Revisiting Private Health Insurance and Precautionary Saving – A Theoretical and Empirical Analysis

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Abstract

This paper revisits the relationship between health insurance and precautionary saving. The puzzling phenomenon documented by Starr-McCluer (1996) is that the US households covered by private health insurance save more than those without coverage. Guariglia and Rossi (2004) find similar results by studying the UK households. These empirical findings of a positive insurance/savings pattern seem inconsistent with the theory of precautionary saving. This paper suggests that the positive pattern is not because precautionary saving motive does not exist, but because the motive is distorted unevenly across individuals by means-tested social welfare programs if a significant proportion of population is affected. We first use a dynamic equilibrium model to quantitatively show that economies with sizable social welfare systems generate the same insurance/saving pattern as found in the US and the UK. In contrast, the model predicts that in an economy without or with a relatively small social welfare system, a negative relationship between private health insurance coverage and savings should be observed. We then provide an empirical test. Taiwan, which has a much smaller welfare system than the US and the UK, is selected for a comparison. With the same empirical approach, Taiwanese household data shows a negative pattern that is opposite to the previous studies but supports the theoretical prediction of precautionary saving.

JEL Classification:
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1 Introduction

The standard theory of consumption and precautionary saving suggests that an introduction of insurance, which moderates risk-averse households' income or expenditure uncertainties, is expected to reduce households' precautionary savings. Medical expenditures have been known as a major uncertainty to human life, and expected to induce the motive of precautionary saving and the demand of health insurance. Theoretically individuals should be able to use health insurance to substitute their precautionary savings.

However, empirical findings based on private health insurance (PHI) coverage are not consistent with the standard theoretical expectation. Starr-McCluer (1996) finds that the US households covered by private health insurance save more than those without coverage even when other observed characteristics are controlled . Guariglia and Rossi (2004) find similar results using the data from the UK. Both studies suggest a positive relationship between PHI and savings that seems to be inconsistent with the theory of precautionary saving. To our best knowledge, no further explanations are provided in the existing literature.[1]

In this paper, we provide a theoretical and empirical analysis, and suggest that the means-tested social welfare system plays an important role in explaining this puzzling insurance/saving pattern. A dynamic general equilibrium model with endogenous PHI decision is employed to illustrate that an economy with a large social welfare system displays a positive insurance coverage/savings correlation as found in the previous empirical studies. In contrast, an economy without (or with low) social welfare support shows the opposite pattern (consistent with the standard theory). We further use household survey data from Taiwan, which has a small social welfare system, to perform an empirical investigation. We follow the similar empirical approach, but find that the empirical results are opposite to Starr-McCluer (1996) and Guariglia and Rossi (2004). This finding provides evidence to our theoretical explanation and supports the theory of precautionary saving.

Starr-McCluer (1996) reports a phenomenon of household savings in the US: households covered by private health insurance save more than those without coverage. The results remain unchanged even if household characteristics are controlled. Besides, Starr-McCluer applies several econometric approaches to reduce the problem of selectivity.[2] She concludes that the results still hold and the selectivity might not play a

[1]There are some studies using different types of health insurance (eg. public health insurance) to investigate the insurance/saving pattern. See Gruber and Yelowitz (1999), Chou, Liu, and Hammitt (2003), Chou, Liu, and Huang (2004), and Maynard and Qiu (2009).

[2]The problem of "Selectivity" indicates that people who are more risk-averse may tend to save more

crucial role in this phenomenon.

Guariglia and Rossi (2004) also investigates the effects of private health insurance on household savings using the British Household Panel Survey data. Although the health insurance system in the UK is different from that in the US (i.e., PHI is supplementary to the universal health insurance (UHI), National Health Service, in the UK), their findings are similar to those in Starr-McCluer(1996): PHI coverage increases the probability of household saving and selectivity is not the reason for the puzzling results.

This paper undertakes a dynamic stochastic general equilibrium model with uncertain retirement/death, endogenous labor supply, and PHI purchasing choices to provide a theoretical explanation.[3] We use the model to perform quantitative experiments with various sizes of social welfare system and with/without public universal health insurance. The results of model simulations show that if an economy has a sizable means-tested social welfare system, the households' PHI coverage and savings will show a positive pattern, as found in Starr-McCluer (1996) and Guariglia and Rossi (2004). In contrast, the opposite pattern is found in a model economy with a relatively small social welfare system. The results are robust regardless of whether UHI is available (i.e., no matter PHI is primary or supplementary). We suggest that the empirical findings in the US, the UK and Taiwan are all consistent with the standard theory of precautionary saving if we take into account the distortion from the social welfare system.

The mechanism is briefly explained as follows. Consider a means-tested social welfare system that provides a safety net so that households will not fall below a guaranteed living standard – they receive subsidies from government if their disposable income and assets are less than a certain level. Although the effect is continuous and there is no clear boundary between groups, we separate households into three groups in order to explain the intuition: people who are already qualified, who are likely to be qualified (whose income and asset are close to the income and asset requirement), and who are less likely to be qualified for the means-tested social welfare subsidies.

First, we consider the behavior of people who are already qualified for the social welfare assistance. Because the living standard is always guaranteed, they actually face very low (or even no) income and medical expenditure uncertainties. Therefore, they have the least incentives to save and to purchase insurance in a precautionary manner.

Similarly, those who are likely to be qualified for the social welfare benefits will not be worse than the guaranteed living standard. Therefore they also face low uncertainties even a bad income shock or a large medical expenditure happens. Besides, they have

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and also buy health insurance.

[3] Jeske and Kitao (2009) use a similar framework to study the effect of US tax treatment on private health insurance take-ups.

some incentives to maintain fewer savings in order to satisfy the requirement of the means-tested social welfare subsidies.

In contrast, those who are less likely to be qualified have to guard against uncertainties by themselves. Thus, they have more incentives to accumulate precautionary savings and purchase PHI. Because PHI and savings are substitutes in term of reducing the uncertainty of medical expenditure, a negative pattern between savings and PHI coverage is expected. In addition, even for those who have PHI coverage, they still need to save against possible income uncertainties.

Therefore, although PHI and precautionary savings are in general substitutable to each other, it is possible to observe a positive pattern between savings and PHI coverage over the whole society, if the first two groups are significantly large. This positive pattern is not because precautionary saving motive does not exist, but because the motive is distorted unevenly across individuals by the social welfare system.

According to the above discussion, we expect that in an economy with a sizable means-tested social welfare system (for example, the US and the UK), a larger proportion of population are qualified or likely to be qualified for the welfare benefits. Therefore, a positive pattern between savings and PHI purchase is more likely to be observed. In contrast, if we can find an economy with a relatively small social welfare system that only affects an insignificant proportion of population, it is possible to observe the substitution effect of PHI on savings.

To examine the above theoretical prediction, we use Taiwanese household survey data for our empirical tests. Taiwan is selected because (1) its means-tested social welfare system is much smaller than that in the US and in the UK. We use the same measure for the size of the social welfare system and find that Taiwan's social welfare assistance is less than a half of that in the US and less than a third of that in the UK. (2) The health insurance system in Taiwan is similar to that in the UK. Taiwan has introduced the National Health Insurance since 1995 that provides an universal coverage. In addition, PHI is available and provides supplementary coverage as in the UK. (3) Taiwan has good household survey data that have been used in many empirical studies.[4] We use comparable empirical approach as in Guariglia and Rossi (2004), and show that Taiwanese households covered by supplementary PHI save less than those without PHI coverage. This finding is opposite to Starr-McCluer (1996) and Guariglia and Rossi (2004), and confirms our theoretical prediction.

The rest of this paper is organized as follows. Section 2 introduces the model and discusses the mechanism. Section 3 measures the social welfare systems in the US and

[4]For example, Chou, Liu, and Hammitt (2003) and Chou, Liu, and Huang (2004).

the UK, describes the model settings for quantitative simulations and provides numerical experiments for illustration. Section 4 describes the data and provide empirical tests. Section 5 concludes this paper.

2 The Model

We undertake a dynamic general equilibrium model with endogenous working/saving choices and PHI purchasing decisions based on Aiyagari-Bewley type models. As in Castaneda, Daz-Gimenez, and Ros-Rull (2003), Heathcote (2005), and Jeske and Kitao (2009), the life cycle is modeled as a stochastic transition from the young to the old.

