing from Health Insurance	Cost of Health Insurance
1	240	-Price
2	210	- Price
3	180	- Price
4	150	-Price
5	120	-Price
6	90	-Price
7	60	-Price
8	30	-Price
9	0	-Price

(a) Payoffs shown in Treatment R_0

Health Status Drawn	Loss in Wellbeing without Health Insurance	Saving from not purchasing Health Insurance
1	-240	Price
2	-210	Price
3	-180	Price
4	-150	Price
5	-120	Price
6	-90	Price
7	-60	Price
8	-30	Price
9	0	Price

(b) Payoffs shown in Treatment R_1

Table 1: Difference in instructions across the two treatments. Subjects only received the table corresponding to one treatment.

The demographics of the subjects in the two treatments is shown below in Table 2. The two treatments are very similar in terms of demographics.[16] There is a relatively

[16] Note that the two treatments are not significantly different in any demographic variable except

even split of males and females, and a high proportion of the subjects had studied high level maths in high school. The majority of subjects are aged 16-25 undergraduate students who are studying either commerce or engineering.

	Overall	Treatment R_0	Treatment R_1
Gender (Male=1)	0.63	0.61	0.66
Studied High Level Maths in High School (Yes=1)	0.71	0.76	0.66
Age Group			
16-25	0.70	0.67	0.74
26-30	0.17	0.22	0.13
31-40	0.07	0.04	0.11
41-50	0.04	0.06	0.02
Over 60	0.01	0.02	0.00
Highest University Degree			
Postgraduate Coursework	0.23	0.29	0.17
Postgraduate Research	0.12	0.16	0.09
University Undergraduate	0.62	0.55	0.70
Vocational Training	0.01	0.00	0.02
Year 12 or under	0.01	0.00	0.02
Course Studying			
Arts	0.09	0.12	0.06
Commerce/Finance	0.27	0.27	0.26
Economics	0.10	0.12	0.09
Engineering	0.30	0.27	0.32
Law	0.05	0.06	0.04
Medicine	0.12	0.14	0.11
None	0.01	0.00	0.02
Other	0.06	0.02	0.11
Observations	98	51	47

Table 2: Summary Statistics of the demographics in the two treatments

for course studied. Treatment R_1 has more subjects who studied 'Other' than treatment R_0 at the 10% significance level for a two tailed test of the difference in the proportion.

4.3. Health insurance decision

Subjects are asked to make 16 decisions about purchasing private health insurance. For each decision they could indicate yes or no to paying a price $p \in [0, 300]$. The price of health insurance increased in increments of 20. Subjects must make a yes or no decision for all prices. No feedback is given until all decisions have been made. Once all decisions have been made a health status was drawn which determined the subject's payoffs for all 16 choices. The health status is drawn randomly from a uniform distribution between 1 and 9. Out of the 16 decisions made, 1 decision was drawn and the payoff for this decision was paid. Recall that payoffs depend on h, p, and insurance decision a in the following way:

$$H(h, p, a = 1) = \alpha_1 + \beta_1 h - p$$

$$H(h, p, a = 0) = \alpha_0 + \beta_0 h$$

In the experiment we use $\alpha_1 = 200, \alpha_0 = -70, \beta_1 = 40, \beta_0 = 70$. These parameters have been chosen in order to offer a large difference between payoffs when a subject receives the lowest health status, and when they receive the highest health status. Further as discussed in our assumptions, we assumed that the health outcomes for private health care and public health care were the same when the subject had the highest health status. This assumption is satisfied by our choice of parameters[17].

4.4. Predictions

We can identify if subjects in the experiment understood the instructions and the game by their decisions. Not buying private health insurance when the price is 0 is a strictly dominated strategy. A rational subject will make his decision by comparing the benefit from private health insurance, which is better health outcomes, with the cost, that is the price. The price below which a subject buys private health insurance

[17] We use a linear formulation for health outcomes in the experiment so that subjects can calculate simply the effect of their decisions.

depends on her risk preferences and loss aversion if it exists. Using the parameters previously described, an individual who is risk neutral and does not have reference dependent preferences ($\eta = 0$) purchases private health insurance if:

$$p \leq 270 - 30\frac{1}{9}\sum_{1}^{9} h$$

$$p \leq 120$$

If the subject still does not have reference dependent preferences, but is risk averse rather than risk neutral, then she will have a higher cut-off price than the one above.

