WHY DO THE RICH SAVE MORE? A THEORY AND AUSTRALIAN EVIDENCE *

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Abstract

We provide a theory to explain the existence of inequality in an economy where agents have identical preferences and have access to the same production technology. Agents consume a "utility" good and a "health" good which determines their subjective discount factor. Depending on initial distribution of capital the economy gets separated into different permanent-income groups. This leads to a testable hypothesis: "The rich save a larger proportion of their permanent income". We test this implication for the savings behaviour in Australia. We show that even after controlling for life-cycle characteristics permanent income and savings are positively correlated. An improvement in the health leads to a positive effect on savings behaviour.

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1. Introduction

Household consumption and savings behaviour is an issue which remains at the heart of Macroeconomics. It is central to understanding the impact of tax and other government policies. It is also central to understanding the evolution of the wealth distribution. Researchers in this area have commonly used Freidman's (1957) permanent income hypothesis and Modigliani's (1954) life-cycle hypothesis as a theoretical framework to model consumption behaviour of households. As such the permanent income and life-cycle theories have spawned a large theoretical and empirical literature in macroeconomics. On the theoretical part there are hybrid models which try to blend both permanent income and life-cycle motives to come up with a richer and more realistic theory of consumption. Empirical papers try to test whether the theoretical predictions of these models can be validated in the data.

Friedman strongly believed in the proportionality hypothesis i.e., household of all levels of lifetime income save a constant proportion of their permanent income. He claimed that the observed positive correlation between savings and income is spurious. As we can only observe current income and it is prone to transitory shocks, the observed correlation between savings and current income is simply the result of a household trying to smooth consumption over its lifetime. The life-cycle model on the other hand predicts that agents will save primarily during the middle stages of their life. The savings in these years of their life will be used to pay off debt incurred when young for education and to fund consumption during retirement. Thus, it is possible to observe different savings behaviour among agents with the same lifetime income. It is simply due to the fact that different households in the economy at a given point in time could be at different stages of their life cycle.

In a recent paper, Dynan, Skinner and Zeldes (DSZ hereafter) (2004) show that with reasonable parametric specifications of the permanent income, the life cycle and the hybrid models, it is impossible to reconcile with the savings behaviour in U.S.A. Using a variety of data sets, the Panel Study of Income Dynamics (PSID), the Survey of Consumer Finances (SCF), and the Consumer Expenditure Survey (CEX), DSZ find that savings rates are increasing with permanent income. This is even after controlling for life-cycle characteristics of the households. This could potentially also explain the very high degree of wealth concentration in U.S.A.[1]

In this paper, we propose a plausible theoretical channel which may explain savings heterogeneity in an economy. We study the role played by the rate of time preference of individuals, i.e., the level of patience in determining their savings behaviour. The level of patience of an individual is an important aspect of her preferences. Let us explain with the help of an example. If an agent is maximizing welfare over two periods say $t = 0$ and $t = 1$, it is customary to represent her preference as

$$u(c_0) + \beta u(c_1),$$

where $u(.)$ is the period utility function and c_0, c_1 are the level of consumption in periods 0 and 1. The parameter $\beta \in (0,1)$ is commonly referred to as the subjective discount factor or the level of patience. The level of patience is the weight given to future welfare in comparison to present welfare. β^{-1} is called the rate of time preference. A more patient individual (i.e., higher β) has less rate of time preference and therefore gives more importance to future welfare. Everything else remaining the same, she would save a larger proportion of her income. This enables her to accumulate more wealth over her lifetime in comparison to an impatient individual.

Differences in the rate of time preference across individuals can potentially explain persistence in inequality. Even if every individual has access to the same production technology, inequality could persist in an economy due to differences in the rate of time preference across individuals.[2] The role of "rate of time preference" in explaining inequality, however, has received relatively less attention in the theoretical literature.

In a standard permanent income model like Ben Porath (1967), we allow the individual agents to choose their level of patience by consumption of a good which we interpret as the "health" good. One possible interpretation of this could be that higher consumption of the "health" good increases the probability of survival of an agent and makes her give more importance to future utility. The positive

[1] See Cagetti and De Nardi (2005).

[2] Becker and Mulligan (1997) first introduced the idea that the level of investment in patience can have important bearing on the growth rate of an economy.

relationship between consumption and health has been well established in the development economics literature. Deaton (2003) reports a strong correlation between health status and income both across countries and within an economy. If we plot the relation between per-capita income and life expectancy, we can see a strong correlation between them. In U.S.A., the probability of death at the age of 50 for both males and females is decreasing in family income.[3] This suggests a particular channel through which income may affect the "rate of time preference" of an individual. Smith (1999) also finds a strong relationship between economic and health status of households. While there have been empirical studies on the behaviour of savings rates across households, the theoretical work in this area is very much limited. For policy analysis, it is essential to have a theoretical model that explicitly models the behaviour of the "rate of time preference". The theoretical model is necessary for an empirical purpose as well, because it helps identify the important causal relationship – do richer individuals save more or, more patient individuals save more and end up rich.

Our theoretical results show that even when agents in the economy are identical in terms of their preferences and have access to the same production technology there may be permanent income inequality in steady state. Also, richer agents save a larger proportion of their permanent income. Agents who consume more of the "health" good are more patient and as such save more. This result is consistent with other empirical studies. Lawrance (1991) in her study on inter-temporal preferences based on U.S. panel data finds that "rate of time preference" is about three to five percentage points higher for households with lower incomes than those with higher incomes. Controlling for race and education widens this difference even more.

We then test the prediction of our model using the Household Income and Labour Dynamics in Australia (HILDA) data set. As this dataset is fairly recent, we are forced to use an empirical strategy similar to DSZ. There have been empirical studies documenting the wealth distribution (Headey et. all (2005)) and consumption inequality (Barett et. all (2000)) in Australia. However, to the best of our knowledge, this is the first study documenting the savings behaviour in Australia. We find strong evidence in favour of the theoretical implication of our model. After controlling for life-cycle characteristics of a household, their savings are increasing as households move up the permanent

[3] See Deaton (2003) for an excellent survey of the literature studying the link between health and development.

income quintiles. We also examine the impact of health status of households on their savings behaviour. For every proxy of the health status of a household, we find that the health status of the head of the household has strong positive effect on their savings behaviour.

The rest of the paper is organized as follows. The next section presents our model and we derive our basic results in section 3. In section 4 we explain our empirical strategy and provide details of our data set in section 5. Our estimation results are in section 6 and section 7 concludes.

2. Model

Production Technology:

Consider an economy producing a single homogeneous commodity. Time is discrete and is indexed by $t = 0, 1, 2, \ldots\infty$. The economy consists of a continuum of infinitely lived agents who differ only in terms of their initial endowment of capital k_0. Every agent is endowed with one unit labour time at each period however they are able to accumulate capital by saving out of their income. The final good is produced using a standard neoclassical production technology

$$y_t = F(k_t, 1) \equiv f(k_t),$$

where $(k_t, 1)$ denote the amount of capital and labour input employed by an agent in the production process in period t.[4] The final good produced is denoted by y_t.

(Assumption 1) The production function $f(.)$ is increasing and concave in its argument and satisfies the inada conditions.

