Health Insurance, the Social Welfare System and Household Saving

Hsu, Minchung
National Graduate Institute for Policy Studies (GRIPS)

2008

Health Insurance, the Social Welfare System and Household Saving

Minchung Hsu*
National Graduate Institute for Policy Studies (GRIPS), Tokyo

Abstract

This paper studies the factors that can generate the puzzling saving phenomenon in the US: 1) Starr-McCluer (1996) finds that households covered by private health insurance save more than comparable households without coverage, even when controlling for other variables. 2) The asset holding ratio of the insured to the uninsured decreases with increased income level. This paper suggests that institutional factors, in particular, a means-tested social welfare system and an employment-based health insurance system, can account for the phenomenon. I develop a dynamic equilibrium model, and show that the model economy presents the same saving pattern as in the US and that the empirical finding as in Starr-McCluer (1996) is replicated. Implications for empirical approaches to testing the precautionary saving hypothesis are also provided.

JEL Classification: E21, I38, D52

Keywords: Precautionary Saving, Means-tested Social Welfare, Employment-based Health Insurance.

*Email: minchunghsu@grips.ac.jp. This paper is a revised version of a chapter of my doctoral dissertation written at UCLA. I am greatly indebted to my advisor, Gary Hansen, for his valuable advice and constant encouragement. In addition, I would like to thank Lee Ohanian and Hanno Lustig for their helpful comments and advice. I also benefited from conversations with many other people, including Andrew Atkeson, William Zame, Roger Farmer, Matthias Doepke, Christian Hellwig and the members of UCLA Prodec. All errors, of course, are mine.

1 Introduction

This paper provides both qualitative and quantitative analyses to study the factors that can generate a puzzling pattern of household saving observed in the US data. Theoretically, an introduction of insurance, which moderates households' income or expenditure uncertainties, is expected to reduce their precautionary savings.[1] Starr-McCluer (1996) reported a phenomenon of household savings in the US that is puzzling from the vantage point of the standard precautionary saving model: households covered by private health insurance save more than comparable households without coverage. Even when applying econometric methods to control for other household characteristics, including "selectivity", Starr-McCluer still found a significant and positive effect of health insurance coverage on household asset holdings.[2] In addition, It is observed that the difference in asset holdings between insured and uninsured households decreases with increased income level. The ratio of median asset holdings of the insured to the uninsured is much greater than one in low income groups. The ratio decreases as income increases and becomes close to one in the top income group.[3] The main purposes of this paper are: 1) providing a theoretical explanation to the above findings and a model can quantitatively present the saving behavior differences between the insured and the uninsured households with different income levels; 2) performing empirical tests as in Starr-McCluer's paper in the model economy that can replicate her results.

Starr-McCluer suggests that selectivity might not play a main role with this phenomenon, and there is no further analysis of this puzzling saving pattern provided in the existing literature.[4] Rather than appealing to selectivity, which depends greatly on the setting of individual preferences, as an explanatory factor, I suggest that two US institutions can account for this puzzling phenomenon: the asset-based means-tested

[1]This is also known as the precautionary saving hypothesis. Aiyagari (1994) presents qualitative and quantitative analyses of the impact of uninsured idiosyncratic risk on individual and aggregate saving. Because health care has been a large portion of individual expenditure, Kotlikoff (1989) and Hubbard et al. (1995) suggest that the uncertainty of medical expenditure has significant effects on household saving behavior. De Nardi et al. (2006), using data from Assets and Health Dynamics of the Oldest Old (AHEAD) to estimate a life-cycle model, have shown the importance of medical expenditure shocks for savings of the elderly.

[2]"Selectivity" means that people have heterogeneous risk aversion, and people who are more risk-averse may tend to save more and also buy health insurance.

[3]The details will be discussed in section 2.

[4]Guariglia and Rossi (2004), for example, use UK data and find results similar to Starr-McCluer. However, others, for example, Gruber and Yelowitz (1999), Chuo et al. (2003, 2004), and Maynard and Qiu (2005) use different types of health insurance to test the precautionary saving and prevent controlling selectivity.

social welfare system and the employment-based health insurance system. I show that, in a standard model incorporating these two institutions, although health insurance has a negative effect on precautionary saving, it also has a positive saving effect because of the presence of the two institutions. The observable net effect on savings is consequently ambiguous. The quantitative analysis in this paper shows that if an economy has a sizable means-tested social welfare system and an employment-based health insurance system, as does the US economy, the simulated household insurance-saving pattern will be very close to that observed in the US data. This finding explains the puzzling phenomenon, and calls into question the appropriateness of empirical approaches to testing the precautionary saving hypothesis through the effect of health insurance.[5] I show that even if we can control adequately for all household characteristics, the regressions capture the *net* saving effect of health insurance rather than exclusively the effect on precautionary saving.

Previous studies have discussed the effects of asset-based means-tested social welfare program on savings. The social welfare system provides financial support for households in bad times and this reduces precautionary savings. In addition, the asset-based means testing creates an incentive for households to reduce savings in order to qualify for social welfare benefits.[6] This paper further explores the interaction between health insurance coverage and the social welfare system and examines how this interaction affects household savings. As in the standard model, health insurance still has a negative effect on precautionary saving. However, because health insurance coverage will decrease the probability that households will qualify for the means-tested social welfare programs and the expected benefits of the social welfare programs, it will reduce the negative saving effect caused by the social welfare system, which amounts to a positive effect on saving. Therefore, the net effect of health insurance is ambiguous. I show that, if the means-tested social welfare system is sizable (in a reasonable range), the net saving effect of health insurance will be positive for households with lower income.[7]

The employment-based health insurance system also plays an important role to ex-

[5]The common approach is regressing household savings on health insurance status and controlling for other household characteristics. A significant and negative coefficient of health insurance implies that the precautionary saving hypothesis holds.

[6]Hubbard et al. (1995) provide a theoretical analysis and suggest that this kind of means-tested social welfare program can depress savings and explain why many American households hold very few or even no assets. Some recent empirical studies have confirmed their analysis, for example, Powers(1998), Gruber and Yelowitz (1999) and Maynard and Qiu (2005).

[7]It does not mean that precautionary savings will be more. They might still reduce their precautionary savings because of lower risk, but the asset return is higher now since the health insurance makes the social welfare programs less influential. The net level of savings could be higher.

plain the saving behaviors. Previous studies have discussed the features of employment-based health insurance (see McGarry, 2002), but few have explored its effects on saving. One feature of this health insurance system is that when people work full time in good positions (usually in bigger companies), they and their families usually have health insurance coverage provided by employers; however, when people lose their jobs, change to part-time jobs or move to worse positions (usually in smaller companies) and do not qualify for public health insurance programs, they usually become uninsured.[8] Given that health insurance coverage is highly contingent on work status, insurance coverage is also uncertain, so households that are currently insured will save against the possibility that they will encounter bad times in the future when they are not insured. This channel further strengthens the positive saving effect of health insurance.[9]

In addition, because both the means-tested social welfare system and health insurance have smaller effects on high-income households, their saving behavior will not change as much as that of low-income households when health insurance coverage is received. The difference in asset holdings between insured and uninsured households in high-income groups will, therefore, be smaller than the difference in low-income groups. This explains the insurance-saving pattern across income levels observed in the US data.

To analyze this issue comprehensively, I herein develop a dynamic stochastic general equilibrium model with infinitely-lived risk-averse households who are ex ante identical and heterogenous after idiosyncratic income and medical expenditure risks are realized. Unlike in a life-cycle model, there are many factors that together affect saving decisions, for example, lifetime income distribution, retirement, death, bequest, and precaution against future uncertainty; in this model, the main reason for saving, besides

[8]The main reason for this feature is that for workers (and the unemployed) without employment-based health insurance who are not qualified for public insurance programs, the only option to access health insurance is individual (non-group) health insurance, which is much more expensive than employment-based (group) health insurance. Many people are even turned down for coverage because they can not meet certain conditions. For example, people who are 40 years old or older are often turned down (Swartz, 2003). The high premiums and lack of access of individual health insurance are caused by many factors, such as higher administration costs, higher advertisement costs, and adverse selection problems in the individual health insurance market (see the discussion in McGarry, 2002 and Swartz, 2003). In the US data, we observe that about 90% of private health insurance is employment-based and that most of those without employment-based insurance coverage and who do not qualify for public health insurance programs are uninsured. See McGarry (2002) for more detailed information.

[9]Because currently-insured households usually have higher current income, this situation further lowers insured households' expected benefits from the means-tested social welfare system, and then further increases their savings; on the other hand, the currently uninsured usually have lower income, and this raises their expected benefits from the social welfare system, and then further reduces their savings.

accumulating capital, is precaution against uncertainty. One goal of this paper is to answer the question "if people do have precautionary motives and other variables are well controlled, why is their saving behavior under insurance coverage so different from the expectation under a standard model?" This simple model shows the reason clearly, and prevents complex analysis across many different factors that affect saving, and thereby avoids the difficulty of distinguishing the effects of precautionary saving from the effects of other factors.