Besides the framing of the decision problem, the two treatments are identical. As such, any differences between treatments can be attributed to the effect that the framing had on setting the expectations of the subjects. This is because if a subject does not have reference dependent preferences, then the framing will have no effect. However if the subject does have reference dependent preferences, then shifting the reference point will change his behaviour. Assuming risk neutrality and the reference dependent preferences discussed above, the cut-off price under reference point R_1 (i.e. insurance is purchased) will be determined by:

$$p \leq \left(\frac{1+\eta\lambda}{1+\eta}\right)\left[200 + 70 + \frac{1}{9}(40-70)\sum_{1}^{9} h\right] \equiv \hat{p_1}$$

Under the R_0 reference point (i.e. insurance is not purchased) a subject with reference dependent preferences will purchase private health insurance if:

$$p \leq \left(\frac{1+\eta}{1+\eta\lambda}\right)\left[200 + 70 + \frac{1}{9}(40-70)\sum_{1}^{9} h\right] \equiv \hat{p_0}$$

As discussed in Section 1, $\hat{p_0} < \hat{p_1}$. The magnitude of the effect depends on the parameters of loss aversion such that $\hat{p_1} = \hat{p_0}\left[\left(\frac{1+\eta\lambda}{1+\eta}\right)^2\right]$. As such if a framing effect exists we should see a higher willingness to pay for health insurance in the treatment R_1 than in the treatment R_0. While the exact cut-off price $\hat{p}$ in the different treatments will depend on the loss aversion parameters η and λ, the ordering of $\hat{p_1} > \hat{p_0}$ will be observed provided that $\eta > 0$ and $\lambda > 0$ which is the case if we observe reference dependent preferences.

Hypothesis 1. *Observe more private health insurance buying decisions (or equivalently a higher maximum price) in the treatment where the framing is consistent with expectations to buy private health insurance (R_1) than in the treatment where the framing is consistent with expectations not to buy (R_0).*

5. Estimation and Results

In determining whether our hypothesis was correct we can use either the average maximum price that was paid for health insurance in both treatments or the frequency of buying in both treatments. Frequency of buying is determined by the number of 'yes' decisions by each individual in each treatment out of a possible 16. In treatment R_0, 53 per cent of decisions were to buy private health insurance, compared to 50 per cent in treatment R_1. A Wilcoxon rank-sum test[18] where the number of times the subject chose 'buy' is treated as the independent variable fails to reject the null-hypothesis that there is a difference between the intensity of buying private health insurance in the two treatments ($z = 0.849$). Further we do not find a relation between the frequency of buying private health insurance and socio-demographics. The model estimated is:

$$f = \alpha + \beta T + \gamma X_i + \varepsilon_i$$

where T is the treatment variable, and X_i is a vector containing socio-demographic variables including gender, whether the subject did high-level maths in year twelve, whether the subject had an undergraduate degree or not, whether the subject was

[18] Individuals who did not purchase private health insurance when the price was zero have been excluded from the sample for this test, and for all proceeding analysis. The reason for this is that these subjects clearly have not understood the experiment properly, as buying private health insurance when the price is 0 is a dominant strategy. As such we are unaware if the framing effect influenced their reference point or not. In treatment R_0 19 observations were removed (from a total of 70). In treatment R_1 15 observations were removed (from a total of 62). This leaves 99 observations used in the analysis.

over 25, and which course a subject was studying if they were at university. The reference group is: female who is over 25, with an undergraduate degree, studying in arts, who did not do high-level maths in high school. A tobit model is used since the fraction of insurance bought is bound between 0 and 1.[19] The results from the regression are presented in Table 3. It can be seen that there is no significant difference between purchasing intensity across treatments or across any of the socio-demographic variables.

	β	OLS Standard Errors
Treatment	5.971	(14.686)
Gender (Male=1)	−23.138	(15.116)
Studied High Level Maths in High School (Yes=1)	−8.594	(16.982)
Age		
26-30	−22.687	(19.956)
31-40	−64.762**	(30.186)
41-50	20.956	(36.159)
Over 60	−75.819	(69.362)
Highest Degree		
Postgraduate Research	−21.095	(25.308)
University Undergraduate	−20.409	(19.559)
Vocational Training	−11.150	(77.597)
Year 12 or under	−21.493	(75.997)
Course		
Commerce/Finance	−2.390	(29.767)
Economics	23.671	(33.441)
Engineering	26.083	(29.838)
Law	57.672	(39.343)
Medicine	6.734	(31.807)
Other	−37.114	(74.667)
Science	−36.193	(38.201)
Constant	183.970***	(33.929)
Obvservations	99	
Prob>F	0.33	

Table 3: Estimation of Equation (5).

Moving from this aggregated data, we can shift our focus to the decisions made by each individual for each price. Below in Figure 1 is the proportion of subjects who purchased private health insurance for a given price, in each treatment. If the

[19] There are zero left censored observations (≤ 0) and five right censored observations (≥ 1).