2.1 General Model Environment

2.1.1 Demographics

The economy is populated by a continuum of agents and the total population measure is normalized to be one. The population consists of two generations - the young and the old. Young agents supply labor and earn wage income. Old agents retire from market work and receive social security benefits. Young agents become retired with a probability ρ_o. Old agents pass away and leave the economy with a probability ρ_d. In each period, new-born young agents replace the dead, so the measure of total population remains unchanged. The demographic setting implies that the fraction of the old is $\frac{\rho_o}{\rho_o+\rho_d}$ and the fraction of the young is $\frac{\rho_d}{\rho_o+\rho_d}$.

2.1.2 Uncertainties

Labor Productivity Shock

Young agent's effective labor supply depends on hours worked and an idiosyncratic labor productivity shock z, which is stochastic. In each period t, an idiosyncratic labor productivity shock takes one of l values in a finite set $Z = \{z_1, z_2, ..., z_l\}$. Each young agent's productivity shock evolves independently according to a first-order Markov process with a transition probability matrix π_z and a corresponding invariant distribution $\bar{\pi}_z$. Old agents retire from the labor market. Their labor productivity shock z is fixed at zero.

Medical Expenditure Shock

Both the young and the old face medical expenditure shocks m. In period t, an agent's medical expenditure shock takes one of h values in a finite set $M_i = \{m_{1,i}, m_{2,i}, ..., m_{h,i}\}$

for $i \in \{y, o\}$ denoting the young and the old, respectively. The medical expenditure shock also evolves independently according to a first-order Markov process with the transition probability matrix $\pi_{m,i}$ and a corresponding invariant distribution $\bar{\pi}_{m,i}$ for $i \in \{y, o\}$.

2.1.3 Government and Social Programs

Government's revenues consist of labor income tax τ_n, capital income tax τ_k and consumption tax τ_c. Government runs the following social programs:

Social Security
The social security program provides the old (the retired) with a benefit ss. The young does not receive social security benefits (i.e., $ss = 0$).

Means-tested Social Welfare (Safety Net)
The asset-based means-tested social welfare program enables households to maintain a minimum consumption level (denoted by $\underline{c}$). We employ a simple rule as in Hubbard et al. (1995) for the operation of the social welfare: if a household's disposable income and assets (net after tax and medical expenditure) are lower than $\underline{c}$, the household is qualified and receives a transfer payment from the government so that the minimum consumption level is guaranteed.

2.1.4 Health Insurance System

Public Universal Health Insurance
If a public UHI program is available, it covers a fraction ω of realized medical expenditure m. In this case, individuals pay $(1 - \omega)\, m$ out of pocket for the medical expenditure m.

Private Health Insurance
Everyone can purchase a PHI contract in the current period and the PHI covers a fraction of medical expenditure next period. Two types of PHI are discussed in this paper. First, if UHI is not available ($\omega = 0$), PHI provides a primary coverage and covers a fraction $\bar{\omega}_p(m)$ of realized medical expenditure m. Those with PHI coverage pay $(1 - \bar{\omega}_p(m))\, m$ out of pocket for their medical expenditures. Second, when UHI is provided, PHI becomes supplementary and covers the remaining medical expenditures. Hence, the out-of-pocket medical expenditure becomes $(1 - \omega)(1 - \bar{\omega}_p(m))\, m$.

If an agent decides to buy PHI, a premium $q(m)$ has to be paid in the current period. The premium $q(m)$ depends on the current health state (i.e. current medical expenditure m). We assume private health insurance companies are risk-neutral and competitive. They can monitor each household's state of medical expenditure without costs. Each household's state of medical expenditure is public information. We assume that there is no cross-subsidy across contracts. Premium $q(m)$ satisfies:

$$q(m) = (1+\psi)E\left[\omega_p(m')\cdot m'|m\right] \tag{1}$$
$$= \begin{cases} (1+\psi)\sum_{j=1}^{h}\Big[(1-\rho_o)\omega_p(m'_{j,i})\cdot m'_{j,i}\cdot \pi_{h,i}(m'_{j,i}|m)+ \\ \rho_o\omega_p(m'_o)\cdot m'_{j,o}\cdot \pi_{h,o}(m'_{j,o}|m)\Big], \text{ if } i=y; \\ (1+\psi)(1-\rho_d)\sum_{j=1}^{h}\omega_p(m'_{j,i})\cdot m'_{j,i}\cdot \pi_{h,i}(m'_{j,i}|m), \text{ if } i=o, \end{cases}$$

where ψ denotes a proportional mark-up/administration cost for the insurance contract, and $\omega_p(m) = \bar{\omega}_p(m)(1-\omega)$.

Production Technology and Preference

On the production side, we assume perfect competitive firms operating a technology with constant returns to scale. Firms rent capital with a rental rate r (net after depreciation) and hire effective labor with a wage rate w. Aggregate output Y is given by

$$Y = F(K,L) = AK^{\theta}L^{1-\theta},$$

where K and L are the aggregate capital and aggregate effective labor employed, θ denotes the capital income share, and A is the total factor productivity. Capital depreciates at a rate δ every period.

A standard period utility function $u(c,n)$ is adopted,

$$u(c,n) = \frac{\left[c^{\varphi}(1-n)^{1-\varphi}\right]^{1-\mu}}{1-\mu}, \tag{2}$$

where c is consumption, n is labor hours ($1-n$ is leisure time), φ denotes leisure utility parameter, and μ is the relative risk aversion coefficient. The utility function is balanced-growth-path consistent and implies that labor supply is a function of consumption and effective wage rate:

$$n = 1 - \frac{(1-\varphi)(1+\tau_c)c}{\varphi(1-\tau_n)wz}.$$

2.2 Household Problem

The Young

The state of an agent is summarized by a vector $s = (a, z, m, i_{HI})$, where a denotes asset holdings brought into the current period, z represents the idiosyncratic shock to labor productivity, and m is the idiosyncratic medical expenditure shock. The indicator i_{HI} takes a value of 1 if the agent purchased PHI in the last period and 0 otherwise. A young agent's maximization problem is given by:

$$V_y(s) = \max_{c,n,a',i'_{HI}} \left\{ u(c,n) + \beta(1-\rho_o) E\left[V_y(s')\right] + \beta\rho_o E\left[V_o(s')\right] \right\},$$

subject to

$$\begin{aligned}
&(1+\tau_c)c + a' + q(m)\, i'_{HI} = Wel_y + Tr;\\
&Wel_y \equiv (1-\tau_{ss}-\tau_n)\, wzn + [1+(1-\tau_k)\, r]\,(a+b) - [1-\omega-i_{HI}\omega_p(m)]\, m;\\
&Tr = \max\{0,\ (1+\tau_c)\underline{c} - Wel_y\};\\
&i'_{HI} \in \{0,1\};\ \ a' \geq 0;\ \ 1 > n \geq 0;
\end{aligned}$$

where V_y is the value when the agent is young, and Tr is the transfer made by the means-tested social welfare system. We assume that accidental bequests are equally distributed to all survivals with an amount b.

The Old

Retired people do not supply labor but receive social security payment as their main income. Their labor productivity z is fixed at 0. Therefore, they only face medical expenditure shocks. An old agent's problem is given by:

$$V_o(s) = \max_{c,a',i'_{HI}} \left\{ u(c,0) + \beta(1-\rho_d) E\left[V_o(s')\right] \right\}$$

, subject to

$$\begin{aligned}
&(1+\tau_c)c + a' + q(m)\, i'_{HI} = Wel_o + Tr;\\
&Wel_o \equiv ss + [1+(1-\tau_k)\, r]\,(a+b) - [1-\omega-i_{HI}\omega_p(m)]\, m;\\
&Tr = \max\{0,\ (1+\tau_c)\underline{c} - Wel_o\};\\
&i'_{HI} \in \{0,1\};\ \ a' \geq 0;
\end{aligned}$$

where V_o is the value when the agent becomes old.

