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Health Insurance and Precautionary Saving: A Structural Analysis

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Abstract

Starr-McCluer (1996) documented an empirical finding that the US households covered by health insurance saved more than those without coverage, which is inconsistent with the standard consumption-saving theory. This study provides a structural analysis and suggests that institutional factors, in particular, a social insurance (safety net) system and an employment-based health insurance system, can account for this puzzling finding. A dynamic stochastic general equilibrium model is built that incorporates these two institutions with heterogeneous agents making decisions regarding saving, labor supply and health insurance endogenously when they are young. The model, in which agents save in a precautionary manner, can generate Starr-McCluer's empirical finding and it indicates that the empirical finding is not inconsistent with the standard theory of saving under uncertainty. Counterfactual experiments are performed to provide implications for empirical analyses and illustrate the danger of empirical work without a sound theoretical background.

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1 Introduction

Starr-McCluer (1996) argued that the standard consumption-saving theory, which implies that more insured households should save less for precautionary motives, is inconsistent with their empirical finding that US households covered by private health insurance save more than comparable uninsured households. To examine this issue, I build a structural model, in which the majority of health insurance is privately provided through employment and the government operates a social insurance system that covers medical expenditures when they become so significant as to reduce household wealth below a pre-specified threshold. The model, in which households save in a precautionary manner, can generate Starr-McCluer's (1996) empirical finding for two reasons: 1) the social insurance system creates a strong disincentive to save (as discussed in Hubbard et al., 1995) and to purchase health insurance. However, the availability of health insurance (e.g., insurance offers from employers) reduces the likelihood of accessing the social insurance, and so has a positive effect on saving; 2) the health insurance status is uncertain (highly contingent on employment) and mean-reverting, and therefore households currently covered by health insurance are in a good state and will save for a precautionary motive against the positive probability that they will move to the bad state and lose the insurance coverage that reinforces the positive insurance-saving correlation. This paper suggests that Starr-McCluer's finding is not at odds with the standard theory of saving under uncertainty, and that the above two institutional factors can account for the insurance-savings correlation. Counterfactual experiments are performed to provide implications for empirical analyses and illustrate the danger of empirical work without a sound theoretical background.[1]

To provide a structural analysis, I build a dynamic stochastic general equilibrium model, where heterogeneous agents face uncertain retirement/death, idiosyncratic income and medical shocks, and make decisions regarding saving, labor supply and health insurance endogenously. Markets are incomplete, and so risk-averse agents in the economy have an incentive to save in a precautionary manner and to purchase health insurance. Two institutions, a social insurance (safety net) system and an employment-based health insurance system, are incorporated as key factors to examine the insurance-savings correlation. Although the focus of this study is on the saving-insurance decisions of the working-age population, Social security and Medicare are also incorporated because they affect young agents' expectation of their life after retirement.

[1]This model predicts that in an economy without either a large social insurance system or an employment-based health insurance system, an empirical result contrary to Starr-McCluer's finding would be found.

The goal of this study is to diagnose the empirical puzzle with a structural approach and provide implications for studies on related saving/insurance issues. This study contributes to the literature pioneered by Kotlikoff (1989) analyzing the effects of health expenditure shocks on precautionary savings, and the literature of dynamic equilibrium models with heterogeneous agents in incomplete markets.[2] Several recent studies have examined the impacts of health and medical expenditures in Aiyagari-Bewley type models.[3] However, there are relatively few studies that have applied this approach to the study of health insurance programs. Attanasio, Kitao and Violante (2008) and Jeske and Kitao (2009) are two exceptions.

The theoretical framework in this study is similar to that in Jeske and Kitao (2009), who analyze the effects of the US tax policy on health insurance choices, and different from previous studies by endogenizing the health insurance decision, rather than treating households' out-of-pocket health expenditures as an exogenous shock. The main differences between the model in this study and that of Jeske and Kitao are the following: 1) the labor decision is endogenous in this study, and therefore in addition to savings, agents can adjust labor supply as well for consumption smoothing; 2) the timing of purchasing health insurance is made consistent with the timing of receiving Medicare – A young agent makes a decision of accepting an offer of employer-sponsored health insurance (EHI) if available, purchasing private individual health insurance (IHI), or being uninsured at the beginning of each period rather than at the end of each period.[4] The medical shock is realized after the insurance decision is made, and then agents make other economic decisions (e.g., consumption and saving). In addition to the consistency issue, because retirement is stochastic and realized at the beginning of each period in such models, this setting prevents forcing agents to carry EHI or IHI purchased in the last period to the first period of the retirement stage and forego the Medicare benefit, which provides universal coverage with a highly subsidized premium to retired agents.[5]

Attanasio, Kitao and Violante (2008) use a general equilibrium life cycle model with incomplete markets, endogenous labor decisions and medical expenditure shocks

[2]Bewley (1986), Imrohoroglu (1989), Huggett (1993) and Aiyagari (1994) pioneered the literature.