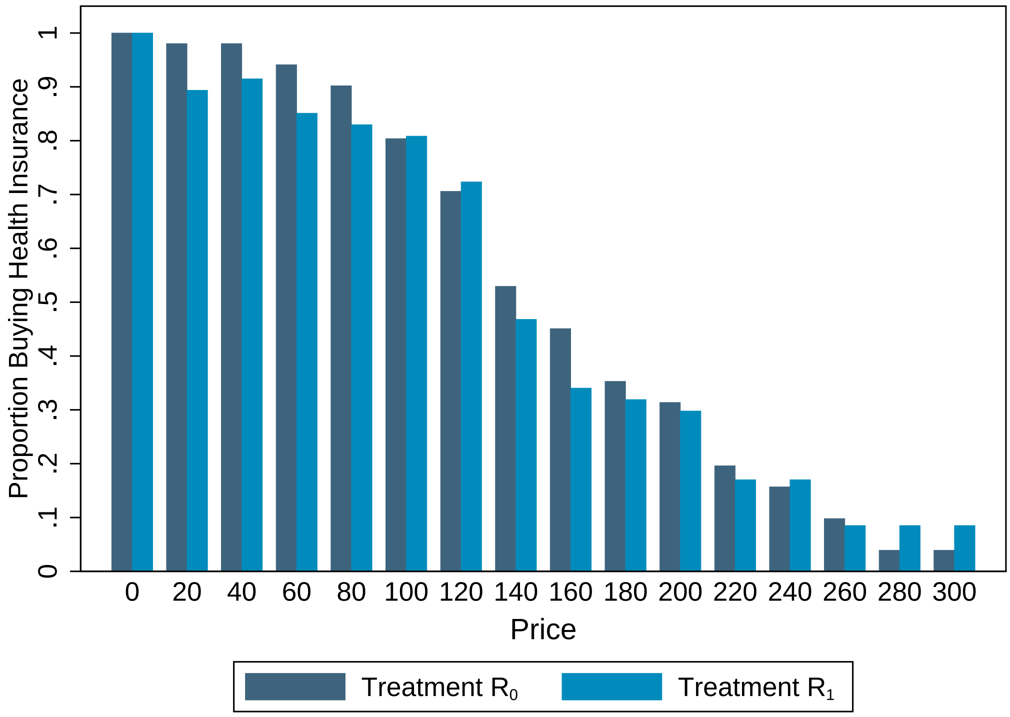


Figure 1: Proportion of subjects who purchased private health insurance for each price in the two treatments.

subjects in the experiment were expected utility maximisers we would see a clear cut-off between buying decisions and not buying decisions. There does not appear to be such a cut-off in the data. Instead we see a slow decline in the proportion of subjects who purchase insurance from all subjects purchasing insurance[20] when the price is 0 and approaches no subjects buying insurance as the price increases. Between the two treatments there does not appear to be a noticeable difference in the decision making. By visual inspection, it appears that the proportion of buying health insurance is lower, for many prices, in the treatment R_1 than in the treatment R_0. However, if we compare the proportions across the two treatments using a two group (two sided) proportion test, then we fail to reject to null hypothesis at the 5% level that the difference is zero, for each price.

We still do not observe a strict cut-off between buying and not buying in either treatment. As such we might expect that a structural decision model which allows

[20] The proportion of subjects who buy insurance when the price is zero is defined to be 1, since the observations of those who did not purchase for this price have been removed from the sample for all proceeding analysis.

for some degree of bounded rationality and noise when making decisions may provide an explanation for the apparent shape of the decision rule observed in the data. In order to do this we can use a model of expected utility with noisy probabilistic choice.

5.1. Probabilistic Choice Model

The advantage to using a model of probabilistic choice is that it allows for subjects to make mistakes, and also allows determination of risk behaviour. It is clear that subjects are making mistakes when comparing the observed decisions to decisions which would have been made under expected utility maximisation, or with reference dependent preferences. In order to look at the risk behaviour of the subjects we first assume that the subjects have constant relative risk aversion (CRRA), and that utility is quasilinear in health outcomes and wealth such that their utility function is given by $U(H_a - p) = U(H_a)^r - p$. We use this formulation for two reasons. Firstly, as reported by Bayer and Trogdon (2014, mimeo), risk preferences across health states and wealth states are not correlated. Secondly, if the actual utility function of individuals is not additively separable as we assume, then the utility function we use is transformed such that the price is the certainty equivalent of the difference between the utility of the two gambles. Using the parameters defined previously, the expected utility from buying health insurance is:

$$\mathbb{E}U(h, a = 1) = \left(200 + 40 \times f(h) \sum_{h=1}^{9} h\right)^r - p$$

and from not buying is:

$$\mathbb{E}U(h, a = 0) = \left(-70 + 70 \times f(h) \sum_{h=1}^{9} h\right)^r$$

With this formulation of risk preferences, $r < 1$ indicates risk aversion, $r = 1$ indicates risk neutrality and $r > 1$ indicates risk seeking behaviour[21]. Given the separa-