2.3 Recursive Competitive Equilibrium

A stationary recursive competitive equilibrium consists of a set of household's decision rules of asset holding a', labor supply n, PHI purchase i'_{HI}, and consumption c, a set of firm's decision rules of capital rented K and effective labor employed L, a price system of w and r, and a stationary distribution of households over the state space $\Phi(s)$, under government policies of tax rates (τ_n, τ_k, τ_c), of social security benefit ss, of UHI coverage ω (if UHI is provided), and of the minimum consumption floor $\underline{c}$, such that:

(1) given the price system, the decision rules of K and L solve the firm's maximization problem;

(2) given the price system, the insurance premium and the policy of tax rates, the decision rules of (a', n, i'_{HI}, c) solve the young and the old agents' problem;

(3) government policies $(\tau_k, \tau_n, \tau_c, ss, \underline{c})$ satisfy the government's budget constraint, which is given by

$$\int [Tr + \omega m] \mathrm{d}\Phi(s) + ss(\frac{\rho_o}{\rho_o + \rho_d}) + G = \int [\tau_n(wzn) + \tau_k r(a+b) + \tau_c c] \mathrm{d}\Phi(s),$$

where G is the government expenditure. It is treated as a residual here;

(4) all markets clear: $L = \int (zn) \mathrm{d}\Phi(s)$, $K = \int a \mathrm{d}\Phi(s) + b$, and $Y = C + K' - (1 - \delta)K + M$, where C is the aggregate consumption, and M is the aggregate medical expenditure.

2.4 Discussion: Mechanism of Means-Tested Social Welfare

The intuition of the impact of the means-tested social welfare on saving/PHI choice has been shortly discussed in the introduction. With the model, the mechanism can be more clearly illustrated. Because the focus is the saving/PHI decisions of the working-age population, we analyze a young agent's decisions to show the mechanism.

For a young agent who is not qualified for the social welfare benefit, the current consumption is given by

$$c = \frac{(1 - \tau_{ss} - \tau_n) wzn + [1 + (1 - \tau_k) r] (a + b) - [1 - \omega - i_{HI} \omega_p(m)] m - a' - q(m) i'_{HI}}{1 + \tau_c}.$$

Marginal utility of one unit increase in current asset holdings a is $\frac{\partial u(c,n)}{\partial a} = \frac{[1+(1-\tau_k)r]u_c}{1+\tau_c}$, where u_c denotes marginal utility of consumption. In addition, marginal dis-utility (cost) of one unit increase in current medical expenditure m is $\frac{\partial u(c,n)}{\partial m} = \frac{-[1-\omega-i_{HI}\omega_p(m)]u_c}{1+\tau_c}$.

One incentive for the agent to save (i.e., increase a') is that savings can help to improve or maintain consumption (as well as utility) even if any bad income or medical expenditure shock happens next period. Similarly, purchasing PHI this period (i.e., $i'_{HI} = 1$) can help to reduce the possible cost caused by medical expenditures next period (the marginal impact of medical expenditure in the next period shock m' will be smaller, $\frac{-[1-\omega-\omega_p(m')]u'_c}{1+\tau_c}$, compared with that in the case without PHI purchase, $\frac{-(1-\omega)u'_c}{1+\tau_c}$). When the young makes decisions on savings and PHI, she uses all available information to form an expectation for the future.

However, for a young agent who is qualified for the social welfare assistance, the current consumption becomes

$$c = \frac{(1+\tau_c)\underline{c} - a' - q(m)i'_{HI}}{1+\tau_c}.$$

Clearly, the marginal utility of one unit increase in a or m is 0. It indicates that benefits of savings and PHI will be low if the young is likely to be qualified for the social welfare assistance next period. In this case, the agent will reduce savings and tend to drop PHI.

Because of the distortion of the social welfare program, positive correlation between savings and PHI coverage could be found among the whole working-age population, particularly when the size of the social welfare benefits are significant. Moreover, saving and PHI decisions are distorted unevenly by the social welfare system across individuals, that creates the difficulty of controlling its impact in empirical studies.

3 Numerical Experiments and Model Prediction

To perform quantitative experiments and to further illustrate the mechanism discussed above, we first measure how large the means-tested social welfare systems in the US and the UK are. Then we set up the parameters and numerically simulate the model to provide experiments.

3.1 Means-tested Social Welfare in the US and the UK

Because a social welfare system usually consists of many programs with different requirements, it is not easy to quantify the size (or the total benefits) of the social welfare system with one measure. We try to approximate the consumption floor ($\underline{c}$) that the government guarantees as a measure. Hubbard et al. (1995) make the first approximation by calculating the consumption floor for a representative US family, a female-headed family with two dependent children and no outside earnings or assets. Their estimate includes only asset- and means-tested transfer payments, such as Aid to Families with

Dependent Children (AFDC), food stamps, and Section 8 housing assistance for those under age 65. Unemployment insurance is not included because it is not means-tested, and it is already in the measure of income. Medicaid (for the poor) is a part of the means-tested social welfare system, but it is not included because it is used exclusively to pay for medical expenses.

Hubbard et al. (1995) suggest that, for that representative family, the median AFDC and food stamp transfers ($5,764) and expected housing subsidies ($1,173) were $6,937 in 1984. In terms of subsidy per household member ($6,937/3), it was about 14% of GDP per capita in 1984.[5]

Following the above method, we estimate the means-tested social benefits for the same representative family in the UK of 2009. The following three benefits are included: (1) Housing benefit: it varies with living locations. We choose a female-headed family with two dependent children and no outside earnings or assets in Birmingham as the representative family because the housing price in Birmingham is roughly in the middle of all cities in the UK. We find that housing benefit for two bedrooms was 524.98 pounds per month; with three bedrooms it was 574.99 pounds per month in 2009.[6] (2) Income support: it was 65.45 pounds per week for the representative family.[7] (3) Tax credits: child tax credit was 4,240 pounds per year for the representative family.[8] Therefore, the estimated means-tested benefits in 2009 were about 13,943 pounds per year. In terms of subsidy per household member (13,943/3), it was about 21% of GDP per capita.[9]

Based on the measures of social welfare in terms of percentage of GDP per capital, we will investigate various settings of $\underline{c}$ in the numerical experiments to check the corresponding impacts on savings/PHI coverage pattern.

3.2 Model Parameterizations

We choose a model economy without UHI as the benchmark, and parameters are selected mainly based on the US data.

[5] GDP per capita in the US of 1984 was $16,549.

[6] More detailed information of housing benefit can be found through the following link to the web page of public services: `http://www.birmingham.gov.uk/cs/Satellite`.

[7] More detailed information of Income Support can be found on: `http://www.direct.gov.uk/en/MoneyTaxAndBenefits/BenefitsTaxCreditsAndOtherSupport/On_a_low_income/DG_185670`.

[8] For more information of child tax credit, see: `http://www.hmrc.gov.uk/pdfs/wtc1.pdf`.

[9] GDP per capita in the UK of 2009 was 22,474 pounds.

Demographics, Preference, and Production Function

The probability ρ_o is set at $1/45$ to imply that a young agent on average works for 45 years (age 20 – 64) before retirement. The fraction of working-age population is set at 80 percent. Thus, ρ_d is equal to 0.0889.

The risk aversion parameter μ in the utility is set at 3, which is the middle value of the estimations in empirical studies. It is frequently used in the literature. Different values of μ are investigated in Appendix 1. The utility discount factor β is chosen to be 0.96 and the corresponding capital-output ratio is 2.6 in the benchmark. The leisure utility parameter φ is 0.455 so that aggregate labor hours is equal to 0.33.

In the production function, the capital income share θ is set at 0.33. The depreciation rate of capital δ is set at 0.08. Total factor productivity A is normalized to unity.

Labor Productivity Shock

The process of labor productivity shocks (z_t) is used to capture the income uncertainty that is not explained by individual characteristics. We use a first order autoregressive process to approximate the pattern of logarithm of labor productivity shocks. The process is set to be:

$$\log(z_{t+1}) = \rho_z \log(z_t) + \varepsilon_{zt},$$

where ρ_z is the serial correlation coefficient of labor productivity shock and ε_{zt} is white noise. We adopt the estimation of labor productivity provided by Floden and Linde (2001) and set ρ_z to be 0.92 and the standard deviation of ε_{zt} at 0.21. Then the procedure described in Tauchen (1986) is applied to approximate the AR(1) process using a five-state Markov chain, with a maximum and minimum equal to ± 2.5 standard deviations of the unconditional distribution.