The two institutions are incorporated in the model. Because the asset markets are incomplete (i.e. households are borrowing constrained), households have an incentive to accumulate assets against the uncertainty.[10] Without the addition of the two institutions, this model will present the features as in a standard precautionary saving model: households save in a precautionary manner, and the introduction of health insurance will reduce savings. However, I show that in the presence of the two institutions, the net saving effect of health insurance is reversed for households in some income groups. My quantitative analysis shows that when the model is calibrated to match the US economy, the simulated household insurance-saving pattern will be very close to that observed in the US data.

The above findings call into question the appropriateness of empirical approaches for testing the precautionary saving hypothesis that are based on the standard precautionary saving model. The basic idea of these approaches is regressing savings/asset holdings on health insurance coverage and controlling for other household characteristics to estimate the saving equation. I suggest that, in an economy with a means-tested and social welfare system and a work-contingent health insurance system, this kind of empirical approach might easily lead one to conclude that health insurance has a positive effect on savings and to reject the hypothesis of precautionary saving. This is because the regression captures the net saving effect of health insurance, rather than exclusively the effect on precautionary saving. I also apply this regression approach in the model economy. Although households do have precautionary saving motives by construction, the regression result shows a significant and positive saving effect of health insurance coverage, which leads to a rejection of the precautionary saving hypothesis. I also suggest that if we can observe an economy that is experiencing regime changes in its social welfare system and health insurance system, we will be able to identify these combined effects separately. However, if these data are unavailable, developing an adequate approach to examining the effects on precautionary saving still requires more research.

The rest of this paper is organized as follows. Section 2 describes the puzzling

[10] If the asset markets are complete, households can be fully insured by trading assets. Consequently, precautionary saving and insurance will be meaningless. This situation is not consistent with the real world.

empirical findings. Section 3 introduces the model. Section 4 provides an intuition to show the mechanism that can lead to the puzzling household insurance-saving patterns. Section 5 presents specifications of the model, calibration of the parameters, and measurement of the shocks. The quantitative analysis is provided in Section 6. Section 7 discusses the implication of this model for empirical studies on precautionary saving. Section 8 concludes.

2 Some Puzzling Features of Health Insurance Coverage and Household Asset Holdings

Starr-McCluer (1996) studies the impact of private health insurance on household savings in the US working age population and uses the results to test the precautionary saving hypothesis. She finds that households that are covered by private health insurance maintain much higher assets than those comparable households without coverage, contrary to what the precautionary saving hypothesis predicts.

Table 1 shows the ratios of median asset holdings (a_{in}/a_{un}) calculated from Starr-McCluer's report (the original source is the 1989 Survey of Consumer Finance (SCF)). The asset holding ration is defined as the median of insured households' asset holdings (a_{in}) divided by the median of uninsured households' asset holdings (a_{un}). A ratio greater than 1 implies that the insured hold more assets than the uninsured. There are three measures of assets considered: "liquid assets," "financial assets" and "net worth."[11] We can see that most figures are greater than 1, which represents a positive correlation between health insurance coverage and asset holdings, regardless of which measure of assets is used. We can also observe that the ratio decreases with increased income level, regardless of the measures used, which implies that the difference between higher income insured and uninsured households is smaller.[12]

Descriptive statistics are not sufficient to show the true saving effect of health insurance. That being so, Starr-McCluer also applies econometric methods, the ordinary least squares (OLS) and maximum likelihood selection models, to control for other household

[11]In Starr-McCluer (1996), the first "liquid assets" refers to assets that can be rapidly converted into cash, including checking accounts, money market deposit accounts, saving accounts, certificates of deposit, and savings bonds. The second "financial assets" includes liquid assets plus stocks, bonds, mutual funds, Individual Retirement Accounts, Keogh accounts, defined contribution pension plans, trusts, and cash value of life insurance. The "net worth" is defined as the total value of the household's assets minus its total liabilities. Please see Starr-McCluer (1996) for the detailed discussion of these three measures.

[12]The income groups in the table are classified by current income. Hence, the income groups in the table might not represent permanent income levels precisely. Even so, the information provided by this table still shows the pattern of asset holdings across income levels.

Table 1: Ratio of median asset holdings of the insured to the uninsured

Income Groups	Percent of Households	Ratio of median asset holdings (a_{in}/a_{un}) Measure 1 (Liquid assets)	Measure 2 (Financial assets)	Measure 3 (Net worth)
Below \$15K	24.0	∞	∞	41.07
\$15-30K	25.4	6.00	11.33	7.15
\$30-50K	25.6	2.95	9.46	6.47
Above \$50K	25.0	1.39	4.72	0.89

Source: Starr-McCluer (1996); original source: SCF (1989), weighted under-65 sample.
"Liquid assets," "financial assets" and "net worth" are three measures of assets.
The ratio $(a_{in}/a_{un}) > 1$ implies that the insured hold more assets than the uninsured.
The median asset holdings of uninsured households is zero in the bottom income group in the first two columns.

characteristics and selectivity.[13] The results still show that health insurance has a significant and positive effect on savings. Table 2 shows part of the empirical results presented in her paper. We can see that the coefficients of health insurance coverage (HI coverage) are significant positive for all three measures of assets.

Guariglia and Rossi (2004) also study the effects of private medical insurance on household savings, but use the British Household Panel Survey data. Their findings are similar to those of Starr-McCluer's findings: health insurance coverage increases the probability of saving.[14] On the basis of these empirical findings, they suggest that British households do not have precautionary savings for health risk, and that selectivity is not the reason for these puzzling empirical results. Although Guariglia and Rossi have the results similar to Starr-McCluer's, The UK health insurance environment is largely different from the US. The National Health Service (NHS) is the dominant provider of health care in the UK, with universal provision that is generally free at source. The private insurance is just supplementary. In the US, the private health insurance is dominant and many Americans are uninsured. This paper focuses on the US environment and Starr-Maclure's study. The analysis provided in this paper might not be directly applicable to the UK's case.

[13] In order to control for selectivity, she uses a maximum likelihood selection model in which she simultaneously estimates the insurance coverage and the saving equations.

[14] Because the survey only asks households if they save, a yes-or-no question, actual values of the households' savings were not obtained.

Table 2: Regression of log asset holdings - selected variables

Variables / Assets	Measure 1 (Liquid assets)	Measure 2 (Financial assets)	Measure 3 (Net worth)
HI coverage	**2.66***	**2.97***	**1.72***
	(0.18)	(0.16)	(0.19)
Perm't Income	1.53*	1.71*	1.69*
	(0.11)	(0.11)	(0.15)
Health problems	-0.34*	-0.28*	-0.41*
	(0.10)	(0.10)	(0.12)

Source: Starr-McCluer (1996), page 290. Only selected variables are reported here.
*Significant at the 5% level.

There are no further analyses of the puzzling saving patterns – the asset holding ratio is greater than 1 and decreasing with increased income. The main reason for this phenomenon is still an open question.

3 The Model

I undertake a standard dynamic stochastic general equilibrium model that incorporates two institutions: an asset-based means-tested social welfare system and an employment-based health insurance system.[15]

3.1 Household Heterogeneity

The model economy is populated by a large number of infinitely-lived risk-averse households (with measure one) that have identical preferences and risk aversion. Households are endowed with different labor efficiency λ, which is given in the beginning of the lifetime from a finite set $\Lambda = \{\lambda_1, \lambda_2, ...\lambda_J\}$ and lasts forever. The wage rate is given by $w\lambda l$, where w is the market wage and l is labor endowment. The efficiency λ therefore

[15]Households' saving decisions will affect capital supply and then affect the interest rate and wage rate. Given that this is so, I use a general equilibrium approach, which will facilitate an understanding of the whole structure of the economy. The equilibrium interest rate and wage rate are determined by capital demand (firms) and capital supply (households). In addition, as discussed in Aiyagari (1994), in a partial equilibrium analysis, by choosing an interest rate close enough to the rate of time preference, one can generate arbitrary large precautionary saving. This is another reason for using a general equilibrium analysis in this paper.

determines households' permanent income levels. Within a permanent income group, households are identical ex ante but will be also heterogeneous after shocks are realized.

3.2 Shocks

All households face idiosyncratic labor endowment shocks l (equivalently, income shocks) and medical expenditure shocks x every period. Labor supply is assumed inelastic and so an agent will supply its full l, which takes a value from a finite set $L = \{l_1, l_2 ... l_n\}$ every period and evolves according to a first-order Markov process with transition probability matrix π_l and an invariant distribution $\bar{\pi}_l$. The medical expenditure shock x takes a value from $X = \{x_1, x_2 ... x_m\}$ and also follows a finite-state first-order Markov process with with transition probability matrix π_x and an invariant distribution $\bar{\pi}_x$.