[21] This formulation for CRRA implies that the utility function in health does not necessarily have to be concave.

ble utility function, the risk preferences which we identify apply only to the health domain. That is, if a subject is risk averse then they will purchase private health insurance for a price higher than if they were expected utility maximisers. An expected utility maximiser would choose to buy insurance with the following probabilities:

$$\text{prob}(a = 1 \mid p) = \begin{cases} 1 & \text{if } \mathbb{E}U(h, a = 1) - \mathbb{E}U(h, a = 0) > \hat{p} \\ 0 & \text{if } \mathbb{E}U(h, a = 1) - \mathbb{E}U(h, a = 0) \leq \hat{p} \end{cases} \tag{8}$$

Figure 1 shows the proportion of individuals who purchases private health insurance, for each price, in both treatments. It can be seen that there is no clear cut-off between decisions to buy and decisions not to buy. We can introduce some noise into the decision making of the subjects which allows them to make mistakes when making their decisions. As 15 of the 98 subjects analysed had invalid switching choices (such as having more than one switch between buy and not buy decisions),this noisy probabilistic choice model introduces a parameter μ which allows for individuals to tremble in their decision making. Under such a model, individuals will purchase private health insurance with a probability defined by:

$$\text{prob}(a = 1 \mid p) = \frac{[\mathbb{E}U(h, a = 1) - p]^{\mu}}{[\mathbb{E}U(h, a = 1) - p]^{\mu} + [\mathbb{E}U(h, a = 0)]^{\mu}} \tag{9}$$

The probability of buying private health insurance in this model is dependent on the price of insurance, the difference in utility between purchasing and not purchasing private health insurance, the parameter μ which is a measure of how much noise is present in individuals decision making, and r which is a measure of risk preferences. The parameters μ and r which best fit the data will be estimated. As $\mu \to 0$ the probability of buying health insurance conditional on the price approaches $\frac{1}{2}$, that is the decision to purchase or not becomes completely random for every price. As $\mu \to \infty$ the choice model converges to the step function of an expected utility maximiser who purchase private health insurance consistent with the model shown in Equation (8). We also observe that as the difference in expected utility of the two outcomes increases then the probability of choosing the outcome with the higher expected utility increases. Furthermore, we allow the risk aversion coefficient to depend on individual characteristics, such as age, gender, in order to account for the heterogeneity of the subjects. This model can be estimated using Maximum Likelihood. The log-likelihood is simply the natural log of the probabilistic choice function such that the values of r and μ which maximise Equation (10) are estimated.

$$\log \mathcal{L} = \log \left(\frac{[\mathbb{E}U(h, a = 1) - p]^{\mu}}{[\mathbb{E}U(h, a = 1) - p]^{\mu} + [\mathbb{E}U(h, a = 0)]^{\mu}} \right) \tag{10}$$

The results are presented below in Table 4.

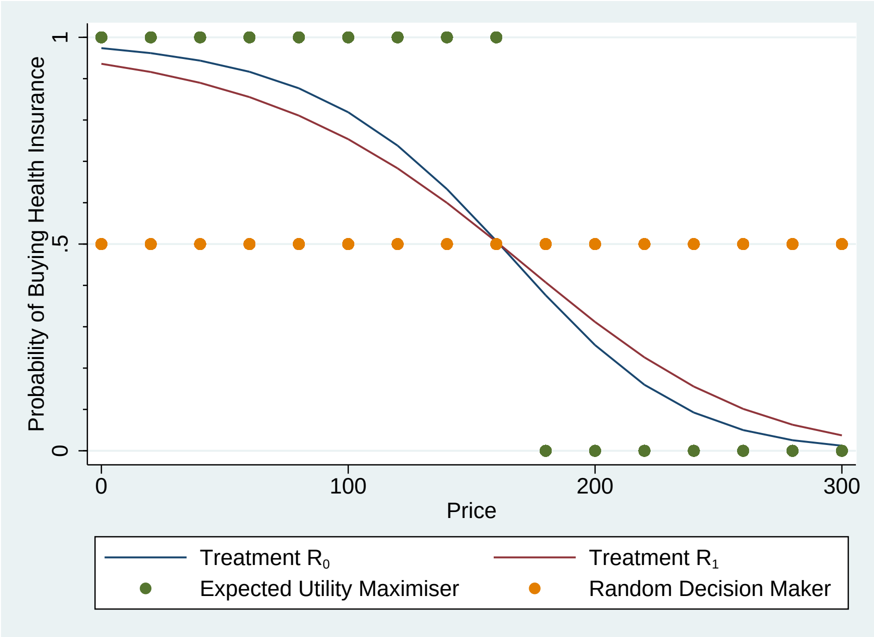
	(1) MLE β	Standard Errors
$\mu =$		
Treatment	−3.106*	(1.818)
Studied High Level Maths in High School (Yes=1)	−0.880	(1.793)
Constant	15.433***	(3.343)
$r =$		
Treatment	−0.007	(0.014)
Over 25	−0.015	(0.015)
Gender (Male=1)	−0.018	(0.013)
Constant	0.730***	(0.019)
Obvservations	1568	
Prob>F	0.23	

Table 4: Maximum Likelihood Estimation of risk preferences and noise in decision making.