Medical Expenditure Shock

To characterize medical expenditure shocks, we directly use a Markov process instead of an AR(1) process because of the skewness of medical expenditure. We define four medical expenditure states as "low," " fair," "high," and "very high," to represent average medical expenditures in the groups of bottom 60%, from 60 to 95%, from 95 to 99%, and the top 1%, respectively. Jeske and Kitao (2009) use a similar setting and estimate the process of medical expenditure based on the Medical Expenditure Panel Survey (MEPS). Based on their report, we calculate the mean of medical expenditure in each group for working-age and retired population. These expenditures were 0.9%, 10.8%,

Table 1: States of Medical Expenditure

State	Expenditure range	Young (m_y) Average amount	Young (m_y) Ratio of avg income	Old (m_o) Average amount	Old (m_o) Ratio of avg income
1. Low	bottom 60%	310	0.9%	1,630	4.9%
2. Fair	60 – 95%	3,597	10.8%	9,474	28.5%
3. High	95 – 99%	16,629	50.0%	34,455	103.6%
4. Very High	top 1%	53,013	159.4%	75,329	226.5%

Original source: MEPS. Calculation based on Jeske and Kitao (2009).
Average expenditure amounts are in 2003 prices (US dollars) and compared with average income in 2003.

50.0%, and 159.4% of the average income in 2003 for the working-age population, and were 4.9%, 28.5%, 103.6%, and 226.5% for the retired population. The percentages of average labor income are set to be the four-state medical expenditure shocks, m_y and m_o for the young and the old in the model, respectively. They are summarized in Table 1.

The MEPS provides two-year panels since 1996 for the estimation on transitions of medical expenditure states. Monheit (2003) uses the data of 1996 and 1997 to study the persistence of medical expenditure. Jeske and Kitao (2009) also use the MEPS data to determine the transition probabilities of medical expenditure states. Our transition probabilities of medical expenditures are calibrated based on Jeske and Kitao (2009) and reported in Table 2.

Health Insurance

According to the MEPS, the private health insurance in the US provides various expenditure coverage rates depending on age and the amount of medical expenditure. We use the report in Jeske and Kitao (2009) to set the effective coverage of PHI, $\bar{\omega}_p(m)$, to be $(.528\ .702\ .765\ .845)$ for the young and $(.315\ .511\ .637\ .768)$ for the old.

The PHI serves as a primary insurance in the benchmark economy in which the UHI is not available. The markup ψ of PHI is chosen to be 1% so that in the benchmark economy 60% of households purchase PHI. This is consistent with the PHI market for the working-age population in the US.

When UHI is provided, we set the expenditure coverage rate of UHI, ω, at 65%. Different values of ω are also investigated. The results are reported in Appendix 1.

Table 2: Transition Probabilities of m

t\t+1	Low	Fair	High	Very High
Young (m_y)				
Low	0.784	0.199	0.014	0.003
Fair	0.337	0.591	0.062	0.010
High	0.173	0.562	0.200	0.065
Very High	0.105	0.376	0.286	0.233
Old (m_o)				
Low	0.761	0.217	0.019	0.003
Fair	0.368	0.551	0.062	0.019
High	0.218	0.591	0.137	0.054
Very High	0.118	0.608	0.264	0.010

Original source: MEPS.
Calculation based on Jeske and Kitao (2009).

Social Security and Government Taxation

The social security payment (ss) is set to be 45% of average labor income.[10] Consumption tax rate is 5%, capital income tax is 30%, and labor income tax rate is 35% (social security tax is included in the labor income tax).

3.3 Model Prediction

The PHI for the working-age population in the US provides a primary coverage. However, it is a supplementary coverage in the UK. In the following experiments, we show that in both cases the means-tested social welfare is crucial to understand the insurnce/saving pattern.

3.3.1 Private Health Insurance as a Primary Coverage

We first consider an economy that UHI is not available and PHI serves as a primary coverage. Various sizes of means-tested social welfare systems ($\underline{c}$) are examined. All of them are simulated in the steady state equilibria. Basic characteristics of these economies in steady state equilibria are presented in Table 3. Clearly, the social welfare crowds out asset holdings and PHI take-ups. Therefore, capital-output ratio and PHI take-up ratio among the working-age population both decrease as $\underline{c}$ increases.

[10]The results of different social security payment are reported in Appendix 1.

Table 3: Model Economies with Primary PHI

Variable\Welfare size	$\underline{c} = .01\overline{y}$	$\underline{c} = .05\overline{y}$	$\underline{c} = .10\overline{y}$	$\underline{c} = .15\overline{y}$	$\underline{c} = .20\overline{y}$
Interest rate (r)	3.72%	3.90%	4.30%	4.66%	4.83%
PHI take-up ratio (young)	0.89	0.85	0.64	0.60	0.42
K/Y ratio	2.82	2.77	2.68	2.61	2.57
Labor hours	0.36	0.36	0.34	0.33	0.33

Note: $\underline{c}$ represents the size of means-tested social welfare. $\overline{y}$ denotes output per capita.

Table 4: Regression of log Asset Holdings (Model) – Primary PHI

Variable\Welfare size	$\underline{c} = .01\overline{y}$	$\underline{c} = .05\overline{y}$	$\underline{c} = .10\overline{y}$	$\underline{c} = .15\overline{y}$	$\underline{c} = .20\overline{y}$
Intercept	8.360	6.350	6.131	4.818	3.949
log earnings	0.395	0.434	0.155	0.247	0.381
log medical expenditure	-0.132	-0.074	-0.215	-0.202	-0.078
PHI coverage	-1.535	-0.567	3.668	3.899	3.358

Note: $\underline{c}$ represents the size of means-tested social welfare. $\overline{y}$ denotes output per capita. All are significant at the 5% level.

Using the simulated data in each economy, we run an regression, as in empirical studies, to study the effect of private health insurance coverage on savings.[11] Following previous empirical studies, we focus on the working-age population (only young agents in the sample). The dependent variable is asset holdings. Independent variables are earnings, health expenditure, and PHI coverage. All variables are in the logarithm scale, except PHI coverage. The PHI coverage is an indicator with 1 denoting that the agent has an PHI coverage and 0 otherwise. The results are summarized in Table 4. The first column represents an economy with a very small means-tested social welfare system that provides a minimum consumption floor 1% of its output per capita. Other columns represent economies with different sizes of means-tested social welfare. In particular, the US case can be represented by the economy with $\underline{c} = .15\overline{y}$.

We find that the PHI coverage has a significantly positive effect on asset holdings when the minimum consumption floor is higher (when $\underline{c} \geq 0.1\overline{y}$). This result is consistent with Starr-McCluer (1996), and seems contrary to the theory of precautionary

[11]Here we simply use an ordinary least squares regression to illustrate the main idea because the model economy is not as complicated as the real world. We will carefully perform an empirical analysis with the real data in the next section.

Table 5: Model Economies with UHI (Supplementary PHI)

Variable \Welfare size	$\underline{c} = .01\overline{y}$	$\underline{c} = .05\overline{y}$	$\underline{c} = .10\overline{y}$	$\underline{c} = .15\overline{y}$	$\underline{c} = .20\overline{y}$
Interest rate (r)	4.35%	4.36%	4.41%	4.70%	4.77%
PHI take-up ratio (young)	0.76	0.76	0.54	0.54	0.54
K/Y ratio	2.67	2.67	2.66	2.60	2.58
Labor hours	0.34	0.34	0.34	0.32	0.32

Note: $\underline{c}$ represents the size of means-tested social welfare. $\overline{y}$ denotes output per capita.

Table 6: Regression of log Asset Holdings (Model) – Supplementary PHI

Variable\Welfare size	$\underline{c} = .01\overline{y}$	$\underline{c} = .05\overline{y}$	$\underline{c} = .10\overline{y}$	$\underline{c} = .15\overline{y}$	$\underline{c} = .20\overline{y}$
Intercept	6.759	6.656	8.311	4.633	4.501
log earnings	0.543	0.550	0.033	0.410	0.416
log medical expenditure	-0.008	-0.021	-0.110	-0.098	-0.098
PHI coverage	-3.223	-3.112	2.002	1.717	1.749

Note: $\underline{c}$ represents the size of means-tested social welfare. $\overline{y}$ denotes output per capita. UHI coverage rate is equal to 0.65. All are significant at the 5% level.

saving. However, when the size of the means-tested social welfare is relatively small, for example 1% and 5% of per capita output, the effect of PHI coverage on asset holdings becomes negative. In the cases with small means-tested social welfare, the result supports the precautionary saving hypothesis.