Preferences:

Our economy consists of agents who are born into dynastic households. The main difference of our paper from rest of the literature is the nature of preferences of the individual agents. It will be helpful to explain the objective function of an agent through a series of steps. First, unlike the standard Ramsey model, the agents in our model use their income to consume a "utility" good as well as a "health" good. The consumption of "utility" good provides the agent with utility at each time period. Let the period

[4] We have normalized the labour time of every agent to 1 for simplicity and as such we will denote the production function by $f(k_t)$.

utility function be denoted by $u(c_t)$ where c_t is the consumption of “utility” good of an agent in period t. We assume that $u(.)$ is increasing and concave in c_t and satisfies the inada conditions.

(Assumption 2) $u(0) = 0, u'(.) > 0, u''(.) < 0.$

The health good affects the agent’s rate of time preference or the subjective discount factor. The role of the health good is best explained by using a simple two period example. Suppose an agent was making a consumption decision over two time periods say $t = 0$ and $t = 1$. In a standard two-period model, the agent’s preferences would be given by

$$u(c_0) + \beta u(c_1),$$

where $0 < \beta < 1$, is the subjective discount factor of an agent. This discount factor captures the degree of patience of an agent. In our model, this discount factor is determined endogenously instead of being an exogenously given parameter. The discount factor depends on the consumption of another kind of good called the “health good”.[5] In our model the agent’s preferences are given by

$$u(c_0) + \beta(x_0)u(c_1),$$

where x_0 denotes the consumption of the “health” good by an agent in period $t = 0$ and $\beta(.)$ is an increasing function of x_0.

(Assumption 3) $0 < \underline{\beta} \leq \beta(x_t) \leq \overline{\beta} < 1, \beta'(.) > 0, \beta''(.) < 0.$

The behaviour of subjective discount factor with respect to the health good is shown in Figure 1.

INSERT FIGURE 1 HERE

The concavity of the function $\beta(.)$ ensures that the first order conditions for the maximum are also sufficient while we need the upper and lower bound on the function to ensure that the agent’s infinite horizon problem has a non-trivial solution.

The Agent’s Problem:

Now we are in a position to state the infinite horizon problem facing an agent. An agent is identified by her initial endowment of capital. The agent maximizes her lifetime welfare i.e.,

$$\max_{\{c_t\}} \sum_{t=0}^{\infty} \rho_t u(c_t) \tag{1}$$

[5] Becker and Mulligan (1997) call this notion as investment in patience.

subject to a period budget constraint

$$k_{t+1} = f(k_t) + (1-\delta)k_t - c_t - x_t, \tag{2}$$

and the evolution of the discount factor given by

$$\rho_{t+1} = \beta(x_t)\rho_t . \tag{3}$$

The initial conditions are $\rho_0 = 1$ and k_0. We should point out that although we refer to k_t as capital it can be interpreted more generally. It can also be thought of as the innate ability or human capital of an agent without altering the motivation of our model. Equation (2) also assumes that the production good (y_t) can be transformed one for one into consumption good (c_t) and the health good (x_t).[6] The Lagrangian for the agent's problem is given by

$$£ = \sum_{t=0}^{\infty}\{\rho_t u(c_t) + \lambda_t[f(k_t) + (1-\delta)k_t - c_t - x_t - k_{t+1}] + \mu_t[\rho_t\beta(x_t) - \rho_{t+1}]\}.$$

The first-order conditions for maximum are:

$$\partial £/\partial c_t = 0 \Rightarrow \rho_t\, u'(c_t) = \lambda_t \tag{i}$$

$$\partial £/\partial x_t = 0 \Rightarrow \lambda_t = \mu_t\, \rho_t\, \beta'(x_t) \tag{ii}$$

$$\partial £/\partial k_{t+1} = 0 \Rightarrow \lambda_t = \lambda_{t+1}[f'(k_{t+1}) + (1-\delta)] \tag{iii}$$

$$\partial £/\partial \rho_{t+1} = 0 \Rightarrow u(c_{t+1}) + \mu_{t+1}\, \beta(x_{t+1}) = \mu_t \tag{iv}$$

From (i), (iii) and (2) we have

$$u'(c_t) = \beta(x_t)\, u'(c_{t+1})\, [f'(k_{t+1}) + (1-\delta)]. \tag{4}$$

Equation (4) is the standard inter-temporal Euler equation except the discount factor is a function of the "health" good. With forward substitution equation, (iv) can be written as

$$\mu_t = u(c_{t+1}) + \mu_{t+1}\, \beta(x_{t+1}) = u(c_{t+1}) + \beta(x_{t+1})[\, u(c_{t+2}) + \mu_{t+2}\, \beta(x_{t+2})],$$

and with repeated substitution μ_t can be expressed as

$$\mu_t = (\rho_{t+1})^{-1}\sum_{s=t+1}^{\infty}\rho_s u(c_s). \tag{5}$$

[6] In the neo-classical framework it is standard to assume that the production good can be transformed one for one into consumption and capital. We have just extended the same property to the health good.

μ_t represents the present discounted value of future welfare of an agent at time period t. Using (i), condition (ii) can be written as

$$\mu_t = u'(c_t)/\beta'(x_t). \tag{6}$$

From (5) and (6), we get

$$u'(c_t) = \beta'(x_t)\ (\rho_{t+1})^{-1} \sum_{s=t+1}^{\infty} \rho_s u(c_s). \tag{7}$$

Equation (7) summarizes the trade-off facing an agent between the consumption of the “utility” good and the “health” good. At an optimum the loss in current welfare from sacrificing the “utility” good must equal the gain in welfare by consuming the “health” good in the form of the present discounted value of future welfare.

Definition 1: *A perfect foresight equilibrium* (PFE) *of an agent are given by sequences* $\{c_t\}_{t=0}^{\infty}$, $\{x_t\}_{t=0}^{\infty}$, $\{k_{t+1}\}_{t=0}^{\infty}$, *such that* (2), (4) *and* (7) *hold with equality for a given* k_0.

3. Results

We will first characterize the steady state equilibria of an agent. At a steady state, $c_t = c_{t+1} = c$, $x_t = x_{t+1} = x$, and $k_t = k_{t+1} = k$. Equations (4) and (7) reduce to

$$\beta(x)\ [f'(k) + (1-\delta)] = 1, \tag{4'}$$

and

$$\frac{u'(c)}{u(c)} = \frac{\beta'(x)}{1-\beta(x)}. \tag{7'}$$

The left hand side of equation (7') is decreasing in c. However, the right hand side of the equation need not be monotonic in x. In order to derive a unique relationship between c and x we need to impose some additional restriction on the function $\beta(.)$.

(Assumption 4) $[\beta'(x)]^2 < -\beta''(x)[1-\beta(x)]$

For a commonly used functional form for $\beta(.)$ i.e.,

$$\beta(x) = \underline{\beta} + \eta \frac{x}{1+x},$$

where $\underline{\beta}$, η, and $\underline{\beta} + \eta < 1$, the above condition is satisfied. Assumption 4 implies that the steady state consumption of the "health" good is a monotonically increasing function of the level of "utility" good i.e., $x = x(c)$ where $x'(c) > 0$. A graphical derivation of this relationship is shown in Figure 2. The positive relationship between economic and health status has been well documented in the empirical literature.[7] Our model provides a micro foundation behind this association.

INSERT FIGURE 2 HERE

At steady state the budget constraint of the agent is

$$c + x = f(k) - \delta k$$

or

$$c + x(c) = f(k) - \delta k. \tag{2'}$$

Lemma 1 *Let* $k_{\max}$ *solve* $f'(k) = \delta$. *At a steady state solution to an agent's problem*, $k \in (0, k_{\max})$.