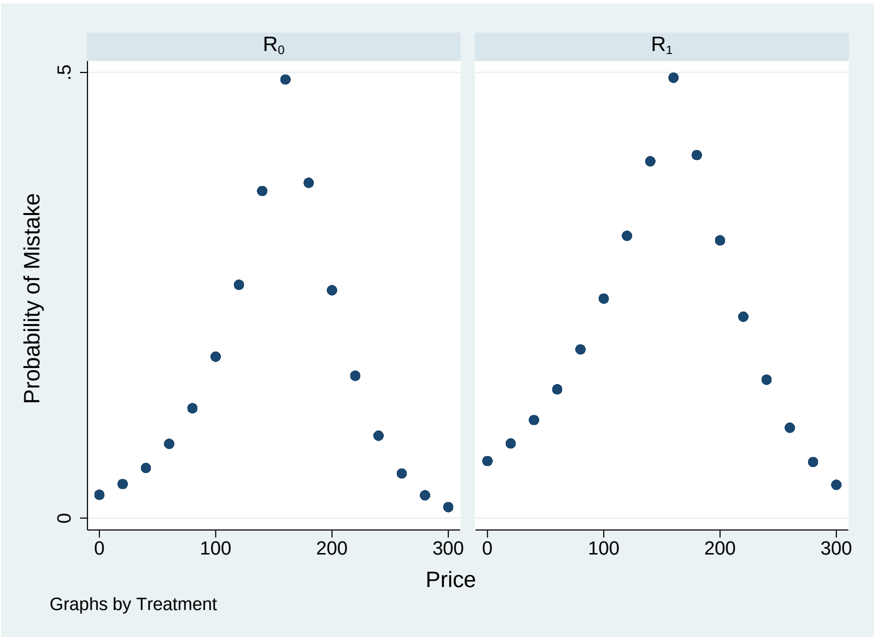
It can be seen that there is a treatment effect on the amount of noise or randomness in the decisions of the subjects. The treatment effect remains significant (at the 10 per cent level) with the inclusion of variables capturing some socio-demographic effects which could influence quality of decision making (gender, high-maths, and age). More observations would be required to include the effect of university course and highest level of education. In treatment R_0 (expectation is not to buy private health insurance) the proportion of subjects who bought insurance at a price of 0 was

0.9725 and in treatment R_1 (expectation is to buy private health insurance) the proportion of subjects who bought insurance at a price of 0 was 0.9431. The difference between them is significant ($z = 7.55$). If the subjects were perfect expected utility maximisers, the probability of buying at a price of 0 should be 1. In both treatments the proportion who bought is significantly different from 1. Further we observe that there is no treatment effect, and also no difference between genders or by age, on the risk preferences. Our hypothesis was that framing had an impact on the propensity to buy health insurance. In the probabilistic choice model, the propensity to buy health insurance is determined by risk preferences, as this is what determines the price at which individuals switch from buying to not buying. As such, the data that we have collected does not support our hypothesis that we would observe more private health insurance buying decisions in the treatment where the framing is consistent with expectations to buy private health insurance than in the treatment where the framing is consistent with expectations not to buy . Therefore if the government or an insurance company were attempting to increase the take up of private health insurance through the use of a framing mechanism, then they may see little impact.

On the other hand, the precision of choices is increased when the problem is framed as a gain of private health insurance. That is, we observe that the parameter capturing how noisy decisions are (μ), is lower in treatment R_1 than in treatment R_0. This indicates that the decisions made by subjects in treatment R_1 more closely resemble that of an expected utility maximiser (who has the same risk preferences as the average subject) compared to the subjects in treatment R_0. This is highlighted in Figure 2a. That means there is some benefit to using framing as a mechanism for influencing decision making in health insurance. As discussed previously it appears that individuals find some difficulties in choosing health insurance plans. If people make better choices when they are shown the gains of purchasing health insurance in terms of their health outcomes (ie better fitness, reduced waiting times) then we may be able to improve welfare of individuals. In what follows, the welfare implication of inducing people to make less noisy choices is quantified.



(a) Decision rule of an expected utility maximiser, average subject in treatment R_0, average subject in treatment R_0, and a random decision maker.