[3]For example, Livshits et al.(2007) and Chatterjee et al.(2007) suggested that medical expenditure shock is an important reason for consumer bankruptcy. Palumbo (1999), De Nardi et al.(2006) and Scholz et al.(2006) studied medical expenses for understanding the pattern of retirement savings.

[4]The timing of making a health insurance decision set at the end of each period in Jeske and Kitao (2009), and the insurance purchased this period will cover the medical expenditures in the next period. However, once an agent retires (i.e. hit by a retirement shock in the model), the agent will qualify for Medicare immediately that covers the current medical expenditures.

[5]However, this setting of consistent timing of insurance coverage results in a more complicated decision process within a time period.

to evaluate alternative financing schemes for Medicare. The health insurance coverage for young agents is not endogenized because they focus on Medicare, which serves the elderly.[6]

The remainder of this paper is organized as follows. Section 2 describes the puzzling empirical finding. Section 3 introduces the model. Section 4 presents specifications of the model and calibration. The quantitative analysis and discussion are provided in Section 5. Section 6 presents the conclusion.

2 The Puzzling Finding 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 tests the precautionary saving hypothesis. Although Starr-McCluer applies several econometric methods to control for other household characteristics and factors that also affect saving, the results indicate that health insurance coverage has a significant and positive effect on savings. Table 1 presents part of the empirical results of her study. We can see that the coefficients of health insurance coverage (labeled "HI coverage") are significant and positive in all the three regressions regardless of the measure of assets.

Guariglia and Rossi (2004) also studied the effects of private medical insurance on household savings, employing the British Household Panel Survey data. Their findings are similar to those of Starr-McCluer: health insurance coverage increases the probability of saving. On the basis of these empirical findings, they suggest that British households do not have precautionary savings for health risk, and that selectivity does not explain these puzzling empirical results. Although Guariglia and Rossi (2004) have results similar to Starr-McCluer's, the UK health insurance environment differs significantly from that in the US. The National Health Service (NHS) is the dominant health care provider in the UK, with universal provision that is generally free at source, with private insurance being supplementary to the NHS. In the US, private health insurance is dominant and many Americans are uninsured. This study focuses on the US environment and Starr-McCluer's empirical finding. The analysis provided in this study might not be directly applicable to the case of UK.[7]

[6] The focus of this paper is on the working-age population, similar to Jeske and Kitao (2009), and a life-cycle analysis is not performed. A general equilibrium life cycle model similar to that in Attanasio, Kitao and Violante (2008) with endogenous health insurance decision is used in Hansen, Hsu and Lee (2011), to evaluate alternative health insurance reform options.

[7] Hsu, Liao and Lin (2011) use a model similar to this study and discuss the impact of supplemental

Table 1: Empirical finding: Regressions with various measures of assets.

Variables (X/Y)	Regression 1 (Liquid assets)	Regression 2 (Financial assets)	Regression 3 (Net worth)
HI coverage	**2.66***	**2.97***	**1.72***
Permanent Income	1.53*	1.71*	1.69*
Health problems	-0.34*	-0.28*	-0.41*

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

3 The Model

This section describes the model settings for the benchmark economy.

3.1 General model environment

3.1.1 Demographics

The economy is populated by a continuum of agents (measure one), who maximize expected discounted lifetime utility from consumption and leisure. The population consists of two generations – the young and the old. Young agents supply labor and earn wage income, while the old agents are retired from work and receive social security benefits. Young agents retire with a probability ρ_o every period, and old retired agents die and leave the economy with a probability ρ_d every period. At the beginning of each period, the economy has new-born young agents replacing those old agents, who died at the end of previous period, such that the measure of total population stays constant. The demographic setting with the probabilities described above implies that the proportion of old agents in the population is $\frac{\rho_o}{\rho_o+\rho_d}$, and that of young agents is $\frac{\rho_d}{\rho_o+\rho_d}$. I do not consider the annuity market for the old in this economy and assume all bequests are accidental and distributed equally to all the surviving households.

3.1.2 Idiosyncratic Shocks

Labor productivity shock

Young agents' effective labor supply depends on the hours worked and a stochastic

private health insurance on household savings in an environment, in which universal health insurance is publicly provided. Empirical evidence to confirm the model prediction is provided as well.

idiosyncratic labor productivity shock z. In each period t, the idiosyncratic labor productivity shock takes a value in a finite set $Z = \{z_1, z_2, ..., z_n\}$. Each agent's productivity shock evolves independently according to a first-order Markov process with a transition probability matrix $P_{(z'|z)}$ and an invariant distribution $\bar{\pi}_z$. Old agents retire from the labor market and therefore do not encounter any labor shock (assuming their z fixed at 0).