Proof: The inada conditions on $u(.)$ and $f(.)$ ensures that at a steady state an agent will always hold some amount of capital. However, an agent will never choose to hold more than $k_{\max}$ amount of capital in steady state. Let stock $k^1 > k_{\max}$ be a steady state level of capital stock. Equation (2') implies that it would be possible to maintain the same level of steady state level of "utility" good consumption and "health" good consumption with a lesser level of capital stock. Thus, it is possible to increase the welfare of an agent by reducing the level of capital stock and consuming it. Therefore, k^1 cannot be an optimum. █

Lemma 1 and equation (2') implies that consumption of the "utility" good can be expressed as a monotonically increasing function of capital i.e.,

$$c = g(k), \tag{BC}$$

where $g'(k) > 0$ and $k \in (0, k_{\max})$. (BC) represents the relationship between c and k according to equation (2'). Equation (4') can be expressed as

$$\beta(x(c))\,[f'(k) + (1-\delta)] = 1. \tag{EE}$$

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[7] See for instance Smith (1999) and Deaton (2003).

(EE) implicitly defines an increasing monotonic relationship between c and k.[8] (BC) and (EE) together characterize the steady state equilibrium of an agent. Figure 3 shows a possible scenario of steady state equilibrium of an agent.

INSERT FIGURE 3 HERE

In Figure 3, we present a scenario where the solution to an agent's problem may have three stationary solutions. The equilibrium an agent converges to will depend on her initial endowment of capital. We first present some results regarding the existence and number of steady state equilibria. It will be helpful to use (BC) to substitute for c in equation (EE) and write the steady state condition of an agent as an equation in one variable. Let us define

$$\Phi(k) = \beta[x(g(k))]\,[f'(k) + (1-\delta)] - 1.$$

Notice when $\Phi(k) = 0$ both (BC) and (EE) conditions for the steady state equilibrium are satisfied.

Proposition 1 *There exists at least one steady state solution to an agent's maximization problem. The total number of steady state equilibria is odd.*

Proof: The function $\beta(.)$ is bounded below by $\underline{\beta}$. Since $f(.)$ satisfies the inada conditions it follows that $\Phi(0) > 0$. As $\beta(.) \leq \overline{\beta} <1$ and $f'(k_{\max}) = \delta$, it means that $\Phi(k_{\max}) < 0$. Continuity of the function $\Phi(.)$ implies that there must exist at least one $k \in (0, k_{\max})$ such that $\Phi(k) = 0$. Without loss of generality, suppose there exist two steady state equilibria k_1 , $k_2 \in (0, k_{\max})$. Continuity of the function $\Phi(k)$ implies that there exists a $\overline{k} < k_{\max}$ such that $\Phi(\overline{k}) > 0$. Since $\Phi(k_{\max}) < 0$ it follows that there must exist another steady state $k_3 \in (\overline{k}, k_{\max})$. Hence, the number of state equilibria is odd. ∎

Figure 4 depicts a scenario where an agent's optimization problem has three possible steady state solutions. k_L denotes a low level equilibrium where the agent ends up low level of capital and permanent income. k_H on the other hand is a high level equilibrium where the agent accumulates larger amount of capital in steady state and ends up with a higher level of permanent income.

INSERT FIGURE 4 HERE

[8] $f'(.)$ is decreasing in k. As $\beta(.)$ and $x(.)$ are increasing in their argument it follows that for (EE) to hold c must be increasing in k.

The significance of the steady state k_U will become clear soon.[9] Although it is possible to have more than three steady state equilibria from a theoretical standpoint, all the interesting features of the model can be studied within such a scenario. Our next proposition characterizes the global dynamics of the model.

Proposition 2 *Let k_t be the endowment of capital of an agent at time period t. If the marginal product of capital exceeds the rate of time preference at k_t i.e.,*

$$f'(k_t)+(1-\delta)>1/\beta[x(g(k_t))]$$

the agent will accumulate capital and vice-versa.

Proof: k_t is the endowment of capital of an agent at time period t. If this was a steady state, then the equilibrium sequences solving an agent's maximization problem would be given $k_{t+1} = k_t$; $c_t = g(k_t)$; and $x_t = x(g(k_t))$ for all t. We want to show that if $f'(k_t)+(1-\delta)>1/\beta[x(g(k_t))]$ then the sequences given above cannot be an optimum. Suppose we consider a one time deviation in the consumption of the "utility" good i.e., let $\tilde{c}_t = c_t - \varepsilon$ where ε is sufficiently small. If we keep x_t constant the budget constraint equation (2) implies that $k_{t+1} = k_t + \varepsilon$. The loss in utility from foregoing consumption of c_t in period t is given by $u'(c_t)$. The foregone consumption is accumulated as capital and allows higher level consumption in period t+1. The present discounted value of the gain in utility is given by $\beta(x_t)][f'(k_t)+(1-\delta)]u(c_t)$. Since $f'(k_t)+(1-\delta)>1/\beta(x_t)$ it follows that the agent can increase welfare by consuming less and accumulating more capital. A similar argument can be applied to show that the capital stock is decreasing when $f'(k_t)+(1-\delta)>1/\beta[x(g(k_t))]$. █

Proposition 4 helps in understanding which equilibrium will be reached by an agent in long run. It implies that an agent will accumulate capital when $\Phi(k) > 0$ while she will reduce her capital stock when $\Phi(k) < 0$. Hence, the steady state an agent attains in long run depends on her initial endowment of capital. This dynamics is depicted in Figure 5.

INSERT FIGURE 5 HERE

[9] We have ruled out the possibility of the function Φ(.) being tangential to the horizontal axis. For a generic class of functions such tangencies will occur with probability zero.

Agents who have initial endowment of capital less than k_U (i.e., $k_0 < k_U$) will converge to the low level steady state k_L. Those agents with initial endowment above k_U will converge to the high level equilibrium k_H.

This result warrants some explanation. In a standard Keynes-Ramsey model, every agent is assumed to have the same degree of patience i.e., the same subjective discount factor β. Hence, every agent accumulates capital until the marginal return from capital equals the rate of time preference i.e.,

$$f'(k) + (1 - \delta) = \beta^{-1}.$$

In our model, the degree of patience of an agent is endogenously determined. The subjective discount factor of an agent depends on the level of consumption of the "health" good. Hence, it is possible for an agent to have a very low endowment of capital (and a high marginal product of capital) and choose to reduce her capital stock due to a high rate of time preference.

In Figure 5, k_U acts as the threshold level of capital needed to induce an agent to accumulate capital and reach the high capital steady state k_H. Let $\Psi_0(k_0)$ denote the initial distribution of capital in the economy. From Proposition 2, it follows that $\Psi(k_U)$ proportion of the agents in the population will converge to k_L while $(1 - \Psi(k_0))$ will converge k_H level of capital. With endogenous rate of time preference, it is possible to have inequality in permanent income even though agents are identical in terms of their preferences and have access to the same production technology.

So far in our analysis we have not allowed for any kind of uncertainty. That is why we end up with a two point distribution in steady state. However, it is quite easy to incorporate some form of uncertainty in the production function without altering the qualitative nature of our results. For instance, let the production function take the following form

$$y_t = \theta_t F(k_t, 1) \equiv \theta_t f(k_t),$$

where θ_t is identically and independently distributed with a distribution function $\xi(\theta_t)$. The long run distribution of capital is shown in Figure 6.