(b) Probability of the average individual making a mistake in treatment R_0 and R_1.

Figure 2: Impact of difference in precision of decision making in the two treatments on the decision rule of an average subject, and the probability of making a mistake.

5.2. Welfare Comparison

In what follows we take our model seriously in order to evaluate the welfare gain from framing due to individuals making more precise decisions. We can compare the two treatments in terms of how much surplus is produced relative to an individual who makes decisions randomly. First we need to calculate the decision rule which an expected utility maximiser with the same risk preferences as the average subject would make. Then we introduce noise into the decision making process such that the formulation of the decision rule matches that of Equation (9). We use the parameters estimated from the maximum likelihood model. The average coefficient of risk aversion across both treatments is estimated to be $\hat{r} = 0.703$. In treatment R_0 the average estimated coefficient of noise is $\hat{\mu}_{R_0} = 11.65$ and in treatment R_1 is $\hat{\mu}_{R_1} = 8.64$. The decision rule for an average subject in treatment R_0 and treatment R_1, as well as for an individual who maximises expected utility without bounded rationality, and an individual who plays randomly is shown in Figure 2a. We use the different decision rules to determine the differences in welfare arising from the different precision of decision making. The difference between the four decision rules is in the probability that a subject makes a mistake. We define a decision as a mistake if it does not coincide with the decision of an expected utility maximiser. We define the probability of an individual making a mistake as the absolute value of the difference between the decision of an expected utility maximiser and the decision of an average individual in each treatment. Figure 2b shows the probability of a mistake being made for both treatments. The probability of a mistake being made increases as the price approaches the point where the expected utility maximiser switches his decision. Since the risk preferences in both treatments are the same, the switching point for treatment R_0 and R_1 is the same, occurring when the price of insurance is 140. There is a difference between the two treatments. It can be seen that in treatment R_1 the probability of making a mistake for low prices (less than 100) appears higher than in treatment R_0. In quantifying the total welfare in each treatment we denote the probability a subject makes a mistake in either treatment as $p(m_i)$. Denote the welfare in either treatment as W_i where i represents the treatment (either R_0, or R_1). As we did not observe a difference in risk preferences between the two treatments the cut-off price for purchasing insurance is the same on average in both treatments, and is denoted $\hat{p}$. Welfare (sum of utility) can be determined by the following:

$$W_i = \begin{cases} p(m_i)\left(\mathbb{E}U(H_0)\right) + (1 - p(m_i))\left(\mathbb{E}U(H_1) - p\right) & \text{if } p \leq \hat{p} \\ p(m_i)\left(\mathbb{E}U(H_1) - p\right) + (1 - p(m_i))\left(\mathbb{E}U(H_0)\right) & \text{if } p > \hat{p} \end{cases} \tag{11}$$

In the case where subjects are perfect expected utility maximisers, $p(m_i) = 0$. In the case where subjects play randomly, $p(m_i) = 0.5$, such that subjects are indifferent between buying and not buying for all prices. The measure of welfare we use is how much of the surplus from rationality is realised in the two treatments. That is, what proportion of the welfare gain between an expected utility maximiser and a subject who plays randomly is realised when subjects follow a decision rule governed by the noisy probabilistic model. In both treatments there is a loss in welfare compared to an expected utility maximiser:

Treatment	Rationality Surplus Realised (%)
R_0	83%
R_1	73%

Table 5: Proportion of rationality surplus realised in both treatments.

6. Conclusion

This study investigates the affect of framing on the decision of individuals to purchase private health insurance. We consider that framing is able to effect decision making on individuals who have reference dependent preferences and are loss averse. We develop a model of the decision to purchase private health insurance as a means to access better health care. Our model is formulated using a model of reference dependent preferences by Kőszegi and Rabin (2006); however we do not endogenise the reference point. Instead we use the original formulation of prospect theory by Tversky and Kahneman (1981) and treat the reference point as manipulable by framing. Our model considers two reference points - the expectation of having private health insurance and the expectation of not having private health insurance. We attempt to induce these reference points using a controlled laboratory experiment. Our framing is implemented by giving instructions the participants of the experiment which describe the decision to purchase health insurance in terms of the gains and losses. If individuals had reference dependent preferences and were influenced by the framing, we would observe different frequencies of health insurance purchases in the two treatments. We test whether this effect is observed. Further, we test whether there is a relation between socio-demographic variables and buying health insurance. In addition to this we use a model of noisy probabilistic choice to estimate risk preferences and the precision of decision making.