Medical expenditure shock

Both young and old agents face medical expenditure shocks x. In each period t, each agent's medical expenditure shock takes a value in a finite set $X_i = \{x_{1,i}, x_{2,i}, ..., x_{m,i}\}$ for $i \in \{old, young\}$. Each household's medical expenditure shock also evolves independently according to a first-order Markov process with a transition probability matrix $P^i_{(x'|x)}$ for $i \in \{old, young\}$ and an invariant distribution $\bar{\pi}_{x,i}$ for $i \in \{old, young\}$.

3.1.3 Production Technology

On the production side, we assume that there is a continuum of competitive firms operating a technology with constant returns to scale. Aggregate output Y is given by

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

where K and L are the aggregate capital and effective labor employed by the firm's sector and A is the total factor productivity. Capital depreciates at the rate of δ every period. θ denotes the capital income share.

3.1.4 Preference

I adopt a standard utility function $u(c,n)$, which is consistent with a balanced growth path and is widely used in the growth literature, as shown below:

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

where μ is the relative risk aversion coefficient.

3.1.5 Asset Market

Individuals can hold assets, and therefore they can partially insure themselves against income/expenditure uncertainties by accumulating precautionary asset holdings. While they are allowed to insure themselves by accumulating positive asset holdings, borrowing is limited to reflect the market incompleteness in the real world.

3.2 Government and Social Programs

Government's revenue consists of revenues from different tax instruments, labor income tax τ_n, capital income tax τ_k, consumption tax τ_c, and social security tax τ_{ss}. The social security tax τ_{ss} is imposed on young agents' labor income.

The government runs three social programs: social security, Medicare, and means-tested social insurance (safety net).

Social Security

The social security program provides the old (retired) agents with a benefit ss. . As shown below, it is self-financed by the social security tax revenue:

$$\int (ss) d\Phi(s) = \int \tau_{ss}(wzn) d\Phi(s), \tag{2}$$

where $\Phi(s)$ is the distribution of population over the state space s.

Medicare

Medicare is a public program through which the government provides health insurance for the elderly. Once agents reach the old age in the model, they are automatically covered by Medicare. Medicare covers a fraction $\omega_o(x)$ of realized medical expenditure x, and it is financed by a combination of general government budget and a Medicare premium q_{med} from each benefit recipient.

Social insurance

The asset-based, means-tested social insurance system enables households to maintain a minimum consumption level (denoted by $\underline{c}$) that the government would like to guarantee. I employ a simple rule for the operation of the social insurance system similar to that used by Hubbard et al. (1995): if a household's disposable income and assets H (net after medical expenditure) are lower than $\underline{c}$, the household qualifies for and will receive social-insurance benefits (a transfer payment) to the extent that households can have at least $\underline{c}$ cash on hand to spend.[8]

Social insurance payments, Medicare, repayment of government debt D, and other government expenditures are financed by the revenue earned from labor income tax (τ_n),

[8] This simple social insurance 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.

capital income tax τ_k, consumption tax τ_c, Medicare premiums q_{med}, and new debt D'.

$$G+\int[TR+\omega_o(x)x]d\Phi(s)+(1+r)D=\int[\tau_n(wzn)+\tau_k r(a+b)+\tau_c c+q_{med}]d\Phi(s)+D', \tag{3}$$

where TR is the amount of financial transfer from the social insurance system, x is individual medical expenditure, a denotes the individual asset holdings, b represents accidental bequests, G represents all other government expenditures, and $\Phi(s)$ is the distribution of population over the state space.

3.3 Private Health Insurance

To characterize the current US health insurance market, two types of private health insurance (PHI) are incorporated in the model – employment-based health insurance (EHI) and individual health insurance (IHI). The former, which is offered by employers and required by law not to discriminate on the basis of health, is also called a group health insurance. In the latter, insurance companies have an incentive to price-discriminate.

Everyone has access to IHI, but EHI is available only if it is offered by the employer. I use e to denote the EHI offer status. EHI's premium, q_e, does not depend on individual statuses. If EHI is offered ($e=1$), the premium cost is partially shared by the employer (with a share ε_e) but an amount ($\varepsilon_e q_e$) will be deducted from employees' wages to ensure the firm's break-even condition. If an agent decides to accept the EHI offer at the beginning of a period, a fraction $\omega_e(x')$ of the realized medical cost x' in this period will be covered by the EHI.

If an agent is not offered an EHI ($e=0$) or declines the EHI offer, she/he can still purchase an IHI contract to cover medical shocks. A premium $q_p(x)$, which depends on the agent's initial health status (i.e. last medical expenditure) x, must be paid at the beginning of the period before the medical shock of this period (x') is realized . The status-dependent insurance premium reflects the actual price discrimination in the IHI market.