INSERT FIGURE 6 HERE

In the neighbourhood of the non-stochastic steady states there exits rational expectations equilibrium. The shaded region mirrors the density function of θ_t.

4. Empirical Strategy

The ideal way to test the empirical validity of our model would be to estimate the Euler equation generated by an agent's optimizing behaviour given by equation

$$u'(c_t) = \beta(x_t)\, u'(c_{t+1})\, [f'(k_{t+1}) + (1\text{-}\delta)]. \tag{4}$$

This requires a large panel data set with detailed breakdown of the household expenditures and wealth. Unfortunately, even the Panel Study of Income Dynamics (PSID) dataset, a commonly used dataset in this literature has very limited data on household expenditures. It mainly consists of food and household rent. We face a similar paucity of data for Australia as well. However, there is another implication of our model which is possible to test by using with cross-sectional techniques.

Proposition 3 *Agents with higher permanent income have higher savings rates.*

Proof: The steady state savings rate is given by $s(k) = \left[f(k) - x - c\right] / f(k)$. Using equation (2'), the savings rate can be written as: $s(k) = \delta k / f(k)$. From the concavity of $f(.)$, it follows that an agent with higher permanent income i.e., $k_H > k_L$, also has a higher savings rate i.e., $s(k_H) > s(k_L)$. ∎

This prediction is totally consistent with evidence provided by DSZ (2004). Using a wide variety of data sets for U.S.A., they find strong evidence that households with higher permanent income save a larger proportion of their income.

In this paper, we test whether such a relationship exits in **Australia**. Even with a simple testable hypothesis as ours, one needs to be careful. First, we are interested in the effect of a household's permanent (not current) income on saving. The problem with permanent income is that it is inherently unobservable. To deal with this, we use a two stage procedure as in DSZ (2004). In the first stage, we regress current income on age dummies and instruments which would be good predictors of permanent income. The fitted values from this regression are used as a proxy for permanent income. Then, we divide the distribution of fitted values up into quintiles and create dummy variables for each quintile. As argued in DSZ (2004), using these dummies as regressors allows for nonlinearities in the saving–income relationship.

Having come up with a measure of permanent income, we are faced with another problem. How do we measure the savings behaviour of a household? We consider two possible variables. First is an active measure of savings: the savings rate. It is simply calculated by deducting household expenditures from income and divided by the household income. With this being the dependent variable, in the second stage, we run a median regression[10] where regressors are permanent income quintile dummies, age dummies, and other control variables. We also consider another measure of savings behaviour which is a self-reported qualitative variable. This variable takes discrete values between 0, 1, and 2 based on a household's self-assessment of their savings habit. Having this as the dependent variable, in the second stage, we estimate a multinomial logit model with same regressors in the median regression.

5. Data Description

For our estimation, we use the Household Income and Labour Dynamics in Australia Survey (HILDA)[11]. HILDA is the first large-scale panel data set in Australia and has covered the period from 2001 to 2003 at the time of this study. It initially provided information on 19,914 individuals and annually asks individuals a wide range of questions regarding income, work, health conditions, and socio-economic backgrounds. In what follows, we discuss how a measure of saving rate and a measure of saving habits are constructed and also discuss other variables used in this study.

Saving Rate

The "true" saving rate is not straightforward to measure for various reasons. First, there are several saving measures that we may use and there is no clear-cut answer for which measure we should use. For example, one measure is "active" saving which is the difference between after-tax income and consumption. Another is the change in net wealth, which would include all aspects of saving. Each saving measure may yield a substantially different saving rate. Second, the saving rate depends on whether we calculate it at an individual or household level and for each level it must be measured in a different way. Finally, the saving rate also depends on whether or not we measure a gross or a net

[9] A median regression minimises the sum of absolute deviations of the error. It is well known that a median regression is robust to outliers, compared to least squares.

[10] More specifically, we use the unit-record data from the HILDA survey.

saving rate. If we calculate the net saving rate, then we must deduct consumption of fixed capital from gross (DSZ 2004).

It would be ideal to use various saving measures and to verify that findings are robust across different measures. Due to data limitations, however, we only have one saving measure available: the active saving measure. We define the saving rate to be the difference between household income (net of taxes) and consumption, all divided by after-tax household income.[12] Consumption is defined as the sum of food consumption (i.e., grocery spending and spending on meals outside the home) and rental expenses. If households do not rent but instead own a mortgage, these loan repayments are used to proxy for rental expenses. We admit that the constructed saving rate is very crude, but this limited measure is due to the lack of detailed information on consumption in HILDA.

When constructing the data set, we restrict households to those containing 'typical' families – childless couples, couples with children, lone parents with children and single-person families, all of which do not have any other family or non-family members living with them. The head of the household is defined as the oldest male in households with couples and the lone parent in lone-parent families[13]. Since we cannot determine the head of the household for all same-sex couples based on our definition of the household head, these families are excluded from the sample even if they have previously had children with former partners.

In addition, we exclude any households with negative disposable income to ensure that negative saving rates occur only when consumption is greater than income. We also eliminate any households that have saving rates of less than minus fifty percent, because we presume that any value below this is unsustainable and therefore, erroneous. Finally, we do not use data for 2002 since no

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[11] It would be best to use the proportion of current saving relative to the permanent income as the saving rate. However, since data on permanent income is inherently unavailable, we use current after-tax income as the denominator. This may not be too much of a problem. Dynan, et al. (2004) test the sensitivity of a change in the denominator for their active saving measures and find that their results are quite robust.

[12] Obviously, a single person gets head of the household status.

questions on food consumption were asked in that year. Having done this gives us the final sample of 5838 households for 2001 and 5420 households for 2003.

Saving Behaviour

To construct a measure of saving habits, we use a survey question about saving habits in HILDA. In the question, respondents are given five options to choose from: (i) Don't save: usually spend more than income, (ii) Don't save: usually spend about as much as income, (iii) Save whatever is left over at the end of the month – no regular plan, (iv) Spend regular income, save other income, and (v) Save regularly by putting money aside. We construct a variable named SAVING that takes on three values[14]: 0 if the individual chose either option (i) or (ii); 1 if the individual chose option (iii); and 2 if the individual chose either option (iv) or (v). We restrict the sample similarly with the saving rate. Unlike the saving rate, all three waves of the survey contain information on saving habits. This results in a larger sample of 7,025 households with heads aged sixteen and above and 15,855 observations.

Health Variables

In the theoretical model, individuals can consume a "health" good which determines their subjective discount factor, as well as consuming a "utility" good. We thus feel it important to control for health status of a household. Using questions in HILDA, we construct several health variables. The first variable is constructed to proxy for health: a dummy variable that takes one if the head of the household smoked at the time of the survey. There has been much research on the relationship between smoking and its contribution to poor health (see, for example, Smith and Johnson, 1997), which makes it relevant as an indicator of the health status. The second measure of health is a dummy variable that takes one if the head of the household reported that he was in poor health. The third measure of health is also a dummy variable that takes one if the respondent considered him/herself as having a long-term health condition, disability or other impairment.

[13] The saving variable was originally constructed to take on five discrete values between 0-4. However, when we estimated the logit model with savings taking five values, the predictive power of the model was very poor.