We find that there is no effect of the framing on decisions to purchase private health insurance. In both treatments we observe similar purchasing decisions in terms of the price at which subjects switch from buying to not buying private health insurance. This price is 140 in both treatments. We also identify risk preferences for subjects over their health status and find that subjects are on average risk averse. The average risk aversion coefficient is $r = 0.703$. There is no difference between risk preferences across the two treatments. We do find that there is a difference in the quality of decision making across the two treatments. This is identified through a model of noisy probabilistic choice. We estimate a parameter μ which quantifies the quality of decision making in reference to an expected utility maximiser. In treatment R_0 this parameter is $\mu = 11.65$ and in treatment R_1 is $\mu = 8.64$. Subjects in the treatment where the framing attempts to influence the reference point such that subjects do not already have health insurance make decisions which more closely resemble the decisions of an expected utility maximiser. These results have some implications for policy in the future. Firstly since we do not identify any framing effect on the decision to purchase private health insurance, then policy makers need to consider that framing may not be a suitable mechanism for influencing decisions in the health insurance domain. There does appear to be a benefit to framing health insurance decision problems as a gain in terms of health outcomes for a loss in the price paid. When the problem was framed in this way, the decision making of subjects in the experiment were more precise in the sense that they more closely resembled the decision of an expected utility maximiser. There is potential to use framing in this way in order to reduce the number of individuals who make poor decisions when purchasing health insurance.

There are some limitations to this work. Caution should be taken in extrapolating results from an incentivised controlled lab experiment to contexts outside of this setting. The results obtained in this work can only strictly be interpreted as results in this specific setting. Application of these results outside of this setting will not necessarily result in the same outcomes. Further, it appears that some subjects may not have read the instructions thoroughly, as evidenced by the fifteen subjects who did not purchase private health insurance when the price was zero. This may have had an impact on the framing effect not being observed in the data. A more appropriate mechanism may be to show the subject the impact of their decision, every time a decision is made. For example, in treatment R_0 when a subject is asked whether they want to buy insurance when the price is 100, they would be shown the table shown in Table 1a.

Future research related to this topic could revolve around the importance of the reduction in waiting times that is offered by private health insurance such that the loss aversion motivation for purchasing private health insurance is about reducing waiting time, rather than price or health outcomes. We could also incorporate different types of health insurance plans rather than simply choosing comprehensive private or comprehensive public care.

A. Instructions - Treatment R_0

Instructions

Below you will find instructions for the game you are about to play. Please read them silently. If you have any questions, raise your hand and one of the lab supervisors will come to you.

The Game

You are about to play a game involving economic decision making. In this game you will be asked to decide to buy health insurance or not. You must make this decision without knowing how healthy you will be in the future. Having health insurance improves your health outcomes. The worse your health status in the future, the greater the benefit of health insurance will be. Your health status is a number, determined randomly, between 1 and 9 inclusive which will only be revealed to you after you have made your decisions. The probability of each health status occurring is equal. A health status of 9 means you are in perfect health. A health status of 1 is the worst possible health. When making your decision about buying health insurance, the price of health insurance will be shown to you. Your health status and your insurance decision will determine your payoff.

On the screen you will be shown sixteen prices between 0 and 300 inclusive. Underneath each price you will have the option to buy or not buy health insurance for this price. Clicking the button next to buy or do not buy records your decision for this price. You will be able to change your decisions up until you click the 'OK' button in the lower right hand corner. At the end of the game you will be shown a summary of your decisions, health status, and payoffs, for each price.

The Payoff

Your decision and your health status combine to determine your payoff. Your payoff if you purchase health insurance for a given price is:

$$40 \times \text{Health Status} + 200 - \text{ Price of Insurance}$$

Your payoff if you do not purchase health insurance, regardless of price is:

$$70 \times \text{Health Status} - 70$$

At the end of the game a price will be determined randomly, and your decision for this price will determine your payoff. For every 70 experiment currency units you earn, you will receive 1 AUD.

On the next page you will find a summary of the gain from purchasing health insurance for different health statuses. Please read this carefully. You may refer to it at any time during the experiment.

The table below will help you when you are making your decisions to purchase health insurance. The values in this table have been calculated using the payoff functions you have already seen. For example, for a health status of 1, the gain in wellbeing from health insurance is $(40 \times 1 + 200) - (70 \times 1 - 70) = 240$

Health Status Drawn	**Gain in Wellbeing from Health Insurance**	**Cost of Health Insurance**
1	240	-Price
2	210	-Price
3	180	-Price
4	150	-Price
5	120	-Price
6	90	-Price
7	60	-Price
8	30	-Price
9	0	-Price

B. Instructions - Treatment R_1

Instructions

Below you will find instructions for the game you are about to play. Please read them silently. If you have any questions, raise your hand and one of the lab supervisors will come to you.