Since the asset markets are incomplete, households will save in a precautionary manner to guard against the uncertainty.

3.3 Social Welfare System

There exists an asset-based means-tested social welfare system that enables households to maintain a minimum consumption level (denoted by $\underline{C}$). I employ a simple rule for the operation of the social welfare system similar to that used by Hubbard et al. (1995): if a household's disposable income and assets (denoted by H) are lower than $\underline{C}$, the household qualifies and will receive the social-welfare benefits (a transfer payment guaranteeing that households can have at least $\underline{C}$ to spend). As introduced in Hubbard et al. (1995), this simple social welfare system is used to characterize the social programs with means tests and asset restrictions in the US, such as Aid to Families with Dependent Children (AFDC), Medicaid, Supplemental Security Income (SSI), and food stamps.

3.4 Production

On the production side, there is a single firm with a production technology that displays constant returns to scale (CRS).[16] The firm hires labor and rents capital from households. To have permanent income groups, it is assumed that households have different values of labor efficiency, λ, and that only effective labor (λl) is productive. There is no uncertainty in production. Let Y denote the total output and K, N denote the aggregate capital and aggregate effective labor, respectively. The total output production function is defined as$Y = F(K,N)$. This CRS production function has standard properties: $F_K >$

[16]As described in Hansen (1985), this setting implies that the firm makes zero profit in the equilibrium. The economy would behave as it would if there were many competitive firms.

0, $F_{KK} < 0$; $F_N > 0$, $F_{NN} < 0$; $F_{KN} > 0$, and F(0, N)= F(K, 0)=0. From the first-order necessary conditions, the rental rate of capital (γ) will equal the marginal product of capital and the wage rate w for per effective labor will equal the marginal product of effective labor:

$$\gamma = F_K(K_t, N_t); \tag{1}$$

$$w = F_N(K_t, N_t). \tag{2}$$

Capital depreciates at rate δ every period.

3.5 Government and Insurance Companies

In this economy, the government operates the social welfare system. It taxes households' labor income with a flat rate τ to finance the social welfare system. Since the supply of labor is inelastic in the model economy, this tax does not affect the supply of labor and will distort households' saving decisions less.[17] The government is required to have a balanced budget every period.

Because the structure of the health insurance market is not the focus of this paper, I assume that insurance market is competitive and insurance companies all provide the same EHI plan that covers a fraction α of medical expenditure x. The group insurance premium (q) is determined competitively so that the zero-profit constraint is satisfied.

3.6 Health Insurance System

3.6.1 Baseline – Permeant difference in health insurance status

In addition to saving, households can have health insurance against medical expenditure shocks. The baseline of this study is to investigate the difference in saving behavior between the insured and the uninsured. I first consider a simple economy, in which each agent's health insurance status is determined in the beginning of the life and lasts forever. The insurance status does not evolves with the labor status, and therefore has permanent difference among households – the insured and the uninsured.

3.6.2 Employment-based Health Insurance

The major private health insurance in the US is employment-based health insurance (EHI). Under EHI, the insurance coverage status is not time invariant. To simply capture the EHI system, I assume that an agent will be insured under a private plan only if

[17] If the government taxes capital income, it will distort the asset prices directly and affect the decisions of asset holding and consumption.

the employer offers health insurance, which by regulation cannot have any price discrimination, and that the probability of receiving the offer is contingent on work status and permanent income level. This setting simply reflects the fact that about 90% of private health insurance is employment-based in the US. The EHI covers a fraction $\alpha \in [0,1]$ of the medical expenditure. If an agent is covered by the EHI, she only pays $(1-\alpha)x$ out of her pocket for but needs to pay premium q.

Let an indicator i_{EHI} denote the status of the offer of EHI. An agent is offered the insurance if $i_{EHI} = 1$, and is not if $i_{EHI} = 0$. The probability of receiving the offer depends on the agent's work status and permanent income level (i.e. labor endowment status l and efficiency λ, in the model): the probability of being insured is higher when a household has a better labor endowment status, which represents a better job position, and a higher skill level ($Prob(i_{EHI} = 1|l_i,\ \lambda) > Prob(i_{EHI} = 1|l_j,\ \lambda)$ if $l_i > l_j$; $Prob(i_{EHI} = 1|l,\ \lambda_i) > Prob(i_{EHI} = 1|l,\ \lambda_j)$ if $\lambda_i > \lambda_j$).[18]

3.7 Household Problem

The state vector of an agent is given by $s = (a, l, x, i_{EHI}, \lambda)$, where a denotes asset holdings, l the idiosyncratic labor endowment shock, x the idiosyncratic medical expenditure shock, i_{EHI} the indicator for the availability of the (employed-based) health insurance offer, and λ the time invariant labor efficiency level. Agents observe the state s at the beginning of a period and choose consumption level (c) and asset holdings (a') to maximize their expected value. Together with allocation decision a', $s' = (a', l', x', i'_{EHI}, \lambda')$ form next period's state.[19] The agent's problem can be expressed in the following recursive form.

[18]As mentioned in Section 1, the price difference in the group and non-group health insurance markets generates the difference in accessing health insurance. Therefore, for simplicity, the decision process of accessing health insurance is simplified to a probability contingent on work status. However, adding the decision process into the model will not change the analysis and results of this paper. Given that every household has the same preference and risk aversion, if we allow households to choose whether they purchase health insurance or not, the decision will depend strongly on whether they are offered employment-based health insurance. If they are offered it, most of them will accept it because of the reasonable premium of employment-based health insurance; if they are not offered it, many of them will not purchase health insurance because individual insurance plans are much more expensive. Hence, the distribution of health insurance coverage with decision process will be consistent with that in this simplified model. Given that the focus of this paper is on the effects of insurance on saving rather than analyzing insurance purchase decisions or insurance market structure, adding the decision process would make the model more complicated without adding too much accuracy to the results.

[19]Note that $\lambda' = \lambda$. λ is determined at the beginning of life and fixed forever.

$$V(s) = \max_{c,a'} \left\{ U(c) + \beta E \left[V(s') \right] \right\} \tag{3}$$

s.t.

$$c + a' = H + TR; \tag{4}$$

$$H \equiv (1-\tau)w\lambda l + (1+r)a - (1 - i_{EHI} \cdot \alpha)x - i_{EHI} \cdot q \tag{5}$$

$$TR = \max\{0,\ \underline{\mathrm{C}} - H\} \tag{6}$$

$$c \geq 0;\ \ a' \geq -b; \tag{7}$$

In (3), $V(s)$ is the value function given the current state s. In order to characterize a risk-averse household, the period utility function, $U(c)$, is assumed with standard properties, such as strictly increasing, strictly concave, continuously differentiable (i.e. $U'(c) > 0$, $U''(c) < 0$), $\lim_{c \to 0} U'(c) = -\infty$ (for interior solution), and $U'''(c) > 0$ (for precautionary saving).[20] E is the expectation operator, which is conditional on information at current period and β is the utility discount factor.

Equation (4) indicates the period budget constraint. The left hand side (LHS) of (1b) indicates that household can spend the money on consumption (c) and asset holdings (a'). The right hand side (RHS) of (1b) is household i's disposable income and assets H plus social welfare transfer TR.

As described in (5), H is a household's disposable income plus assets (net after the necessary medical expenditure). Given the wage rate per efficiency labor unit w and rate of return of assets r_t, the household receives after-tax (with tax rate τ) labor income $(1-\tau)w\lambda l$ and previous assets plus asset return $(1+r)a$ (a is the assets held from last period). In addition, it is assumed that medical expenditure x is required only to offset the damage brought on by poor health or illness; no utility is delivered from medical expenses. The out-of-pocket medical expenditure is $(1-\alpha)x$ for an insured household (i.e. $i_{EHI} = 1$), and q is the premium paid to an insurance company. The uninsured have to pay full medical charge x.

The household may also receive TR, which is the transfer payment from the social welfare program. Equation (6) describes the transfer function of the social welfare

[20]In a partial-equilibrium saving problem, it has been known since Leland (1968) and Sandmo (1970) that precautionary saving in response to risk is associated with a positive third derivative of the utility function, but in a general equilibrium environment, the positive-third-derivative assumption is not necessary (see the discussion in Ljungqvist and Sargent, 2000). However, I still use the stronger third-derivative assumption for precautionary saving because the goal of this paper is to show that, even when households do have precautionary motives, we are still able to observe a positive correlation between health insurance coverage and savings.

system. I consider a simple transfer rule proposed by Hubbard et al. (1995). $\underline{\mathrm{C}}$ is the minimum level of consumption supported by government or society. Transfer TR will be made if H is smaller than $\underline{\mathrm{C}}$, and the transfer amount will be equal to $\underline{\mathrm{C}}$ minus H.[21]

In the economy, households are liquidity constrained. (7) indicates that households can only borrow by a limited amount, b, and therefore cannot fully insure their consumption through asset trading.