Summary Statistics

Table 1 reports summary statistics with definitions of variables used in this study. Table 2 presents summary statistics of saving rates, income, smoking status, and health status across *current* income quintiles. All figures are expressed as percentages, except for income which is reported in 2001 dollars. We can glean several interesting information from these tables. First, saving rates increase across the current income distribution. For example, in 2001, the median saving rate is 40 percent for the lowest quintile group and reaches 75 percent for the highest quintile group. Second, the median saving rate for each quintile is substantially high. This is entirely due to the lack of detailed information on consumption in HILDA as mentioned earlier. Finally, health status improves across current income quintiles, except when we use smoking status as a proxy for health status. The smoking rate peaks in the third quintile and then falls dramatically.

Table 3 presents the distribution of saving habits and health status across current income quintiles. All figures are expressed as percentages. A casual look at the table suggests that the rich tend to have “better” saving habits. The proportion of households that follow a regular saving plan rises monotonically across the income distribution. 23 percent of households in the lowest quintile follow a regular saving plan and 41 percent in the highest quintile. In contrast, the proportion of households that do not save falls as income increases. 41 percent in the lowest quintile do not save, 30 percent in the third, and only 17 percent in the highest quintile.

Despite the clear-cut patterns observed in the data, one should not immediately conclude that the rich save more and have better saving habits. It is well known that saving rates are likely to be positively correlated with current income; those who have higher (lower) transitory income will save more (less) in anticipation of future reductions (increases) in their income (Friedman, 1957). Hence, we are required to examine permanent income, not current income, to draw a conclusion on the relationship between saving and income.

6. Estimation Results

For the first stage of estimation, as an instrument, we use a dummy for the head of the household having completed only secondary education and a dummy for him/her having completed tertiary education. Education, which is relatively stable across an individual's lifetime and is positively correlated with permanent income, has often been used as a proxy for permanent income (see, for example, Zellner, 1960; DSZ., 2004). Several other variables have also been used as instruments in the literature. For example, DSZ (2004) also use future labour income, lagged labour income and consumption as well as education. However, data limitations prevent us from using those other instruments. Our three-year panel makes it impossible to use future and lagged income as instruments. In addition, consumption used in this study is very crude as discussed earlier and hence we do not use it as an instrument. As a result, we are left only with education dummies as instruments. We compute standard errors of the parameters by bootstrapping the entire two step procedures. The number of bootstrap replications is 1,000.

For the multinominal logit estimation, we have four groups of individuals: (i) N_1 individuals that participated in the survey just once (group 1), (ii) N_2 individuals that participated in the survey twice in a row (group 2), (iii) N_3 individuals that participated in the survey twice not in a row (group 3), and (iv) N_4 individuals that participated in the survey three times in a row (group 4). To preserve the dependence structure of the panel, we sample N_j individuals with replacement from groups j, $j = 1,\ldots,4$.

6.1 Estimation Results: Median Regression

We run median regressions for 2001 and 2003 separately. Estimation results are reported in Table 4. The first and third columns contain the 2001 and 2003 results from the baseline model, where regressors are permanent income quintile dummies, age dummies, and the gender dummy. Similarly, the second and fourth columns contain the 2001 and 2003 results from the model with additional explanatory variables: whether the respondent smoked, whether the respondent was in poor health, whether the respondent had a long-term health condition, how many children the respondent had, and whether the respondent was retired.

The results provide strong evidence in favour of the theory. The saving rate increases across the permanent income distribution. In the baseline model with 2001 data, the coefficient on every quintile but the fifth is significantly greater than that on the previous quintile. When adding more control variables, the pattern becomes even stronger; the coefficients are *always* increasing across the permanent income quintiles. In both specifications, the highest quintile has a 12-13% higher saving rate than the lowest quintile. We also observe a similar pattern for 2003, suggesting the robustness of the results across years.

The coefficients on age dummies suggest that households save more as heads become older. It might be odd that households with heads aged 61 or above save more than those with heads less than 60. This finding runs contrary to the life-cycle theory of consumption. Life-cycle theory predicts that households should start dissaving as they age. We can conjecture a couple of explanations. First, our household data is a fairly recent one. The savings of the households with heads over the age of 61 could be higher due to generous tax benefits of superannuation contributions. Another possible explanation behind this behaviour could be the increase in average life expectancy in Australia.

The coefficients on the smoking dummy, the poor health dummy, and the long-term health condition dummy are all negative and significant (except that on the poor health dummy for 2003), suggesting that an improvement in the health status of household heads leads to a positive effect on their saving rate.

6.2 Estimation Results: Multinomial Logit Model

Estimation results are presented as in Table 5. The first column in each choice category corresponds to the baseline model and the second column to the model with additional regressors. The coefficients for SAVE being 0 are all normalized to zero for identification and therefore not presented in the table. We compute the marginal effect of *j* (*j*=2,3,4,5) th permanent income quintile dummy as follows:

$$P\left(Y=k \mid X, D_j=1, D_{j-1}=0, D_l=0 \ \forall l \neq j, j-1\right)-P\left(Y=k \mid X, D_j=0, D_{j-1}=1, D_l=0 \ \forall l \neq j, j-1\right),$$

for each individual and then average it over individuals, where Y is the dependent variable $\left(Y=0,1,2\right)$, D_j is the *j*th permanent income quintile dummy, and X are a vector of other regressors. For the 1st permanent quintile dummy, we compute

$$P\left(Y=k \mid X, D_1=1, D_l=0 \ \forall l \neq 1\right)-P\left(Y=k \mid X, D_1=0, D_l=0 \ \forall l \neq 1\right).$$

As can be see in the table, the probability of the household not saving at all decreases across permanent income quintiles. For example, from the second quintile to the third, the probability decreases by 0.077 Likewise, from the third quintile to the fourth, it decreases by 0.073. Contrastingly, the probability of the household following a regular saving plan rises as the permanent income increases. The probability increases by 0.041 when permanent incomes increase from the first quintile to the second, and by 0.072 from the third to the fourth. Overall, households are more likely to follow a saving plan and are less likely to not save, as they have higher permanent income. There is no clear-cut pattern regarding the relationship between ages and saving habits except the highest age group. The marginal effects of being 61 or older (relative to being 30 or below) suggest that as household heads age, households are more likely to follow a saving plan.

Even after controlling for other factors, we observe the same pattern in the baseline model; households tend to have better saving habits as their permanent income are higher. The probability of the household following a saving plan increases by 0.046 and by 0.035 as the permanent income move from the second quintile to the third and from the forth to the fifth, respectively. On the other hand, the probability of not saving at all decreases by 0.059 and by 0.050 when the permanent income increases from the second quintile to the third and from the third to the fourth, respectively.

The results strongly suggest that households are less likely to save at all when heads have poor health. Being in poor health condition as well as having smoking habits will increase the probability of not saving at all by more than 10 percent. The effect of having a long-term health condition or disability is not as strong, but still increases the probability by 6.5 per.

Whether the head of the household is retired does not appear to affect saving habits. One may argue that households with retired heads have different saving habits than those with non-retired ones. To see whether this is indeed the case, we remove retired individuals from the sample and re-estimate the models. Though not presenting the results, we again observe the same pattern: households with higher permanent income are more likely to follow a regular savings plan than those with lower permanent income. Overall, the results are quite robust; the rich have better saving habits.