The Game

You are about to play a game involving economic decision making. In this game you will be asked to decide to buy health insurance or not. You must make this decision without knowing how healthy you will be in the future. Having health insurance improves your health outcomes. The worse your health status in the future, the greater the benefit of health insurance will be. Your health status is a number, determined randomly, between 1 and 9 inclusive which will only be revealed to you after you have made your decisions. The probability of each health status occurring is equal. A health status of 9 means you are in perfect health. A health status of 1 is the worst possible health. When making your decision about buying health insurance, the price of health insurance will be shown to you. Your health status and your insurance decision will determine your payoff.

On the screen you will be shown sixteen prices between 0 and 300 inclusive. Underneath each price you will have the option to buy or not buy health insurance for this price. Clicking the button next to buy or do not buy records your decision for this price. You will be able to change your decisions up until you click the 'OK' button in the lower right hand corner. At the end of the game you will be shown a summary of your decisions, health status, and payoffs, for each price.

The Payoff

Your decision and your health status combine to determine your payoff. Your payoff if you purchase health insurance for a given price is:

$$40 \times \text{Health Status} + 200 - \text{ Price of Insurance}$$

Your payoff if you do not purchase health insurance, regardless of price is:

$$70 \times \text{Health Status} - 70$$

At the end of the game a price will be determined randomly, and your decision for this price will determine your payoff. For every 70 experiment currency units you earn, you will receive 1 AUD.

On the next page you will find a summary of the loss from not purchasing private health insurance for different health statuses. Please read this carefully. You may refer to it during the experiment.

The table below will help you when you are making your decisions to purchase health insurance. The values in this table have been calculated using the payoff functions you have already seen. For example, for a health status of 1, the loss in wellbeing from not purchasing health insurance is $(70 \times 1 - 70) - (40 \times 1 + 200) = -240$

Health Status Drawn	**Loss in Wellbeing for not purchasing Health Insurance**	**Saving from not purchasing Health Insurance**
1	-240	Price
2	-210	Price
3	-180	Price
4	-150	Price
5	-120	Price
6	-90	Price
7	-60	Price
8	-30	Price
9	0	Price

C. Further details on private health insurance rebate and medicare levy surcharge

Income thresholds				
Status	Base tier	Tier 1	Tier 2	Tier 3
Single	≤$90,000	$90,001 - $105,000	$105,001 - $140,000	>$140,000
Family	≤$180,000	$180,001 - $210,000	$210,001 - $280,000	>$280,000
Medicare levy surcharge (%)				
	0	1	1.25	1.5
Insurance rebate (%)				
Age	Base tier	Tier 1	Tier 2	Tier 3
Under 65 years	27.820	18.547	9.273	0
65-69 years	32.457	23.184	13.910	0
70 years or over	37.094	27.820	18.547	0

D. Australian private hospital insurance coverage

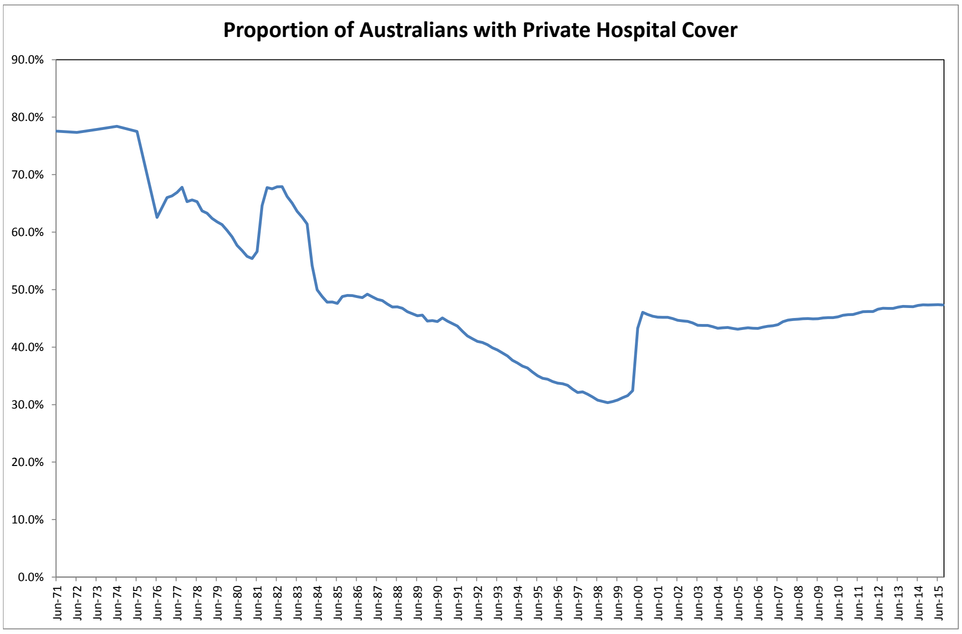


Figure 3: Coverage of hospital coverage in Australia between 1971 and 2015 (Australian Prudential Regulation Authority, 2015).

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