The effects of other variables on asset holdings are stable. Higher labor productivity shocks bring higher current income; thereby increasing asset holdings. Higher medical expenditure shocks lower current cash on hand and decrease asset holdings. Both of them are consistent with the permanent income hypothesis.

3.3.2 Supplementary Private Health Insurance

In this part, we perform quantitative exercises in an environment where UHI is available. UHI covers 65% of medical expenditures. People are allowed to purchase supplementary PHI that provides additional coverage, such as in the UK. Similar to the last sub-section, we examine whether the PHI coverage substitutes precautionary savings under various sizes of means-tested social welfare system. We simulate economies with the minimum consumption floor equal to $0.01\overline{y}$, $0.05\overline{y}$, $0.10\overline{y}$, $0.15\overline{y}$, and $0.20\overline{y}$, respectively. The case of the UK can be represented by the economy with 20% of per capita output. The characteristics of these economies in steady state equilibria are presented in Table 5. We still observe the crowding out effect of the social welfare, but the effect is smaller because people are more secured with UHI. When $\underline{c}$ is small (for example, the $0.01\bar{y}$ case), the capital-output ratio and PHI take-up ratio are both lower than those in the economy with primary PHI.

The same regression is employed to show the effect of each factor on asset holdings. Table 6 reports the results. We find that the pattern is the same as that in Table 4: the PHI coverage has a negative effect on asset holdings when the size of the means-tested social welfare is small. In contrast, the effect becomes positive when the social welfare is large.

The effects of other factors, i.e., labor shocks (earnings) and medical expenditure shocks, are consistent with our expectation. Alternative settings of UHI coverage rate, risk aversion, and social security payment, are examined for robustness. The details are reported in Appendix 1.

4 Empirical Analysis

The quantitative analysis in Section 3 suggests that the social welfare system accounts for the pattern between PHI coverage and savings. The model also predicts that in an economy with a smaller (larger) system, a negative (positive) pattern will be observed.

Starr-McCluer (1996) and Guariglia and Rossi (2004) have found the positive relationship between PHI and savings in the US and UK, both of which provide relatively good social welfare. As a complement to the literature, this section attempts to study an example, an economy with a smaller means-tested social welfare system, to verify the theoretical prediction. For our empirical study, Taiwan is selected as an example because of the following reasons. First, the means-tested social welfare is relatively small in Taiwan. Second, Taiwan has good household survey data that have been used in the literature. Third, the health insurance system is similar to the UK. PHI plays a supplementary role as in the UK. Therefore, we basically follow the empirical approach as in Guariglia and Rossi (2004) so that the results can be comparable. The details are discussed as follows.

4.1 Means-tested Social Welfare in Taiwan

Taiwanese social welfare system before 2008 was based on the “Public Assistance Act” established in 1980. The system has been enacted with the principles of “active concern, respect requirements, help to be independent" and it combines various social benefit resources from the private sector to offer immediate and proper care to the sick and to those dependents whose lives are in great difficulty. Income and asset tests are both required for receiving the benefits. According to the financial sources, the central and municipal or county/city governments can set harsher requirements, which can be inconsistent with the act, for the low-income families. Consequently, only about 1% of families received the social assistances. There was an expansion of the social welfare in 2009 that slightly increased the coverage and benefits. By the end of 2009, the national total of qualified low-income families were 105,265 or 256,342 people, which accounted for 1.11% of total population.[12] The details of the social assistance system in Taiwan is summarized in Appendix 2.

To estimate Taiwan's means-tested social benefit for the representative family, we follow the method in Hubbard et al. (1995). The representative family was qualified for two means-tested benefits in 2009: (1) Life allowance: it was 5,000 Taiwan dollars per month. (2) Children subsidy: it was 2,200 Taiwan dollars per child per month.[13] For our representative family, they received 4,400 Taiwan dollars per month. Thus, the total means-tested social benefits were 112,800 Taiwan dollars per year. In terms of per capita subsidy (112,800/3), it was about 6% of per capita GDP in 2009.[14]

4.2 The Data and Descriptive Statistics

The data used in our empirical analysis are from 2006 to 2007 Taiwan Family Income and Expenditure Survey Database, which is maintained by the General Budget, Account, and Statistics. The survey interviews around 14,000 households every year to collect information on family income and expenditure. To avoid the case that the random sampling process might overlook small zip-codes, the income is calculated on the county basis for 24 (out of 26) counties and on the zip-code basis for two largest counties (Taipei and Kaohsiung). We further restrict these household samples with heads, who are employed and are aged between 25 and 65, to avoid the effects of schooling, retirement, and unemployment on savings. We also exclude the households with self-employed heads because it is particularly difficult to distinguish family savings from the firms' investment. The sample is made up of 15,788 observations. All income and

[12] See `http://www.moi.gov.tw/outline/en/en-04.htmlforthedetails.`

[13] In Taipei city, because the living cost is much higher than other areas, life allowance for the sample family was 5,813 Taiwan dollars, and children subsidy was 5,658 Taiwan dollars per child per month. Since only one tenth of the population in Taiwan live in Taipei city, we estimate the benefits with the standard for the majority.

[14] GDP per capita in Taiwan of 2009 was 574,364 Taiwan dollars.

spending variables are expressed in 2006 NT dollar.

Annual household savings of household are defined as the current income subtracts the current consumption in a household. In addition to the spending on national health insurance, this survey also has the information of whether each household purchases various private insurances or not. In this paper, a household is defined as covered by PHI if the household answers "Yes" to the question, " do you pay premiums for personal medical insurance and/or accident insurance?"[15]

To control the effects from other household and head's characteristics, we further consider the following covariates: the family composition variables (such as the number of employed adults, the number of dependent adults, the number of children, the head's marriage status and gender), household income, household health spending, whether the household with mortgage debts, head's age, age-squared, education dummies, industrial dummies, occupational dummies, public sectoral dummy, and 2007 year dummy. The detailed description of these variables and the reasons of including them in our empirical analysis are discussed in Appendix 3.

Table 7 summarizes the descriptive statistics of the above variables. Regarding the income and spending variables, the average of the household current income is about 1.32 million Taiwan dollars and averaged household annual savings is 0.32 million Taiwan dollars, and average health spending is 0.10 million Taiwan dollars. About 89.04% of all households have positive savings and 84.72% of all households purchased private health insurance. Next we consider the household characteristic variables. The average numbers of adults/dependent children in a household is 2.70/0.99 persons. 27.46% of households have Mortgage debts. Finally, the average age of head is 43 years old and 17.44% of them work in the public sector.

Table 8 presents descriptive statistics on saving behavior and insurance coverage. Column (1) shows that the percentage of savers in the overall sample is 89.04%. This percentage tends to be higher for individuals with no dependent children, aged between 55 and 65, and the heads are not married or co-habiting. It also increases with education and with income. Column (2) reports the percentages of individuals covered by PHI for various social-demographic groups. 84.72% of households in the entire sample are covered. The PHI take-up ratio tends to be higher for the households with higher education level and with higher income.

Columns (3)-(6) report the percentages of savers among the PHI insured and PHI uninsured groups, as well as the amounts saved by these savers. Unlike the findings of

[15]We can not distinguish medical insurance and accident insurance from the data. However, accident insurance in Taiwan is purchased to cover catastrophic medical expenditures/disability caused by accidents, which can not be fully covered by the UHI. It still can be viewed as a supplementary insurance to the UHI.

Guariglia and Rossi (2004), the data indicate that in Taiwan there is a lower percentage of savers among those with PHI coverage (Columns (3) vs. (5)), but they tend to save larger amounts then those without PHI (Columns (4) vs. (6)). The percentage of savers among those with PHI coverage is 88.23, whereas the corresponding percentage among those without PHI is 93.53. The PHI insured's average savings are 375 thousand Taiwan dollars, whereas the PHI uninsured's are 266 thousand Taiwan dollars. This pattern holds for the sample overall, as well as for the various social-demographic groups reported in the Table.