7. Conclusion

In this paper we have provided a micro foundation behind increase in savings rates with permanent income. Our theoretical framework also can explain the existence of inequality in an economy even when agents are identical in terms of their preferences and have access to the same technology. We also test the implication of our model for Australia. We find that savings are increasing with permanent income. We also find a strong relationship between health and savings behaviour.

Recent empirical studies do show an increase in income inequality in many developed countries such as U.S.A., U.K. and Australia.[15] In that context, our findings have significant implications for Australia especially regarding macroeconomic and government policies such as support for healthcare. Our model can be extended in future to analyse the impact of various revenue neutral tax policies. A particular policy instrument worth investigating is the GST. A sales tax would increase the tax burden for poorer section of the society as they consume larger proportion of their income than those affluent whose saving ratio is higher. It may also lead to a higher level of inequality.

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[15] See Alderson and Nielson (2002), Atkinson (2002).

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Figure 1: Subjective Discount Factor

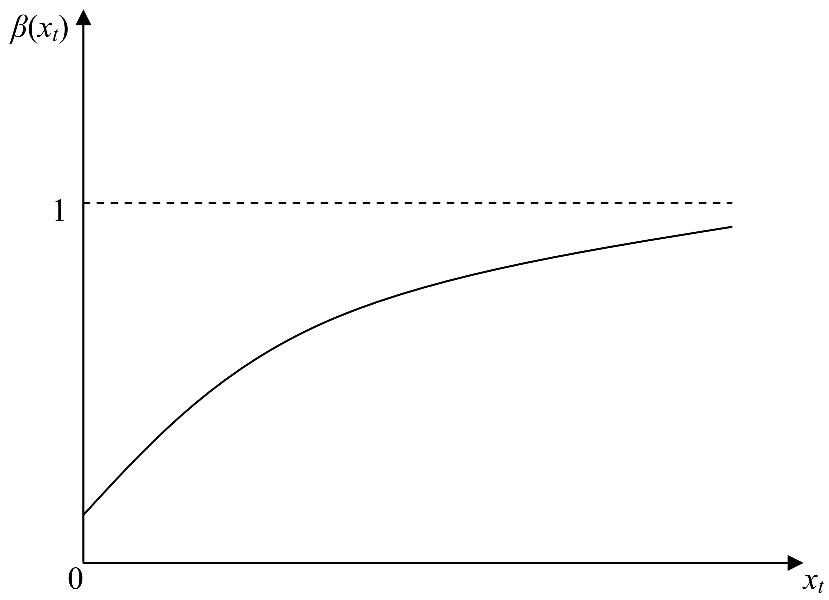

Figure 2: Health Good with respect to Utility Good at Steady State

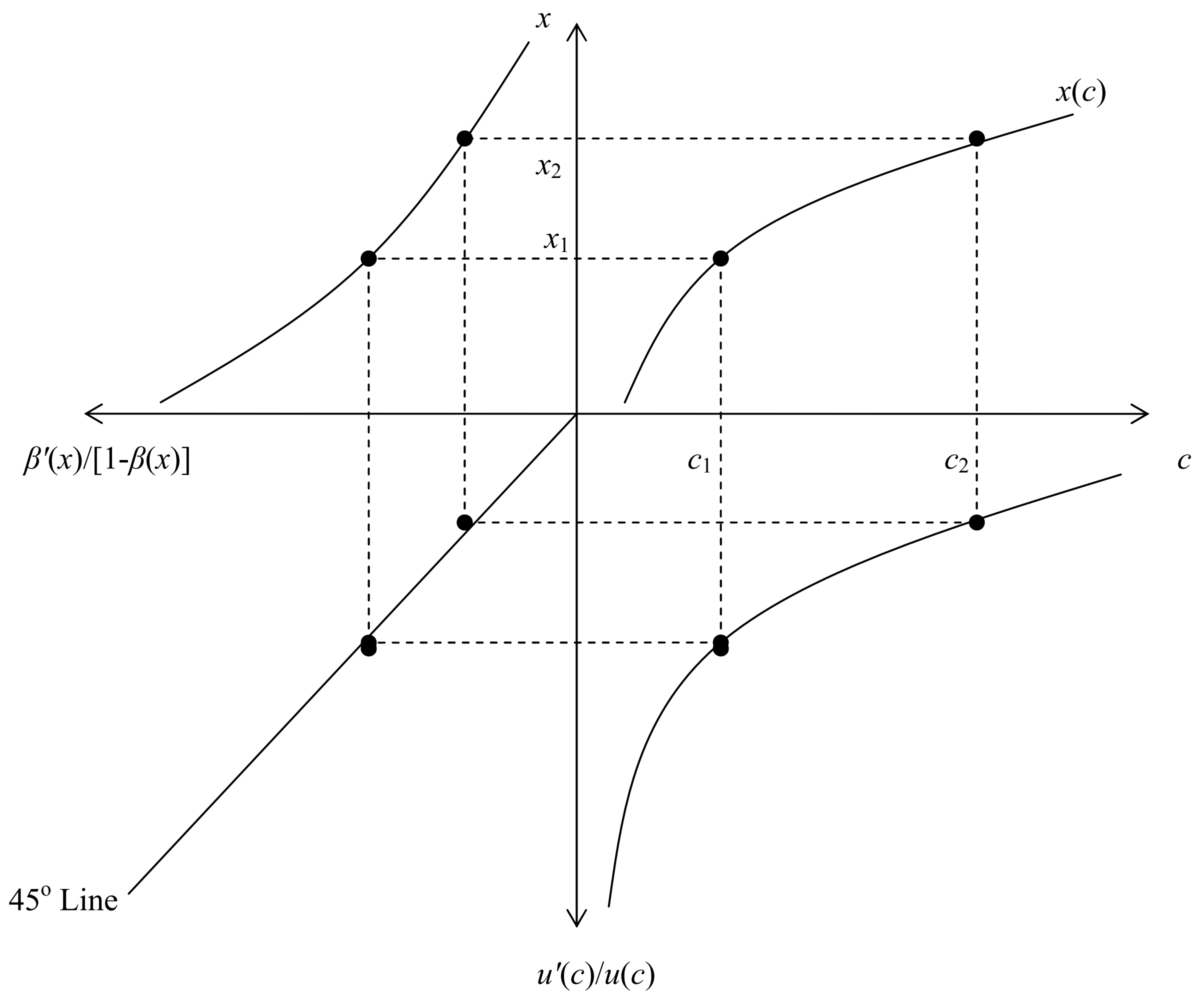

Figure 3: Steady state Equilibria

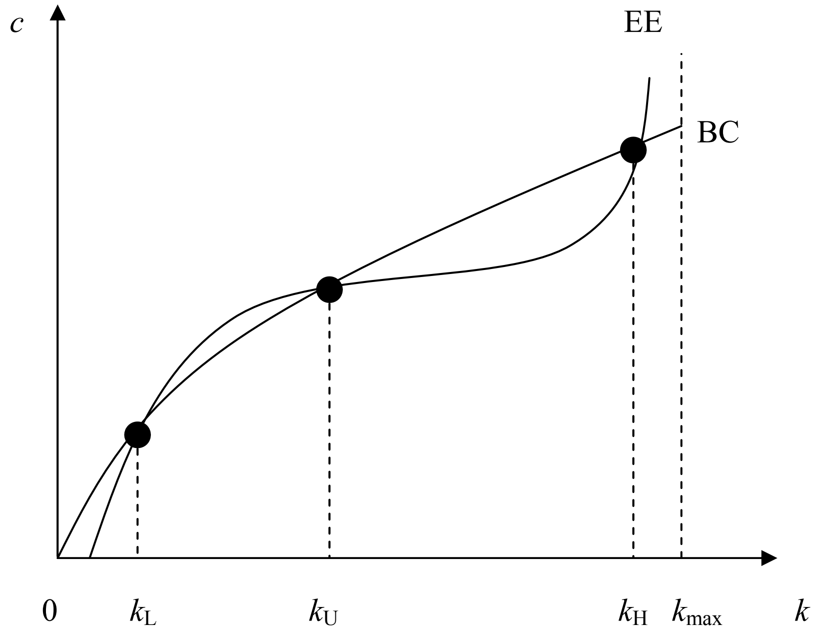

Figure 4: Φ(*k*)