3.8 Recursive Competitive Equilibrium

Let $s \equiv (a, l, x, i_{EHI}, \lambda)$ denote the household state vector. Given the health insurance coverage parameter $\{\alpha\}$ and the institution parameter $\{\underline{\mathrm{C}}\}$, a stationary recursive competitive equilibrium consists of factor prices $\{w, r\}$, a set of household decision rules $\{a', c\}$ for each state s, a value function $V(s)$, firm choices $\{K, N\}$, insurance premium $\{q\}$, the social welfare transfer function $Tr(s)$, tax rate τ, and distribution of households over the state space $\psi(s)$ that satisfy the following conditions:

1) Given the factor prices, the decision rules of a' and c solve household's problem;

2) The factor prices are determined competitively: $w = F_N(K,N)$ and $r = F_K(K,N) - \delta = \gamma - \delta$;

3) τ satisfies the government's budget constraint:

$$\int Tr(s)\psi(s)ds = \int (\tau \cdot w \cdot z \cdot l)\psi(s)ds \tag{8}$$

4) Health insurance premium q is determined so that the zero-profit condition for insurance companies is satisfied:

$$\int q \cdot i_{EHI}\psi(s)ds = \int \alpha \cdot x \cdot i_{EHI}\psi(s)ds \tag{9}$$

5) All markets clear:

$$N = \int (\lambda \cdot l)\psi(s)ds; \tag{10}$$

$$K = \int a(s)\psi(s)ds. \tag{11}$$

6) The aggregate resource constraint is satisfied:

$$Y = C + X + K' - (1-\delta)K; \tag{12}$$

[21] It is not necessary to spend the transfer payment solely on consumption.

where

$$C = \int c(s)\psi(s)ds; \tag{13}$$

$$K' = \int a'(s)\psi(s)ds. \tag{14}$$

In the steady state equilibrium, $K' - (1-\delta)K = \delta K$.

In the general equilibrium model, the capital demand (from the firm) and the capital supply (i.e. the asset demand from households) determine the equilibrium interest rate r . Given that there are no aggregate shocks on either demand side or supply side, there will exist an unique steady-state equilibrium r.

4 The Factors that Affect Household Saving Behavior

There is no simple closed-form solution for the above stochastic dynamic programming problem; hence, I will solve the model numerically and perform a quantitative analysis. Before that, I offer an intuition of the effects of the social welfare system and health insurance on household asset holdings. This will also illustrate the mechanism that can lead to the puzzling insurance-saving phenomenon.

4.1 Effects of the Social Welfare System

The asset-based means-tested social welfare system has a negative effect on saving. The magnitude of this effect decreases as the income level increases.

1) The asset-based means-tested social welfare system decreases savings.

As discussed in Hubbard et al. (1995), there are two channels through which the social welfare system can decrease household asset holdings. The first channel is the reduction of uncertainty with respect to income and expenditure. The social welfare system guarantees that the household disposable resources will never fall below $\underline{C}$; hence, the uncertainty is reduced and households can maintain less precautionary savings.

The second channel comes from the asset-based means test. This test creates an incentive for households to reduce savings and increase consumption in order to receive social welfare benefits. Meanwhile, the expected return of asset holdings is also reduced by the means test of the social welfare system. This is because once households qualify for the social welfare programs, their disposable resources H will be subsidized to the same level $\underline{C}$, which implies that previous savings are not helpful for those qualified households. As long as there exists some probability that a household will qualify, even if it does not currently qualify, the household will have less incentive to maintain their savings.

2) The negative effect on savings decreases with increased permanent income level.

Households with higher permanent income (i.e. a greater λ) are better able to resist uncertainty and obviously have a lower probability of qualifying for the social welfare programs. Therefore, they are less affected by the social welfare system. In addition, higher-income households have higher expected consumption/utility in good states than lower-income households. The social programs cannot greatly reduce their consumption/utility gap between good states and bad states (relative to lower-income households), and so these households have a greater incentive to save in order to smooth their consumption. Both factors lead to the conclusion that the social welfare system has a smaller (negative) saving effect on higher-income households.

Another reason for less negative saving effect on higher-income households is that, in the general equilibrium environment, when households all drop their asset holdings (because of the effects of the social welfare system), the rate of return of assets r is driven up. Households will respond by increasing some asset holdings. If the marginal utility is convex, as is the widely used constant relative risk aversion (CRRA) utility, higher-income households are more sensitive to r changes and will increase their asset holdings more than those with lower income in response to an increase in the rate of return r.[22]

4.2 Effects of Health Insurance on Saving under the Social Welfare System

Here, I explain the effects of health insurance on saving in an economy that has the means-tested social welfare system discussed above. The interaction between health insurance and the social welfare system provides one mechanism that is responsible for the puzzling insurance-saving pattern observed in the US.[23]

1) Positive effects: reducing the negative effects of the social welfare system on savings.

The introduction of health insurance reduces the negative saving effects of the social welfare system in the following two ways.

First, health insurance reduces the fluctuation of disposable income and assets caused by medical expenditure shocks, and then reduces the probability of qualifying for the social welfare benefits. This leads to an increase in the expected marginal return of asset

[22] That property can be represented by $U'''(c) > 0$.

[23] Another mechanism is the employment-based (work-contingent) health insurance system. See further discussion of this below.

holdings, as well as a greater incentive to hold assets, other things being equal.

In addition, health insurance increases the expected utility when households do not qualify for social welfare benefits (denoted by "good states"), but has no effect when households do qualify for social benefits (bad states) because households' disposable wealth is fixed at $\underline{C}$ and therefore no uncertainty exists. This enlarges the expected consumption/utility gap between good states and bad states, and increases the expected return of asset holdings that encourages insured households to save.

In general, the introduction of health insurance allows households to rely less on the social welfare system and thereby reintroduces an incentive to save.

2) Negative effects: decreasing precautionary savings.

The insurance effects still exists: a reduction in income and expenditure fluctuations, and consequently reduced precautionary savings. Therefore, the net effect on saving is ambiguous.

3) The net effect of health insurance depends on the size of the means-tested social welfare system.

Given that the positive saving effect of health insurance results from the reduction of the negative effects of the social welfare system, the size of the social welfare system affects how large the positive effect will be and consequently determines the net saving effect of health insurance.

In the model economy, the means test criterion $\underline{C}$ represents the size of the social welfare system. If $\underline{C}$ is set lower than the minimum of household disposable income, denoted by $\underline{H}$, the social welfare system will not have any effect on households. The only effect of health insurance is a reduction in savings, as in a standard precautionary saving model without the social welfare system.

When $\underline{C}$ is set higher than $\underline{H}$, the social welfare system will affect household savings. Introducing health insurance will reduce the (negative) saving effects generated by the social welfare system and will thereby have positive effects on savings. Within a reasonable range, a higher $\underline{C}$ implies a larger reduction that health insurance can have on the saving effects generated by the social welfare system, and so the positive saving effect that health insurance will have increases.[24] I show in the quantitative analysis that when $\underline{C}$ is set high enough, the positive effect on saving will exceed the negative effect.

In addition, as mentioned above, the negative effect on saving of the social welfare system decreases as the level of a household's income increases; therefore, the positive effect on saving of health insurance also decreases as the level of a household's income

[24] If $\underline{C}$ is set very high (the extreme case is $\underline{C}$ equal to average income), insured households will also have a very high probability of qualifying for social welfare benefits. Then the positive effect of health insurance on saving will decrease.

increases. This results in there being a smaller difference in the assets held by the insured and the uninsured (i.e. a smaller asset holding ratio, a_{in}/a_{un}) in higher income groups, in agreement with the pattern we observe in the data (see Table 1).

4.3 The Role of the Employment-Based (Work-Contingent) Health Insurance System

In the foregoing, we discussed how the introduction of health insurance affects household asset-holding behavior, without any specification of what makes a household eligible for health insurance. If the health insurance system is employment-based, currently insured households will still have the incentive to save for future possible bad times without insurance coverage, because health insurance coverage is also uncertain and is usually accompanied by good labor states (representing full-time and good job positions). Thus, this work-contingent health insurance system reinforces the incentive for insured households to save in an economy that has a means-tested social welfare system.

5 Model Specification and Calibration

To solve the model numerically and provide an adequate quantitative analysis, I begin by providing the specification and parameterization of the model.

5.1 Preference and production

The model period is set at one year. A widely-used constant relative risk aversion (CRRA) utility function is used to characterize household preference:

$$U(c) = (c^{1-\mu})/(1-\mu). \tag{15}$$

It is also assumed that every household has identical preferences, so that the analysis and results do not depend on heterogeneity of preference. The relative risk aversion coefficient (μ) in the utility function is set at 3, which, as Hubbard et al. (1995) suggested, is consistent with many empirical studies. Nevertheless, other possible values of μ will also be tested to ensure the robustness of the results. The utility discount factor (β) is chosen to be 0.91 so that the capital output ratio in the benchmark model economy roughly equals 3.