Table 7: Descriptive Statistics

	No. of obs. N= 15,788	
	Mean	Std
Income and spending (Thousand Taiwan dollars)		
Current income	1,317.02	767.28
Savings	324.51	416.14
Health spending (out-of-pocket)	103.25	88.23
Household characteristics		
No. of adults in a household	2.70	1.11
No. of employed adults in a household	1.72	0.81
No. of children in a household	0.99	1.06
Head's age	43.00	9.28
	Frequency	%
Saving or not		
Negative/Zero	1,731	10.96
Positive	14,057	89.04
Private health insurance coverage		
Uncovered	2,412	15.28
Covered	13,376	84.72
Mortgage debt		
Others	11,452	72.54
Debtors	4,336	27.46
Marriage status		
Married/co-habiting	10,681	67.65
Others	5,107	32.35
Gender		
Female	3,622	22.94
Male	12,166	77.06
Education		
High school drop or less	4,217	26.71
High school graduate	5,183	32.83
Some college	2,704	17.13
College and above	3,684	23.33

next page

continued		
Organization		
Private sector	13,035	82.56
Public sector	2,753	17.44
Occupation		
Legislators, senior officials, managers & professionals	2,668	16.90
Technicians and associate professionals	3,646	23.09
Service, sales & clerical support workers	3,030	18.56
Craft and related trades workers	2,311	14.64
Plant and machine operators, and assemblers	2,728	17.28
Others	1,505	9.53
Industry		
Public administration	1,304	8.26
Finance and insurance	748	4.74
Electricity, gas, water and construction	2,195	13.90
Accommodation and eating-drinking places	534	3.38
Trade	1,521	9.63
Professional, scientific and technical Services	431	2.73
Educational services	985	6.24
Manufacturing	4,813	30.49
Health care and social welfare services	474	3.00
Others	2,783	17.63

4.3 Empirical Specification and Main Results

To analyze the determinants of individual saving decisions, we consider the Tobit regression expressed as follows.

$$s_i^* = \alpha + p_i\gamma + x_i\Gamma + e_i, \quad s_i = \begin{cases} 0 & \text{if } s_i^* \leq 0, \\ s_i^* & \text{if } s_i^* > 0, \end{cases} \quad i = 1, \ldots, N, \tag{3}$$

where s_i denotes the savings of household i; p_i, coded as 1 if household i is covered by private health insurance and 0 otherwise, is the variable used to study how PHI coverage affects saving decisions; x_i are the covariates listed in Appendix 3 except occupational dummies.[16]

Similar to Guariglia and Rossi (2004), we use household permanent income as a regressor instead of current household income. [17]

[16]In the regressions of Section 3 (the model simulation), the dependent variable is asset holdings (stock), instead of savings (flow). Because the model is simulated in steady state equilibria and only asset holdings are available, we adopt the setting in Starr-McCluer (1996) and all variables are in the logarithm scale, except PHI coverage. Here, the question is slightly different: asset holdings are unavailable and s_i is equal to zero if the annual savings are negative or zero. Therefore, we follow Guariglia and Rossi (2004) that all variables are in the original scale.

[17]The household permanent income is taken from the fitted values from least squared regression of the

Table 8: Savings and Private Health Insurance Coverage by Demographic Characteristics, Age, Education, and Income

No. of obs. N= 15,788

	(1)	(2)	(3)	(4)	(5)	(6)
	%	%	%	Thous. TWD	%	Thous. TWD
All	89.04	84.72	88.23	375.2961	93.53	266.6228
Demographic variables						
Married/co-habiting	88.43	90.86	87.91	405.2620	93.55	327.1979
Not married/co-habiting	90.31	71.88	89.05	297.0860	93.52	225.4426
No dependent child	92.64	70.53	92.14	432.8961	93.86	266.2457
One dependent children or more	86.15	96.07	85.93	339.0356	91.59	268.9380
Age						
25-34	89.64	79.74	88.85	334.1669	92.76	263.9230
35-44	88.97	89.22	88.46	331.6297	93.19	232.3122
45-54	87.15	87.45	86.09	379.3478	94.59	260.1544
55-65	92.95	73.88	92.71	573.5208	93.64	316.6478
Education						
High school dropout	87.27	73.87	84.91	257.1116	93.92	218.8152
High school graduate	86.48	85.24	85.36	288.3448	92.94	247.3302
Some college	89.72	91.12	89.45	405.8989	92.50	312.4314
College and above	94.16	91.72	94.14	581.4015	94.43	487.0958
Income						
First quartile	80.85	65.26	76.50	106.7103	89.22	87.0484
Second quartile	85.91	85.89	86.33	194.7958	91.54	144.9223
Third quartile	92.45	92.22	92.97	331.3820	95.52	237.1482
Fourth quartile	96.93	95.52	97.10	814.8569	97.84	590.7498

Note: Column (1) reports the % who save, Column (2) is the % covered by PHI, Column (3) is the % of the PHI insured who save, Column (4) is the non-zero average year savings of the PHI insured (thousand Taiwan dollars), Column (5) is the % of the PHI uninsured who save, and Column (6) is non-zero average year saving of uninsured (thousand Taiwan dollars).

We first investigate how much savings would be different between the PHI insured and the PHI uninsured. The first column of Table 9 reports the regression result. The coefficient of p_i is -34.06 and statistically significant, showing that conditional on other family and head characteristics, the PHI insured tended to save less than the PHI uninsured by 34.06 thousand Taiwan dollars. This negative pattern between PHI purchase and savings suggests that insurance coverage can crowd out private savings. This result supports our theoretical argument and the theory of precautionary saving. In accordance with the life-cycle model, savings tends to be higher for the households with a higher permanent income, more employed adults, and whose heads have higher education degrees. On the other hand, savings also tend to decline with the numbers of dependent adults and children living in the same household. Moreover, the households having mortgage debts and whose heads work in the private sector tend to have fewer savings.

There might exist a bias due to endogeneity – households who are more risk averse tend to save more and buy PHI. Since our Tobit estimated coefficient is significantly negative, the absolute value of the coefficient of p_i should become larger once the endogeneity is taken into account. It can be expected that our main results, which are consistent with the theory of precautionary saving, would not be affected. However, to be more precise on our analysis, we still spend some efforts on controlling for the possible endogeneity bias.

To control for the endogeneity caused by some unobservable factors simultaneously affecting the decisions of saving and purchasing PHI, we consider an IV Tobit model. Particularly, we instrument p_i (PHI coverage) using occupational dummies because occupation choice to some extent reflects household heads' preference (level of risk aversion).[18] To evaluate whether occupational dummies are suitable instrumental variables (IVs), we first regress p_i on the occupational dummies and the other exogenous variables by a Probit method and then test for the joint significance of these IVs by a Wald test (Judge et al. 1985). We obtain $\chi^2(5) = 85.01$ with p-value=0.000, indicating that the occupational dummies generally have a high explanatory power for private health insurance coverage. Another requirement for the valid IVs is that they should have no predictive power on savings when p_i and other exogenous variables are included in a regression as well. Based on the Tobit model, we test the joint significance of the occupational dummies and obtain $F(5,15751) = 1.81$ with p-value=0.108,[19] implying that

annual regular household income on household characteristics and heads' marriage status, gender, age, age squared, public sectoral dummy, educational dummies, occupational dummies, and the interactions of the latter two groups of dummies with age and age squared. The fitted regression has $R^2 = 0.5159$ and adjusted $R^2 = 0.5147$.

[18] See, for example, Browning and Lusardi (1996) and Guariglia and Rossi (2004).

[19] We also conduct a Basmann's (1960) type test of overidentifying restrictions: regressing the residuals

the IVs do not directly affect the savings.

We follow the IV Tobit estimation procedure illustrated in Newey (1987) and report the result in Column 2 of Table 9. The results are consistent. Compared to Column 1, the effect of PHI in Column 2 (-371.455) becomes larger and is still significant.

A more efficient way to take into account the interdependence between private health insurance coverage and saving decisions is to use a Full Information Maximum Likelihood (FIML) method. We consider this method for robustness as well. Specifically, whether to purchase private health insurance can be described by

$$p_i^* = \varpi_i \theta + u_i, \quad p_i = \begin{cases} 0 & \text{if } p_i^* \leq 0, \\ 1 & \text{if } p_i^* > 0, \end{cases} \qquad i = 1, \ldots, N, \tag{4}$$

where ϖ_i consists of x_i and occupational dummies. We also assume the errors in savings equation and the private health insurance coverage (e_i, u_i) are jointly normally distributed with covariance matrix:

$$\begin{bmatrix} \sigma^2 & \rho\sigma \\ \rho\sigma & 1 \end{bmatrix},$$

where the variance of u_i is standardized as unity. We then use the maximum likelihood method to estimate the parameters. The detailed specification of the likelihood function is described in Appendix 4.