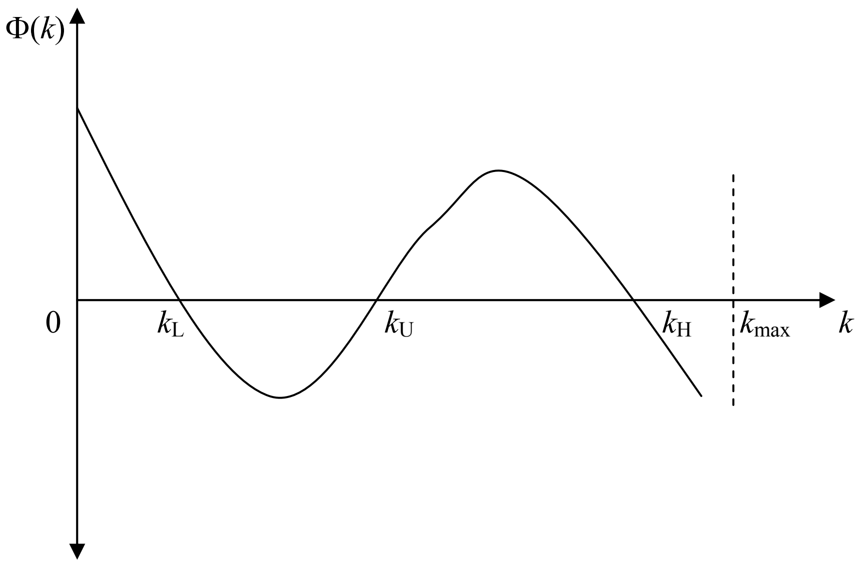

Figure 5: Global Stability

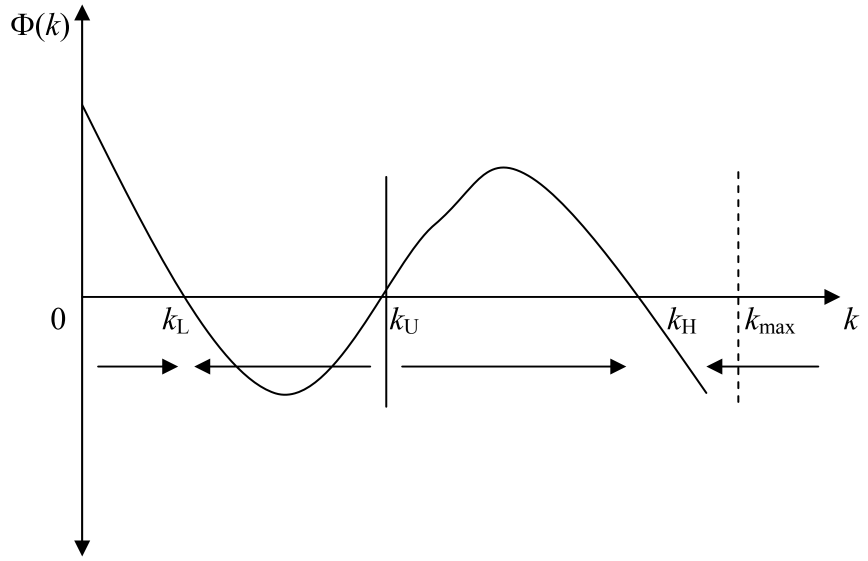

Figure 6: Distribution of Capital with Uncertainty

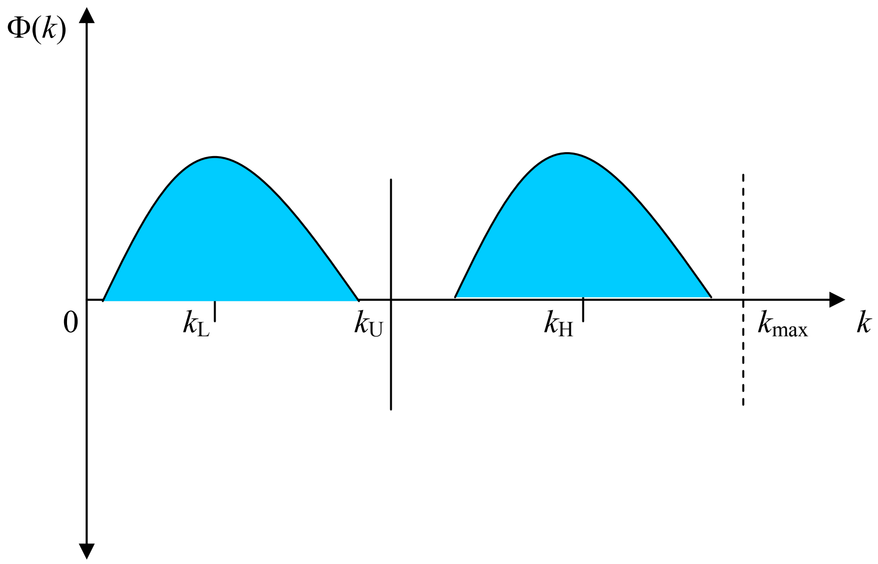

Table 1: Summary Statistics with Definitions of Variables

Variable	Mean	Std. Dev.	Definition
Saving	0.998	0.773	0 (don't save), 1 (save left-over), and 2 (follow saving plan)
Income	44290	36056	Real Disposable Income (2001 $)
Tertiary education	0.629	0.483	1 if having completed tertiary education
Secondary education	0.084	0.278	1 if having completed secondary education
Ages 31-40	0.218	0.413	1 if respondent is between 31 and 40
Ages 41-50	0.235	0.424	1 if respondent is between 41 and 50
Ages 51-60	0.173	0.379	1 if respondent is between 51 and 60
Ages 61 or above	0.234	0.424	1 if respondent is 61 or above
Female	0.232	0.422	1 if respondent is female
Smoke	0.234	0.423	1 if respondent smokes
Poor health	0.038	0.191	1 if respondent is in poor health condition
Long-term health	0.265	0.441	1 if respondent has a long-term health condition or disability
# Children	1.912	1.525	Number of children respondent has had that are still alive
Retired	0.205	0.404	1 if respondent is retired

Table2: Saving Rates and Health across Income Quintiles

	Year	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Average saving rate	2001	-118.02	52.32	60.5	67.4	74.85
	2003	-23.5	56.05	61.47	67.16	74.66
Median saving rate	2001	40.81	56.66	62.17	68.86	76.62
	2003	45.71	59.71	62.68	68.28	76.9
Median income (2001$)	2001	10820	22320	35121	51401	78968
	2003	11934	23483	36377	52765	81506
Smoke	2001	26.05	28.25	29.45	25.45	17.81
	2003	24.17	24.11	24.9	20.9	13.84
Poor health	2001	8.91	6.08	3.25	1.46	1.71
	2003	7.33	5.65	3.05	3.05	1.05
Long-term health	2001	49.96	34.5	22.6	14.48	13.87
	2003	48.81	38.56	26.43	19.85	16.98

Note: All figures are percentages, except for income which is reported in 2001 dollars.