The production function is taken to be a standard Cobb-Douglas type:

$$F(K,N) = AK^{\theta}N^{1-\theta}. \tag{16}$$

The TFP, A, is set at unity, because I focus on a detrended economy without production uncertainty, as in Aiyagari (1994). The capital share θ is taken to be 0.36, and as suggested by Stokey and Rebelo (1995), the depreciation rate of capital δ is set at 0.06. The above specifications and parameter values are chosen in order to be consistent with aggregate features of the postwar US economy and are commonly employed in models of growth and real business cycles.

5.2 Labor endowment shock and labor efficiency

In the model, the idiosyncratic labor endowment shock l is used to capture the income fluctuations and the labor efficiency λ determines the permanent income level. Previous studies suggest that a first-order autoregressive (AR(1)) process can well approximate the pattern of the logarithm of labor endowment shocks (or equivalently, income shocks).[25] The process is set as

$$\log(l_{t+1}) = \rho_l \log(l_t) + \varepsilon_{lt}, \tag{17}$$

where ρ_l is the serial correlation coefficient of labor endowment shocks and ε_{lt} is white noise.

The specification and parameterization for this AR(1) process are based on the results reported in Hubbard et al. (1995). Their estimation of income shock, which includes unemployment insurance benefits and the subtracting of taxes, and which is based on micro data, better fits our model. They estimate the income-shock processes for three educational categories separately. Their results indicate that the values of persistence, ρ_l, are quite similar among the three educational groups; the values range from 0.946 to 0.955. In addition, they find that the variance of ε_{lt} decreases as the level of education decreases, from 0.033 to 0.016. Using their estimations as a basis, ρ_l is set at 0.955 and the variance of ε_{lt} is set at 0.025, as in the middle-education group for the idiosyncratic labor endowment shock. I then apply the procedure described in Tauchen (1986) to approximate this AR(1) process using a five-state Markov chain, with a maximum and minimum equal to plus and minus 2.5 standard deviations of the unconditional distribution.

In order to examine the differences among income groups, from the bottom to the top income level I set four permanent income groups with equal weights, which can be compared with the US data shown in Table 1.[26] The labor efficiency λ is chosen to be 2.10, 1.00, 0.62 and 0.28 for the four permanent-income groups from top to bottom so

[25] See, for example, Aiyagari (1994) and Hubbard et al. (1995)

[26] The income groups in Table 1 are defined by current income, because it is not easy to get true permanent income from the cross-section data. However, each income group includes a range of incomes that can

Table 3: States of medical expenditure

State	Expenditure Range	Average Exp. ($ in 1996)	% of Average Income (1996)
Low	bottom 70%	250	1%
Fair	70 – 95%	3,099	12%
High	95 – 99%	16,173	65%
Very High	top 1%	73,197	293%

Source: MEPS, 1996.

that in the equilibrium of the benchmark (fully-specified) economy the mean household income are consistent with the data in 1989 (U.S. Census Bureau, Current Population Survey).[27]

5.3 Medical expenditure shock

To characterize medical expenditure shock, I calibrate a Markov process directly from the data instead of estimating an AR(1) process, as in some previous studies.[28] The principal reason is that the distribution of medical expenditure is very skewed and clearly not symmetric: 70% of the working-age population spent only $250 on health care in 1996, which was equivalent to 1% of the average labor income in 1996. However, the top 1% of the population spent $73,197, which was 298% of the average labor income.

In addition, the persistence of medical expenditure is not constant in different health states, but an AR(1) process implies a constant persistence for every state. Therefore, I use the report of persistence in health care expenditure in Monheit (2003) to identify the transition probabilities for a four-state Markov chain of medical expenditure.[29] The procedure is described below, the definitions of states are summarized in Table 3, and the results are reported in Table 4.

I define the four states of medical expenditure shock as “low,” “fair,” “high” and

absorb some current income fluctuation. Therefore, the data may still reflect a pattern in different permanent income levels.

[27]The values of mean household income for households in 75-100%, 50-75%, 25-50%, and bottom 25% are 81858, 39231, 22437, and 8524 dollars in 1989, respectively. The values are calculated by using linear interpolation on mean household income received by each fifth and top 5 percent from the report of Current Population Survey.

[28]For example, Freenberg and Skinner (1994) and Hubbard et al. (1995).

[29]Monheit uses the data from the 1996/97 Medical Expenditure Panel Survey (MEPS) to determine the persistence and provides a detailed report.

Table 4: Transition probabilities of X

	Low	Fair	High	Very High
Low	0.821	0.158	0.018	0.003
Fair	0.418	0.495	0.069	0.018
High	0.229	0.470	0.237	0.064
Very High	0.138	0.370	0.330	0.162

Note: Identified from Monheit (2003).

"very high." People who have medical expenditure in the bottom 70% are set in the state "low," those in the range from 70 to 95% are set in the state "fair," those in the range from 95 to 99% are in the state "high" and the top 1% are in the state "very high." In order to reflect the true costs for health care that uninsured households must face, I use the mean of the total annual costs of health care (including both out-of-pocket expenditure and insurance payments) in each range to represent the medical expenditure shock in each state.

As shown in Table 3, among the US working-age population in 1996, the means of medical costs in the "low," " fair," "high" and "very high" groups were \$250, \$3,099, \$16,173 and \$73,197, which were equivalently 1%, 12%, 65% and 293% of the average labor income in 1996, respectively (from the Medical Expenditure Panel Survey, MEPS). Thus, in the model, the medical expenditures X in the four states are set as the above percentages of average labor income.

To calibrate the transition probabilities for the Markov chain, I use the data provided in Monheit (2003). Monheit reports households' medical-expenditure rank in 1996 and 1997 to study the persistence in medical expenditure. This information allows us to calculate the transition probabilities for each state from 1996 to 1997. Note that the data include information for all ages, not only for those of working age. The transition probabilities might overstate the persistence in high-expenditure states because the retired population is also included. However, compared with the persistence used in previous studies for an AR(1) process (see Hubbard et al., 1995, for example), even the persistence in the highest expenditure state is still lower than theirs.[30] The transition probabilities for the medical expenditure states are listed in Table 4. We can see that the

[30]Feenberg and Skinner (1994) estimated the persistence coefficient of the medical-expense AR(1) process at 0.901, but their sample was on households aged 55 and above. Hubbard et al. (1995) also used this number (0.901) in their medical-expenditure-shock process. This setting implies that for all medical expenditure states, the persistence is always 0.901.

matrix is not symmetric and the persistence is not constant across states.

5.4 The social welfare system

We also need to measure the $\underline{C}$ or the consumption floor that the government tries to guarantee, above and beyond medical expenses, through means-tested transfer payments. As stated in Hubbard et al. (1995), measuring the means-tested consumption floor is difficult, because potential payments vary dramatically by family features and even by the recipient's location (state or city). In this paper, I use the consumption floor estimated by Hubbard et al. for the value of $\underline{C}$, but alternative values will be also reviewed.

Hubbard et al. make a first approximation by calculating the consumption floor for representative families based on figures in US House (1991). Their estimate includes only means-tested transfer payments, such as 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 included in the measure of income.[31] Medicaid is also not included as a part of $\underline{C}$ because it is used exclusively by the social welfare system to pay for medical expenses.

Their estimation shows that, for a female-headed family with two dependent children and no outside earnings or assets, the median AFDC and food stamp transfers ($5,764) plus expected housing subsidies ($1,173) were $6,937 in 1984. The average household income was $27,464 in 1984 (U.S. Census Bureau, Current Population Survey). The amount 6,937 is about 25% of the average household income. However, as cautioned by Hubbard et al., the benefits might be greatly reduced if the father were present in the household or were married to the mother, or if the household had fewer children or grown children. That being so, the benefits might be overestimated for a normal family (with both father and mother). Therefore, in the benchmark model I set $\underline{C}$ as 20% of average household income to represent the size of the social welfare system in the US, but a wider range from 15% to 25% will also be reviewed for robustness test.

5.5 Employment-based health insurance

The coinsurance/copayment rate $(1-\alpha)$ is set at 20%, which is roughly equal to the average ratio of out-of-pocket medical expenditure to total medical expenditure in the population under 65. To characterize employment-based health insurance, I simplify the feature of accessing private health insurance as a probability contingent on labor endowment status (equivalently, work status): if a person has a lower labor endowment status

[31] See the calibration of labor endowment shock in section 5.1.2.