The estimated results of saving equation based on the FIML method are reported in Column (3) of Table 9. The coefficient of private health insurance coverage, -42.29 with standard error 19.21, is significantly negative. While the absolute value of this coefficient is smaller than that in the IV-Tobit model, it is larger than the estimate in the standard Tobit model and provides an evidence of the substitute effect between savings and PHI as well.

Although our empirical approach is based on Guariglia and Rossi (2004) and similar to Starr-McCluer (1996), we find an opposite PHI/savings pattern in Taiwan, which has a relatively small size of social welfare. This finding provides an evidence to our theoretical explanation that the means-tested social welfare accounts for the seemingly puzzling findings of PHI/savings pattern in the US and the UK.

from the IV Tobit model on all exogenous variables x_i and occupational dummies, and then testing the joint significance of the occupational dummies. We obtain $F(5, 15759) = 1.16$ with p-value=0.327, which indicates that the IVs have no more predictive power for savings when the endogeneity of p_i and other exogenous variables are controlled in a regression.

Table 9: Empirical Results

Dep. variable: Savings (Thousand Taiwan dollars);									No. of obs. N=15,788
	Tobit			IV-Tobit			FIML		
	(1)			(2)			(3)		
Private insurance	-34.06	***	(8.48)	-371.46	***	(129.41)	-42.29	**	(19.21)
Permanent income	0.38	***	(0.02)	0.41	***	(0.02)	0.40	***	(.03)
Health spending	0.11	**	(0.06)	0.18	***	(0.05)	0.23	***	(.06)
Demographic variables									
Age	-11.69	***	(3.76)	-3.38		(4.55)	-6.97	**	(3.48)
Age-squared	0.15	***	(0.05)	0.05		(0.05)	11.07		(43.91)
No. of emp.	66.71	***	(8.02)	70.14	***	(7.13)	64.26	***	(8.98)
No. of dep adults	-29.33	***	(4.01)	-26.78	***	(4.07)	-37.99	***	(6.85)
No. of kids	-51.92	***	(3.77)	-23.82	**	(11.42)	-25.09	***	(7.27)
Male	9.59		(8.34)	-9.87		(11.58)	-10.55		(10.9)
Married / co-habiting	59.52	***	(8.60)	35.48	***	(13.26)	26.00	**	(11.55)
Education									
High school graduate	-17.59	**	(7.79)	6.45		(13.50)	3.19		(9.5)
Some college	-9.49		(12.62)	23.18		(18.72)	21.92		(14.81)
College degree or above	12.06		(18.27)	42.49	*	(22.08)	41.30	**	(20.66)
Other Variables									
Public sector	63.84	***	(15.20)	62.51	***	(13.33)	63.58	***	(17.68)
Mortgage debtor	-54.06	***	(7.27)	-41.08	***	(8.94)	-41.97	**	(10.67)
2007 dummy	10.22	*	(6.14)	13.30	**	(6.53)	10.80		(6.66)
Constant	19.79		(75.39)	42.74		(72.36)	35.84		(81.02)
ρ							0.71	***	(.03)
Industrial dummies	yes			yes			yes		

*, **, *** denote 10%, 5%, and 1% significance, respectively. The variables used to obtain the household permanent income are household characteristics, household private insurance spending, heads' marriage status, gender, age, age squared, public sectoral dummies, educational dummies, industrial dummies, occupational variables, and the interactions of the latter three groups of dummies with age and age squared with $R^2 = 0.52$. Due to space limitation, here we omit the estimates of year and industrial dummies and omit the results of the PHI equation. The detailed results are available upon request.

5 Concluding Remarks

This paper revisits the puzzling PHI/saving phenomenon in the literature. We suggest that institutional factors, in particular, the size of means-tested social welfare program, are crucial to understand the phenomenon.

We undertake a dynamic equilibrium overlapping-generations model with endogenous private health insurance choices. The simulated results show that a model economy with a sizable social welfare system presents the same insurance/saving pattern as observed in the US and the UK. However, an opposite pattern will be observed in an economy with a smaller social welfare system. We suggest that although PHI and precautionary savings are in general substitutable to each other, if the population affected by the social welfare is significantly large, it is possible to observe a positive pattern between savings and PHI coverage over the whole society. This positive pattern is not because precautionary saving motive does not exist, but because the motive is distorted unevenly across individuals by the social welfare system.

Taiwanese household survey data are used to perform an empirical test because Taiwan has a relatively small means-tested social welfare system. Following the same empirical approach as in the previous studies, we find that, given all others being equal, those covered by PHI save less than those without it. As a compliment to the empirical literature, we provide an example of a negative relationship between PHI coverage and savings, which supports the theory of precautionary saving. This finding is opposite to the previous studies and consistent with our theoretical explanation.

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Appendix 1: Results of Sensitivity Tests

Since factors other than the PHI coverage, i.e., labor shock (earnings) and medical expenditure, have consistent effects on asset holdings, we only report the coefficient of the PHI coverage in each sensitivity test. The results are reported in Table 10, 11, and 12.

Table 10: Sensitivity Tests – Various UHI Coverage Rate

UHI coverage	$\underline{c} = .01\overline{y}$	$\underline{c} = .05\overline{y}$	$\underline{c} = .10\overline{y}$	$\underline{c} = .15\overline{y}$	$\underline{c} = .20\overline{y}$
0.6	-1.535	-2.934	1.534	1.787	1.862
0.65	-3.223	-3.112	2.002	1.717	1.749
0.7	-3.249	-3.104	1.940	1.678	1.767

Notes: $\mu = 3$; social security payment (ss) = 0.45.

Table 11: Sensitivity Tests – Various Risk Aversion

UHI coverage	μ	$\underline{c} = .01\overline{y}$	$\underline{c} = .05\overline{y}$	$\underline{c} = .10\overline{y}$	$\underline{c} = .15\overline{y}$	$\underline{c} = .20\overline{y}$
0	2	-0.435	-0.387	3.805	3.999	3.897
0	3	-1.535	-0.567	3.668	3.899	3.358
0	4	-1.362	-1.449	3.727	3.625	3.004
UHI coverage	μ	$\underline{c} = .01\overline{y}$	$\underline{c} = .05\overline{y}$	$\underline{c} = .10\overline{y}$	$\underline{c} = .15\overline{y}$	$\underline{c} = .20\overline{y}$
0.65	2	-3.327	-1.996	2.179	1.885	1.919
0.65	3	-3.223	-3.112	2.002	1.717	1.749
0.65	4	-3.091	-3.028	-0.345	1.729	1.697

Notes: social security payment (ss) = 0.45.

Table 12: Sensitivity Tests – Various Social Security Payments

UHI coverage	*ss*	$\underline{c} = .01\overline{y}$	$\underline{c} = .05\overline{y}$	$\underline{c} = .10\overline{y}$	$\underline{c} = .15\overline{y}$	$\underline{c} = .20\overline{y}$
0	0	0.593	0.668	4.387	4.374	3.820
0	0.45	-1.535	-0.567	3.668	3.899	3.358
0	0.6	-2.093	-0.772	3.023	2.888	2.521
UHI coverage	*ss*	$\underline{c} = .01\overline{y}$	$\underline{c} = .05\overline{y}$	$\underline{c} = .10\overline{y}$	$\underline{c} = .15\overline{y}$	$\underline{c} = .20\overline{y}$
0.65	0	-1.709	-2.746	2.830	2.204	1.812
0.65	0.45	-3.223	-3.112	2.002	1.717	1.749
0.65	0.6	-3.159	-3.029	1.839	1.593	1.650

Notes: $\mu = 3$.

Appendix 2: Social Assistance System in Taiwan

Taiwanese government provides the following service measurement to low-income families: family living subsidies, pregnant women and baby diet subsidies, living allowances for the elder, for the disabled, for children's lives, and many other forms of subsidies. Furthermore, in order to enhance the working abilities of low-income workers, Taiwan offers professional training and employment services to help recipients to become independent thus improve their living environments. Additionally, the program also includes emergency subsidies, medical treatment subsidies, and homeless people housing. Current important social assistance measures are briefly introduced as follows.