Table 3: Saving Behaviour and Health across Income Quintiles

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Don't save	40.58	38.03	30.72	23.56	17.14
Save left-over income	36.73	37.34	41.44	43.85	41.65
Follow saving plan	22.69	24.63	27.85	32.59	41.21
Smoke	25.34	27.85	25.73	22.49	15.44

Note: All figures are percentages.

Table 4: Median Regression of Saving Rate on Permanent Income Quintiles

Variable	2001 (# Obs = 5838)		2003 (# Obs = 5420)	
Quintile 1	0.4884***	0.5317***	0.5051***	0.5165***
	(-0.0309)	(-0.0265)	(0.0282)	(0.0240)
Quintile 2	0.5237***	0.5717***	0.5369***	0.5570***
	(-0.0232) †††	(-0.0156) ††	(0.0146) †	(0.0158) ††
Quintile 3	0.5792***	0.5966***	0.5711***	0.5988***
	(-0.0134) †††	(-0.0121) ††	(0.0110) ††	(0.0097) †††
Quintile 4	0.6147***	0.6355***	0.6023***	0.6224***
	(-0.014) ††	(-0.0106) ††	(0.0195) ††	(0.0152) ††
Quintile 5	0.6194***	0.6564***	0.6237***	0.6298***
	(-0.0159)	(-0.0125) ††	(0.0231) †	(0.0173)
Ages 31-40	0.0034	0.0027	0.0039	0.0110
	(-0.015)	(-0.0121)	(0.0201)	(0.0158)
Ages 41-50	0.0594***	0.0666***	0.0378**	0.0612***
	(-0.0157)	(-0.0126)	(0.0216)	(0.0173)
Ages 51-60	0.1382***	0.1448***	0.1254***	0.1463***
	(-0.0132)	(-0.0116)	(0.0203)	(0.0175)
Ages 61 & above	0.1964***	0.1844***	0.1860***	0.2169***
	(-0.0228)	(0.0152)	(0.0152)	(0.0161)
Female	-0.0595***	-0.0694***	-0.0251	-0.0406***
	(-0.0179)	(0.0152)	(0.0248)	(0.0168)
Smoke		-0.0265***		-0.0262***
		(0.0091)		(0.0108)
Poor health		-0.0498**		-0.0082
		(0.0091)		(0.0259)
Long-term health		-0.0196*		-0.0289***
		(0.0112)		(0.0098)
# Children		-0.0101***		-0.0085***
		(0.002)		(0.0026)
Retired		0.0042		0.0081
		(0.0131)		(0.0180)

Note: Bootstrap standard deviations are in parentheses. *, **, and *** beside coefficients indicate statistical significance at the 10, 5, and 1 percent levels, respectively. †, ††, and ††† beside standard deviations of parameters for quintile dummies indicate that the coefficient is significantly greater than that for previous quintile at the 10, 5, and 1 percent levels, respectively.

Table 5: Multinomial Logit Model (The Dependent Variable: Save = 0,1,2)

	Coefficient				Marginal Effect					
	Save = 1		Save = 2		Save = 0		Save = 1		Save = 2	
Quintile 1	-0.180	0.162	-0.727***	0.035	0.090***	-0.025	0.032	0.033	-0.121***	-0.008
	(0.165)	(0.145)	(0.180)	(0.164)	(0.034)	(0.030)	(0.032)	(0.027)	(-0.025)	(0.024)
Quintile 2	-0.210*	0.282***	-0.506***	0.222**	-0.015	-0.032	-0.026	0.009	0.041**	0.023
	(0.112)	(0.094)	(0.142)	(0.106)	(0.032)	(0.023)	(0.026)	(0.021)	(0.019)	(0.018)
Quintile 3	0.118	0.513***	-0.121	0.584***	-0.077**	-0.059***	0.036	0.013	0.041	0.046***
	(0.168)	(0.086)	(0.232)	(0.092)	(0.032)	(0.017)	(0.027)	(0.017)	(0.027)	(0.017)
Quintile 4	0.396**	0.838***	0.379	0.770***	-0.073**	-0.050***	0.001	0.054***	0.072**	-0.004
	(0.194)	(0.108)	(0.247)	(0.111)	(0.030)	(0.015)	(0.038)	(0.020)	(0.029)	(0.020)
Quintile 5	0.537**	0.738***	0.418	0.866***	-0.016	0.003	0.028	-0.038*	-0.012	0.035**
	(0.226)	(0.122)	(0.305)	(0.134)	(0.027)	(0.017)	(0.056)	(0.020)	(0.043)	(0.017)
Ages 31-40	-0.271*	-0.149	-0.452*	-0.302***	0.073*	0.042**	-0.013	0.0003	-0.06*	-0.043***
	(0.163)	(0.094)	(0.245)	(0.104)	(0.040)	(0.018)	(0.024)	(0.019)	(0.034)	(0.017)
Ages 41-50	-0.122	0.108	-0.379	-0.118	0.047	-0.003	0.015	0.040**	-0.062	-0.037**
	(0.220)	(0.102)	(0.322)	(0.114)	(0.051)	(0.018)	(0.037)	(0.020)	(0.046)	(0.018)
Ages 51-60	0.227	0.428***	0.118	0.415***	-0.036	-0.079***	0.04	0.049**	-0.004	0.030
	(0.177)	(0.105)	(0.251)	(0.112)	(0.039)	(0.017)	(0.028)	(0.021)	(0.037)	(0.019)
Ages 61 & above	0.794***	1.010***	0.725***	0.905***	-0.143***	-0.170***	0.095****	0.120***	0.048*	0.051**
	(0.120)	(0.117)	(0.157)	(0.127)	(0.021)	(0.017)	(0.021)	(0.021)	(0.025)	(0.02)
Female	-0.144	-0.202**	0.212	-0.055	-0.003	0.028	-0.060**	-0.041	0.063**	0.013
	(0.144)	(0.096)	(0.173)	(0.108)	(0.028)	(0.018)	(0.025)	(0.019)	(0.029)	(0.019)
Smoke		-0.466***		-0.788***		0.125***		-0.024***		-0.101***
		(0.065)		(0.073)		(0.013)		(0.013)		(0.011)
Poor health		-0.395***		-0.677***		0.107***		-0.022		-0.085***
		(0.111)		(0.143)		(0.023)		(0.023)		(0.022)
Long-term health		-0.286***		-0.376***		0.065***		-0.024*		-0.042***
		(0.071)		(0.076)		(0.013)		(0.014)		(0.012)
# Children		-0.129***		-0.184***		0.030***		-0.008**		-0.022***
		(0.019)		(0.022)		(0.003)		(0.004)		(0.004)
Retired		-0.042		0.018		0.003		-0.012		0.009
		(0.103)		(0.115)		(0.019)		(0.019)		(0.019)

Log-likelihood: -17028.3 (baseline model)
-16693.1 (extended model)

Note: Bootstrap standard deviations are in parentheses. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively. Year dummies are included, though not reported here.