(representing a worse work status) in a time period, that person will have a lower probability of being covered by employment-based health insurance. I also allow permanent differences in accessing insurance among the four permanent income groups. Some assumptions and criteria are made to identify the probabilities of accessing private health insurance with each labor status for each income group. They are: (1) the total number of uninsured households constitute 20% of the total working age population in equilibrium, which is consistent with the US data in 1989; (2) agents in higher income level (higher λ) have higher probabilities of accessing insurance – in equilibrium, 10% of the top income group, 17% of the second income group, 23% of the third income group and 30% of the bottom group are uninsured, so that 20% are uninsured in total; (3) the probability of accessing health insurance is increasing with work status (i.e. labor state l). To ensure the above features, the probabilities of being insured conditional on labor states for each permanent income group are set as in table 5. This setting indicates a feature that the distribution of the uninsured over the five labor states are the same for every income group – 75% of the total uninsured are from the lowest two labor states that represent unemployment, part-time or bad job positions, and only 5% are from the top two labor states that represent good job positions. [32]

The conditional probabilities in Table 5 means that, for example, for agents in the top income group, the probability of being insured is 68.3% when agents are in the worst labor state, 77.5% in the second worst, 94.8% in the median state, 98.1% in the second best, and 99.2% in the best that generates 10% uninsured agents in this group. Please see Table 5 for the other groups. [33]

6 Quantitative Analyses and Results

This and next sections provide quantitative analyses, which include model economy simulations and regressions with simulated data. I focus on the features of the steady state equilibrium, the approximation approach introduced in Aiyagari (1994) is applied to solve for the equilibrium numerically.

In the following analyses, I simulate each model economy for 100,000 periods and discard the first 50,000 periods. The remaining observations (50,000 for each income

[32] The shares of the uninsured of the five labor states, from low to high, are 20%, 55%, 20%, 4.5%, and 0.5%. Note that the stationary distribution of the labor states is not uniform. The stationary distribution of the five labor states, from low to high, is (0.0630, 0.2447, 0.3846, 0.2447, 0.0630).

[33] Here I allow that agents in different income groups face different distribution of the probability of accessing insurance. In the appendix, I use a simple setting assuming that households in every income group face the same distribution of the probability of being insured. I show that even with the simple setting, the results of this paper still hold.

Table 5: Conditional probabilities of accessing insurance $Pr(i_{EHI} = 1|l, \lambda)$

Income group	Labor states				
(λ)	l_1 (lowest)	l_2	l_3	l_4	l_5 (highest)
Bottom	0.0476	0.3257	0.8440	0.9448	0.9762
2nd	0.2698	0.4830	0.8804	0.9577	0.9817
3rd	0.4603	0.6179	0.9116	0.9687	0.9865
Top	0.6825	0.7752	0.9480	0.9816	0.9921

group) are used as cross-sectional data since the stationary time-series distribution is equivalent to the stationary cross-sectional distribution. Although this paper does not aim to match the wealth distribution in the US, with the means-tested welfare programs, the benchmark model economy (in which $\underline{C}$ equals 20% of average income) can reproduce the feature of the lower tail that the bottom 40% households hold less than 1% of total wealth.

To show the role of each institution clearly, I first examine the difference in saving behavior between insured and uninsured households in economies with social welfare systems of different sizes. Then I add the employment-based health insurance system to the model (the benchmark economy). With this addition, the simulation results are improved to match the saving pattern observed in the US.

6.1 Baseline Model: Role of the Means-Tested Social Welfare System

In this simpler case, status of health insurance coverage is determined in the beginning of life and kept constant over time. Two groups of households are compared: households in one group are covered by health insurance and those in the other group are not. The employment-based health insurance system is shut down.

6.1.1 Comparison of two economies and the US data

I perform a simulation of two economies: one with a small social welfare system and the other with a large social welfare system.

For the small social welfare system, $\underline{C}$ is set to be only 1% of average income (denoted by $\bar{e}$), while in the economy with a large social welfare system, $\underline{C}$ is set to be 20% of average income. Table 6 presents the comparison of ratios of median asset holdings between insured and uninsured households (denoted by a_{in}/a_{un}) in the two economies.

Table 6: Ratios of median asset holdings (a_{in}/a_{un})

Income group	Baseline Model (Constant HI): Small social welfare system	Baseline Model (Constant HI): Large social welfare system	US Data*: Measure 1 (Liquid)	US Data*: Measure 2 (Financial)	US Data*: Measure 3 (Net worth)
Bottom	0.53	∞	∞	∞	41.07
2nd	0.38	1.75	6.00	11.33	7.15
3rd	0.37	1.11	2.95	9.46	6.47
Top	0.30	0.88	1.39	4.72	0.89

Notes: (1) The ratio is defined as the median asset holdings of insured households divided by that of uninsured households. (2) Small social welfare system: $\underline{C} = .01\bar{e}$. Large social welfare system: $\underline{C} = .20\bar{e}$. *Calculated from the report in Starr-McCluer (1996). Original source: Survey of Consumer Finances (1989).

In addition, the ratios calculated with three measures of assets from the US data are presented, for reference.

The economy with a small social welfare system, which affects households only slightly, is expected to behave as in a standard precautionary saving model: insured households hold less assets than those that are uninsured. The simulated results confirm this expectation (the first column in Table 6). We can clearly observe that the ratios of median asset holdings in all income groups are less than 1, which implies that the insured's median asset holding (a_{in}) is less than the uninsured's (a_{un}) in each income group.

The second column presents the median asset holding ratios in the economy with a large social welfare system. The ratios are greater than 1, except that in the top income group (which is close to 1). Because the means-tested social welfare system is large (a greater $\underline{C}$), the positive effect of health insurance on saving exceeds the negative effect.

In addition, we can observe that the ratio decreases as the level of permanent income increases, because the effect of the social welfare system is smaller on the households that have a higher permanent income. This pattern is also shown in the US data. However, the magnitude of the ratios in this model economy is less than that in the data.

6.1.2 Is positive insurance-saving correlation puzzling?

To illustrate the role of the means-tested social welfare system, economies with various sizes of social welfare systems (represented by values of $\underline{C}$) are simulated here. I vary $\underline{C}$ from 1% to 25% of the average income (denoted by $\bar{e}$) for this exercise. A higher $\underline{C}$

Table 7: Ratios of median asset holdings (a_{in}/a_{un}) with various values of $\underline{C}$

	Size of the social welfare system				
Income group	$\underline{C} = .01\bar{e}$	$\underline{C} = .10\bar{e}$	$\underline{C} = .15\bar{e}$	$\underline{C} = .20\bar{e}$	$\underline{C} = .25\bar{e}$
Bottom	0.53	2.39	∞	∞	∞
2nd	0.38	1.24	1.54	1.75	1.79
3rd	0.37	0.81	0.87	1.11	1.47
Top	0.30	0.68	0.76	0.88	0.95

Note: The value of $\underline{C}$ represents the size of the social welfare system.

means that the economy provides more protection for households' income and expenditure uncertainty, and also implies a higher probability that households will qualify for social welfare benefits.

Table 7 presents the simulation results and shows the pattern that we expect: as $\underline{C}$ increases, the insured households tend to hold more assets than the uninsured so that the median asset holding ratios increase, and the ratios tend to be greater than 1 when $\underline{C}$ is high.

Therefore, in an economy with a means-tested social welfare system, the existence of a motive for precautionary saving does not necessarily warrant the conclusion that insured households should hold less assets than the uninsured even when there is no selection problem.

6.2 Model with Employment-Based Health Insurance System (Full Specification)

Now I examine a model economy with both a social welfare system and an employment-based health insurance system, as in the US. To be comparable with the previous case, two economies with small and large social welfare systems are also simulated. Table 8 reports the results. The first column in the table shows the median asset holding ratios (a_{in}/a_{un}) generated from the economy with a small social welfare system (where $\underline{C} = .01\bar{e}$). The ratios are greater than 1 in all permanent income groups, even with such a low $\underline{C}$, but the magnitude is still smaller than the data. The second column presents the asset holding ratios in the economy with a large social welfare system (where $\underline{C} = .20\bar{e}$). These ratios are enlarged and closer to the US data. In addition, the pattern that the asset holding ratio decreases as income level increases still holds here.

Table 8: Ratios of median asset holdings (a_{in}/a_{un})

	Model (Employment-based HI)		US Data*		
Income group	Small social welfare system	Large social welfare system	Measure 1 (Liquid)	Measure 2 (Financial)	Measure 3 (Net worth)
Bottom	1.45	∞	∞	∞	41.07
2nd	1.14	17.68	6.00	11.33	7.15
3rd	1.13	3.61	2.95	9.46	6.47
Top	1.07	1.84	1.39	4.72	0.89

Notes: Small social welfare system: $\underline{C} = .01\bar{e}$. Large social welfare system: $\underline{C} = .20\bar{e}$.
*Calculated from the report in Starr-McCluer (1996) with three measures of assets.

6.3 Sensitivity Analysis

In the above simulations, the risk aversion coefficient (μ) of the CRRA utility function is set at 3, as is suggested by many empirical studies. In order to show the robustness of the results, I provide a sensitivity test for alternative values of risk aversion μ. The results are reported in Table 9. We can see that the pattern of asset holding ratios still holds under each alternative value of μ (from 2 to 5).