1. Economic Safety:

   (a) Life assistances include life allowance, education allowance and relief subsidy by working, children education subsidy and festival gifts.

   (b) Medical subsidies include those for insurance, and cost sharing and medical expenses not covered in the national health insurance benefit.

   (c) Emergency relief.

   (d) Work relief.

2. Life Care includes providing accommodation and treatment for low-income psychiatric patients, providing education and job training for low-income family, and counseling for the homeless.

Table 13: The Numbers/Percentages of Households and Persons are Benefited from the Social Assistance System

Year	No. of Households	No. of people	% (by Household)	% (by people)
2004	82,783	204,216	1.15	0.90
2005	84,796	211,220	1.16	0.93
2006	89,902	218,151	1.22	0.95
2007	90,682	220,990	1.21	0.96
2008	90,846	218,180	1.19	0.95

Data source: Department of Social Affairs, The Ministry of the Interior, Taiwan.

3. Calamity assistance includes (a) Consolation moneys and civic donations for calamity are given to the people that suffer death, missing, severe injury, etc. to help them reconstruct their families. (b) Placement of the distressed people. (c) Setting up the standard work flow of adjustment and storage of salvation materials, and that of storage of emergent relief materials to cope with natural disasters, so as to ensure the supply of foods and necessities.

As shown in Table 13, which reports the numbers/percentages of households and persons received the aids from the social assistance system, about 1.2% of households in Taiwan have been benefited from this system.

A household is eligible for government subsidies if its household income per capita is less than the minimum cost of living, which is defined as 60 percent of average per capita consumption expenditures and varies from county to county. For example, in 2009 it is 14,558 Taiwan dollars in Taipei City, 11,309 Taiwan dollars in Kaohsiung City, 10,792 Taiwan dollars in Taipei County, and 9,829 Taiwan dollars in other cities and counties around the country (except Kinmen and Lien-Chiang Counties). Table 14 reports the dynamics of the minimum cost of living from 2004 to 2009. Additionally, the total household wealth will be also considered when a household applies the public assistances. For example, if the total amount of household liquid assets excesses 150,000 Taiwan dollars or the total current assessed and public announced value of the owned land/houses/apartments excesses 5,500,000 Taiwan dollars, then a household in Taipei City is not eligible for public subsidies. Again, this requirement varies across counties/cities. Finally, according to household income and wealth, the eligible households are grouped into three categories and receive different aids from the system.

Table 14: The Minimum Cost of Living (Taiwan dollars)

Year	Taipei City	Kaohsiung City	Taipei County	Kinmen County	Lien-Chiang County	Other Counties
2004	13,797	9,102	8,529	6,300	6,300	8,529
2005	13,562	9,711	8,770	6,300	6,300	8,770
2006	14,377	10,072	9,210	6,500	6,500	9,210
2007	14,881	10,708	9,509	6,500	6,500	9,509
2008	14,152	10,991	9,829	6,500	6,500	9,829
2009	14,558	11,309	10,792	7,400	7,400	9,829

Data source: Department of Social Affairs, The Ministry of the Interior, Taiwan.

Appendix 3: Explanatory Variables Used in Empirical Analysis

In our empirical analysis, we investigate the relationship between the PHI coverage and savings. In addition to household permeant income, to control the effects from other household and head's characteristics, we further consider the following covariates in our regression:

Family composition: The variables, including the number of employed adults, the number of dependent adults, the number of children, the head's marriage status and gender, are used to capture the composition of families. It is well-known that different number of (employed) adults/children will result in different household income and consumption.

Education: It is expected that those with higher education tend to save more due to higher income. The sample can be split into four groups according to heads' education level: the college graduates and post-graduate graduates, the junior college school graduates, the high school graduates, and the high school dropout or less.

Age: The age of head and its square are used to describe the nonlinear relationship between the age and household savings. People face different financial constraints and uncertainties in different ages, which can significantly affect their saving decisions.

Employment status: Even though the unemployed,self-employed, and employers are excluded from our sample, people in different industries or occupations still face different job uncertainties. Moreover, we add a dummy to indicate whether a head is employed in the public sector. In Taiwan, those who work in the public sector tend to face less income risk than those who work in the private sector.

Health spending: We use total health spending, including all health related spending and medical expenditure, as the proxy of the health status.

Other variables: It is also expected that the households with mortgage debts tend to save less than those without mortgage debt. The year dummy variable is also included to capture the global changes from 2006 to 2007.

Appendix 4: The Specification in the Full Information Maximum Likelihood Estimation

In this appendix, we describe the detailed specification of the likelihood function, which is also used in Guariglia and Rossi (2004). First, as shown in (4), whether to purchase private health insurance is described by

$$p_i^* = \varpi_i \theta + u_i, \quad p_i = \begin{cases} 0 & \text{if } p_i^* \leq 0, \\ 1 & \text{if } p_i^* > 0, \end{cases}$$

where ϖ_i consists of x_i and occupational dummies. Moreover, similar to (3), saving behavior is captured by

$$s_i^* = \alpha + p_i^* \gamma + x_i \Gamma + e_i = \varpi_i \lambda + \eta_i, \tag{5}$$

where $\eta_i = u_i \gamma + e_i$ and $s_i = s_i^*$ if $s_i^* > 0$; otherwise, $s_i = 0$. Based on the realized values of (s_i, p_i), households can be divided into four groups: Group 1 contains the households who save and are PHI insured, such that $\Pr(s_i^*; p_i^* > 0) = \Pr(s_i^*)\Pr(p_i^* > 0 | s_i^*)$. Group 2 contains those who do not save and are PHI insured, such that $\Pr(s_i^* \leq 0; p_i^* > 0)$. Group 3 contains those who save and are not covered by PHI, such that $\Pr(s_i^*; p_i^* \leq 0) = \Pr(s_i^*) Pr(p_i^* \leq 0 | s_i^*)$. Group 4 contains those who do not save and are not covered by PHI, such that $\Pr(s_i^* \leq 0; p_i^* \leq 0)$.

Notice that we assume the errors in savings equation and the private health insurance coverage (e_i, u_i) are jointly normally distributed with covariance matrix:

$$\begin{bmatrix} \sigma^2 & \rho\sigma \\ \rho\sigma & 1 \end{bmatrix},$$

where the variance of u_i is standardized as unity. Now let $\sigma_\eta^2 = \text{var}(\eta_i)$, $\sigma_{\eta u} = \text{cov}(\eta_i, u_i)$,

$\xi = \sigma_{\eta u}/\sigma_\eta$, and $\zeta = \sigma_{\eta u}/\sigma_\eta$, we have

$$\Pr(s_i^*; p_i^* > 0) = \phi(\eta_i)\Phi_n\left(\frac{z_i\theta + \xi\eta_i}{\sqrt{1-\zeta^2}}\right), \quad \Pr(s_i^* \leq 0; p_i^* > 0) = \Phi_b\left(\frac{-z_i\lambda}{\sigma_\eta}, z_i\theta, -\zeta\right),$$
$$\Pr(s_i^*; p_i^* \leq 0) = \phi(\eta_i)\Phi_n\left(\frac{-z_i\theta - \xi\eta_i}{\sqrt{1-\zeta^2}}\right), \quad \Pr(s_i^* \leq 0; p_i^* \leq 0) = \Phi_b\left(\frac{-z_i\lambda}{\sigma_\eta}, -z_i\theta, \zeta\right),$$

where ϕ, Φ_n, and Φ_b denote the univariate standard normal density function, the univariate standard normal cumulative distribution function, and bivariate normal cumulative distribution function, respectively. The log likelihood function then takes the following form:

$$\begin{aligned} L \;=\; & \sum_{i\in\text{Group 1}} \ln\left[\Pr(s_i^*; p_i^* > 0)\right] + \sum_{i\in\text{Group 2}} \ln\left[\Pr(s_i^* \leq 0; p_i^* > 0)\right] \\ & + \sum_{i\in\text{Group 3}} \ln\left[\Pr(s_i^*; p_i^* \leq 0)\right] + \sum_{i\in\text{Group 4}} \ln\left[\Pr(s_i^* \leq 0; p_i^* \leq 0)\right]. \end{aligned}$$