I also perform a sensitivity test for a range of reasonable social welfare sizes. The values of $\underline{C}$ from 15% to 25% of the average household income are tested. Table 10 presents the results. We can see that the pattern of asset holding ratios under each value of $\underline{C}$ still holds.

6.4 Discussion: Why and When is the Standard Model Invalid?

According to the above quantitative analysis, the negative correlation between insurance and savings that is standardly expected can be observed only when the size of the social welfare system is small and the health insurance coverage is stable. Otherwise, we are likely to observe a positive correlation between health insurance coverage and savings, as seen in the case of the US. Moreover, this positive correlation does not necessarily imply the nonexistence of precautionary saving.

There are at least two assumptions that guarantee the validity of the standard model: (1) no other factors that affect saving decisions vary with the insurance coverage; and (2) the insurance coverage is constant (i.e. there is no uncertainty of insurance coverage). In this paper, the existence of the means-tested social welfare system and the employment-based health insurance system violates these two assumptions.

Table 9: Sensitivity Test – Risk Aversion (μ)

	Ratios of median asset holdings (a_{in}/a_{un})			
Income group	$\mu = 2$	$\mu = 3$	$\mu = 4$	$\mu = 5$
Bottom	∞	∞	∞	∞
2nd	17.76	17.68	63.54	79.53
3rd	2.73	3.61	4.57	4.24
Top	1.57	1.84	2.05	1.96

Note: $\underline{C} = .20\bar{e}$ (large social welfare system).

Table 10: Sensitivity Test – size of the social welfare system ($\underline{C}$)

	Ratios of median asset holdings		
Income group	$\underline{C} = .15\bar{e}$	$\underline{C} = .20\bar{e}$	$\underline{C} = .25\bar{e}$
Bottom	∞	∞	∞
2nd	4.39	17.68	158.71
3rd	2.47	3.61	5.95
Top	1.85	1.84	1.80

Note: risk aversion $\mu = 3$.

With the means-tested social welfare system, health insurance not only decreases precautionary savings, but also reduces the effects of the social welfare system on saving. This violates the first assumption. With the employment-based health insurance, households that are currently in good employment states with insurance coverage will save for possible bad times in the future when they will not have insurance coverage.

Therefore, in a real-world economy (for example, that of the US), it is likely that a positive correlation between insurance and savings correlation indicates that some assumptions behind the standard model do not hold, rather than implies the nonexistence of precautionary saving.

7 Implications for Empirical Testing

Empirical studies also use econometric methods that control for other characteristics in order to analyze more precisely the effect of health insurance on savings and test the precautionary saving hypothesis. I also perform a econometric analysis in the model economy. The "empirical" results from the model economy are consistent with the existing empirical findings, but the interpretation of the results based on this model differs greatly from the interpretation based on the standard precautionary saving model. Moreover, I will discuss the implications of this model for the assessment of the empirical approaches to testing the precautionary saving hypothesis.

7.1 Econometric Method and Regression Results

I use the data generated from simulation of the model to perform an econometric analysis. The model that has a means-tested social welfare system and a employment-based health insurance system ($\underline{C} = .20\bar{e}$ and risk aversion $\mu = 3$) is used to represent the US economy. In the model economy, by construction, every household has identical risk aversion and a motivation for precautionary saving. Therefore, an appropriate regression model should determine correctly the existence of precautionary saving.

The regression model based on the standard precautionary saving model is set as follows:

$$\log(a_{i,t}) = \alpha HI_{i,t} + \beta' Q_{i,t} + \varepsilon_{i,t}, \tag{12}$$

where $a_{i,t}$ is household i's asset holdings at time t, $HI_{i,t}$ is a dummy variable of health insurance coverage, and $Q_{i,t}$ is a vector of variables, which control for all other directly observable household characteristics that also affect saving.[34] According to the standard precautionary saving model, we would interpret a negative coefficient of HI (i.e. $\alpha < 0$) as verification of the existence of precautionary saving. By the same logic, a positive coefficient would be interpreted as rejection of the existence of precautionary saving.

Using this kind of regression model as a basis, Starr-McCluer (1996) estimated the above asset holding equation (12) by controlling for estimated permanent income, health problems, and other household characteristics as independent variables in $Q_{i,t}$, and reported a significant positive coefficient of HI using US cross-section data for the working age population. Starr-McCluer also made a great effort to control for selectivity, and suggested that selectivity cannot explain the puzzling empirical findings.

Here I follow Starr-McCluer's basic approach.Because the model environment is much simpler than the real world, I only need to control for permanent income level and medical expenditure shock as household characteristics. The regression results are reported in Table 11. For comparison, the results in Starr-McCluer (1996) are also

[34] See the control variables used in Starr-McCluer (1996) for example.

Table 11: Comparison of results of regressions

Explanatory Variable	Model Economy	Starr-McCluer (1996) Measure 1 (Liquid)	Measure 2 (Financial)	Measure 3 (Net worth)
HI coverage	**2.08**	**2.66**	**2.97**	**1.72**
	(0.028)	(0.18)	(0.16)	(0.19)
Perm't Income	4.22	1.53	1.71	1.69
	(0.015)	(0.11)	(0.11)	(0.15)
Medical Shock	-0.17	-0.34	-0.28	-0.41
	(0.022)	(0.10)	(0.10)	(0.12)

Notes: (1) Social welfare system: $\underline{C} = .20\bar{e}$. Risk aversion coefficient: $\mu = 3$.
(2) "Medical Shock" is represented by medical expenditure in the model, and by illness status in Starr-McCluer (1996).
(3) All coefficients are significant at the 5% level.

presented in the table.[35] The first column of the table presents the ordinary least square regression results using data from the simulated model economy. The coefficient of health insurance coverage in the model economy is significant positive and consistent with Starr-McCluer's findings.

7.2 Interpretation and Implications for Empirical Testing

Given the conventional interpretation, a significant and positive coefficient of health insurance in the above regression would lead to a rejection of the existence of precautionary saving. However, this interpretation is not always correct. As shown by the above exercise, the regression model is unable to determine correctly the existence of precautionary saving in an economy with a means-tested social welfare system and a employment-based health insurance system. The reason is that the regression model can only capture the net saving effect of health insurance, rather than exclusively the effect on precautionary saving. In what follows, I diagnose the failings of the standard regression model and discuss how empirical testing can be improved.

Table 12: Comparison of regression results - controlling for work status

Explanatory Variable	Model Economy: Without controlling for work status	Model Economy: Controlling for work status
HI coverage	**2.08**	**0.63**
Permanent Income	4.22	4.40
Medical Expenditure Shock	-0.17	-0.17
Work Status		1.85

Notes: (1) Social welfare system: $\underline{C} = .20\bar{e}$. Risk aversion coefficient: $\mu = 3$.
(2) All coefficients are significant at 5%.

7.2.1 Potential bias caused by the employment-based health insurance

In an economy with employment-based health insurance, the regression coefficient of health insurance coverage will be combined with the effect of the incentive of consumption smoothing: people in good times with insurance coverage save for future possible bad times without coverage. Moreover, insurance coverage that is associated with higher income (relative to circumstances without insurance) further reduces the negative effect on saving of the social welfare system and further increases insured households' savings.

To distinguish the effect of the uncertainty of insurance coverage from the effect of insurance itself, we need to control for the level of health insurance eligibility. In the model economy, the insurance eligibility is set as a positive function of the work status, which is represented by the labor endowment state, and so we can easily control for it to show the potential difference in the regression results. The comparison of regression results is presented in Table 12. When controlling for work status (the second column), the coefficient of health insurance is still positive but becomes smaller. This is because the change in work status explains some of the positive effect on saving. In addition, the coefficient of work status is positive, as we would expect.

In practice, it is not easy to measure the insurance eligibility or the work status, and the effect is even harder to identify when using cross-section data.

7.2.2 Potential bias caused by the social welfare system

In an economy with a means-tested social welfare system, the introduction of health insurance will cause two opposing effects on savings. The negative effect is the reduction

[35] Only variables related to the model are reported.

Table 13: Comparison of regression results - economy with regime change

	Regime 1	Regime 2	Regime 3
Explanatory Variables	Small SW system Constant HI	Large SW system Constant HI	Large SW system Employment-based HI
HI coverage	**-0.84**	**0.83**	**2.08**
Permanent Income	0.35	4.75	4.22
Medical Shock	-0.11	-0.27	-0.17

Notes: (1) Large social welfare system: $\underline{C} = .20\bar{e}$. Small social welfare system: $\underline{C} = .01\bar{e}$.
(2) Risk aversion coefficient: $\mu = 3$.
(3) All coefficients are significant at 5%.

of precautionary savings as in a standard model, and the positive effect occurs because of the existence of the social welfare system. However, we can only observe the net effect in the data. To identify and separate these two combined saving effects through a regression model is difficult, even in the model economy.

One possible method is that if we can find an economy experiencing regime changes in its social welfare system and health insurance system, we might be able to identify these combined effects with the regression model. For example, if the economy's regime changes from a small social welfare system (assume $\underline{C} = .01\bar{e}$) and constant health insurance coverage (Regime 1) to a large social welfare system, where $\underline{C} = .20\bar{e}$ (Regime 2), and then the health insurance system changes to an employment-based (work-contingent) health insurance system (Regime 3), with other things being equal, we will be able to observe that:

(1) in Regime 1, the regression coefficient of health insurance mostly reflects the reduction of precautionary savings caused by health insurance, and so it is expected to be negative;

(2) from Regime 1 to Regime 2, the difference in the regression coefficient of health insurance is caused by the regime change in the social welfare system (the positive saving effect of health insurance becomes larger);

(3) from Regime 2 to Regime 3, the difference in the regression coefficient instead results from the regime change in the health insurance system (the uncertain health insurance coverage strengthens the positive effect on saving).

I use the same model to simulate an economy with the above regime changes and run a regression under each regime to show these effects. The regression results are listed in Table 13. We can see that, under Regime 1, the coefficient of health insurance coverage is negative (-0.84). When the economy changes to Regime 2, the coefficient becomes positive (0.83) because of the regime change in the social welfare system. When the economy changes to Regime 3, the coefficient becomes larger (2.08) because of employment-based health insurance.

However, the above approach relies principally on the availability of the data. Another approach would be to compare cross-country data, but that would require a careful study of the institutions in each country, and may require controlling for other country-specific characteristics. Hence, further research remains to be done if an appropriate empirical approach to identify those combined effects, as suggested in this paper, is to be developed.

8 Concluding Remarks

From the vantage point of a standard model of precautionary saving, a puzzling positive correlation between private health insurance coverage and household asset holdings has been observed in the US. I suggested that the puzzling finding can be explained by the existence of two institutions: a sizable asset-based means-tested social welfare system and an employment-based health insurance system. In order to analyze this issue, I developed a standard dynamic stochastic general equilibrium model that incorporates these two institutions. I showed that the model can generate a pattern of asset holding ratios that is consistent with that observed in the US data, i.e. a positive correlation between insurance and saving and a shrinking difference in asset holdings between insured and uninsured households as the level of income increases. This result does not depend on the assumption of heterogeneity of risk aversion (i.e. selectivity).

I point out that the assumptions required by the standard model of precautionary saving can easily be violated by some institutional factors, such as the social welfare system and the health insurance system in the US. I have shown that it is only when the means-tested social welfare system is small and the health insurance coverage is constant that we observe a negative correlation between insurance coverage and household savings as the standard precautionary saving model suggests. As also shown in the analysis, health insurance coverage reduces the negative effect on saving caused by the social welfare system, and an employment-based health insurance system increases the incentive to save when insured. This explains the positive correlation observed in the US. In addition, because the social welfare system has less effect on higher income households, the difference in assets held between insured and uninsured households decreases as the level of income increases.

The findings call into question the appropriateness of the conventional empirical approaches based on the standard precautionary saving model to testing the precautionary saving hypothesis. I applied a regression approach, as used in existing empirical studies, to the model economy. The regression results show a significant positive coefficient of health insurance coverage in an economy that has the above two institutions, which confirms the findings of existing empirical studies. However, the positive coefficient does not imply the nonexistence of precautionary saving. In fact, households do have a motive to engage in precautionary saving in the model economy. This bias is present because the regression model captures the net saving effect of health insurance, rather than exclusively the effect on precautionary savings. In order to test appropriately for the existence of precautionary saving, it is necessary to control for the effects caused by these institutional factors. I have discussed some ways in which empirical testing might be improved. Nevertheless, in practice it is difficult to distinguish the effect on saving caused by the institutions from the effect of health insurance on precautionary saving. Further research is required if this difficulty is to be resolved.

References

Aiyagari, S. Rao (1994), "Uninsured idiosyncratic risk and aggregate saving." *Quarterly Journal of Economics*,109:3, 659–684.

Chou, S., J. Liu and J. Hammitt (2003), "National Health Insurance and Precautionary Saving: Evidence from Taiwan." *Journal of Public Economics*, 87: 1873–1894.

Chou, S., J. Liu and C. J. Huang (2004), "Health Insurance and Savings Over the Life Cycle – A Semiparametric Smooth Coefficient Estimation." *Journal of Applied Econometrics*, 19: 295–322.

De Nardi, Mariacristina, Eric French, and John Bailey Jones (2006), "Differential Mortality, Uncertain Medical Expenses, and the Saving of Elderly Singles." NBER Working Paper No. 12554.

Feenberg, D. and J. Skinner (1994), "The Risk and Duration of Catastrophic Health Care Expenditures." *Review of Economics and Statistics*, 76:4, 633–647.

Gruber, J. and A. Yelowitz (1999), "Public Health Insurance and Private Savings." *Journal of Political Economy*, 107:6, 1249–1274.

Guariglia, A. and M. Rossi (2004), "Private medical insurance and saving: evidence from the British Household Panel Survey." *Journal of Health Economics*, 23:4, 761–783.

Hansen, Gary D. (1985), "Indivisible labor and the business cycle." *Journal of Monetary Economics*, 16:3, 309–327.

Hubbard, R. G., J. Skinner and S. P. Zeldes (1995), "Precautionary saving and social insurance." *Journal of Political Economy*, 103, 360–399.

Leland, H. E. (1968), "Saving and Uncertainty: The Precautionary Demand for Saving." *Quarterly Journal of Economics*, 82:3, 465-473.

Ljungqvist, L. and T. J. Sargent (2000), *Recursive Macroeconomic Theory*, Cambridge, Mass: MIT Press.

Kotlikoff, L. J. (1989), "Health expenditures and precautionary savings." *What Determines Savings?* by L. J. Kotlikoff, Cambridge, Mass: MIT Press.

Maynard, Alex and Jiaping Qiu (2005), "Public insurance and private savings: who is affected and by how much?" *Working Paper*.

McGarry, Kathleen (2002), "Public Policy and the US Health Insurance Market: Direct and Indirect Provision of Insurance." *National Tax Journal*, LV:4, 789–827.

Monheit, Alan C. (2003), "Persistence in Health Expenditures in the Short Run: Prevalence and Consequences." *Medical Care*, 41:7, 53–64.

Powers, E. T. (1998), "Does Means-Testing Welfare Discourage Saving? Evidence from a Change in AFDC Policy in the United States." *Journal of Public Economics*, 68: 33–53

Sandmo, A. (1970), "The Effect of Uncertainty on Saving Decisions." *Review of Economic Studies*, 37, 353-360.

Starr-McCluer, Martha (1996), "Health Insurance and Precautionary Savings." *American Economic Review*, 86:1, 258–295.

Swartz, K. (2003), "Reinsuring Risk to Increase Access to Health Insurance." *American Economic Review*, 93:2, 283–287.

Appendix

A1. Alternative setting of the EHI coverage

In the text I allow households in different income groups face different probabilities of accessing health insurance. Here I use simpler setting that all household face the same uncertainty of accessing insurance. The probabilities of receiving private health insurance coverage conditional on labor (work) states, from low to high, are set as 0.3651, 0.5505, 0.8960, 0.9632 and 0.9841 so that the uninsured are 20% of the total households and the distribution of the uninsured over the five work states is the same as in the text.

All other parameters are kept the same as in the fully-specified model economy with a sizable social welfare system $\bar{C} = .20\bar{e}$. The simulation results of this economy are presented in Table 14. A regression is also preformed as in the text, and the results are shown in Table 15. We can observe that this alternative setting does not change the analysis in the text.

Table 14: Ratios of median asset holdings (a_{in}/a_{un})

		US Data*		
Income group	Model Economy	Measure 1 (Liquid)	Measure 2 (Financial)	Measure 3 (Net worth)
Bottom	∞	∞	∞	41.07
2nd	20.38	6.00	11.33	7.15
3rd	2.99	2.95	9.46	6.47
Top	2.03	1.39	4.72	0.89

Notes: The model economy: $\mu = 3$; $\underline{C} = .20\bar{e}$. *Calculated from the report in Starr-McCluer (1996) with three measures of assets.

Table 15: Comparison of results of regressions

		Starr-McCluer (1996)		
Explanatory Variable	Model Economy	Measure 1 (Liquid)	Measure 2 (Financial)	Measure 3 (Net worth)
HI coverage	**1.74**	**2.66**	**2.97**	**1.72**
	(0.028)	(0.18)	(0.16)	(0.19)
Perm't Income	4.69	1.53	1.71	1.69
	(0.015)	(0.11)	(0.11)	(0.15)
Medical Shock	-0.17	-0.34	-0.28	-0.41
	(0.022)	(0.10)	(0.10)	(0.12)

Notes: (1) "Medical Shock" is represented by medical expenditure in the model, and by illness status in Starr-McCluer (1996).
(2) All coefficients are significant at the 5% level.