Health insurance companies are assumed to be risk-neutral and competitive. They are able to monitor each agent's state of health expenditure. It is assumed that there is no cross-subsidy across contracts. The premium for an insurance contract offered to an individual whose previous medical expenditure was x satisfies the following condition:

$$q_p(x)=(1+\psi)E\left[\omega_p(x')\cdot x'|x\right], \tag{4}$$

where $\omega_p(x)\in[0,1]$ denotes a proportion of total medical expenditure (x) covered by the insurance, and ψ denotes a proportional mark-up.

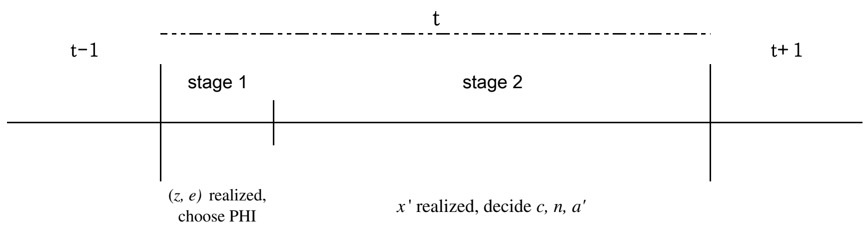

Figure 1: Time line of shock realization and decision making

3.4 Agent's Problem

3.4.1 The Time Line of Decisions

Each model period contains two stages of shock realization and decision making. At the beginning of each period (stage 1), agents observe the asset holdings from the last period a, the labor productivity z, EHI offer e, last period medical expenditure x, and decide whether to take up the EHI (if $e = 1$) or to purchase a private insurance contract IHI before this period's medical shock x' is realized. i_{HI} is an indicator that denotes the insurance decision. After the insurance decision is made (stage 2), medical expenditure shock x' is realized, and then households make decisions on consumption c, labor supply n, and asset holdings a'. Figure 1 illustrates the process of shock realization and decision making at time t in the model.

3.4.2 Young Agent's Problem

The state can be summarized by a vector $s = (a, z, e, x)$ when a young agent makes the insurance decision. Then, additional information on x' is available for forming expectations and other economic decisions. A young agent's problem can be expressed as:

$$V(s) = \max_{i_{HI}} \left\{ \sum_{x'} P^y_{(x'|x)} \max_{c,n,a'} \left\{ u(c,n) + \beta \left\{ (1-\rho_o) E\left[V(s') \middle| s,x' \right] + \rho_o E\left[V_o(s') \middle| s,x' \right] \right\} \right\} \right\} \tag{5}$$

subject to

$$(1+\tau_c)c + a' + \hat{q} = Wel_y + TR \tag{6}$$

$$Wel_y \equiv (1-\tau_{ss}-\tau_n)\hat{LI} + [1+(1-\tau_k)r](a+b) - [1-\hat{\omega}]x' \tag{7}$$

$$\hat{LI} = \begin{cases} wzn & \text{if } e=0 \\ wzn - \varepsilon_e q_e & \text{if } e=1 \end{cases} \tag{8}$$

$$\hat{q} = \begin{cases} 0 & \text{if } i_{HI}=0 \\ (1-\varepsilon_e)q_e & \text{if } e=1 \text{ and } i_{HI}=1 \\ q_p(x) & \text{if } i_{HI}=2 \end{cases} \tag{9}$$

$$\hat{\omega} = \begin{cases} 0 & \text{if } i_{HI}=0 \\ \omega_e(x') & \text{if } e=1 \text{ and } i_{HI}=1 \\ \omega_p(x') & \text{if } i_{HI}=2 \end{cases} \tag{10}$$

$$TR = \max\{0,\ (1+\tau_c)\underline{c} - Wel_y\} \tag{11}$$

$$i_{HI} \in \{0,1,2\};\ \ a' \geq 0;\ \ 0 \geq n < 1; \tag{12}$$

where V_o is the value when the agent becomes old; $\hat{LI}$ denotes the labor income; ε_e is the employer's share of EHI premium; TR is the transfer from the social insurance system; i_{HI} is an indicator that takes a value of 1 if the agent accepts the EHI offer (if $e=1$), a value of 2 if the agent purchases private individual health insurance, and 0 otherwise.[9]

3.4.3 Old Agent's Problem

For the retired, their labor productivity z and EHI offer e are both fixed at 0. They supply no labor and receive social security payment ss as their main income source. Therefore, they encounter the medical shock without income uncertainty. All retired agents are assumed to be automatically enrolled in Medicare. With the Medicare coverage, the out-of-pocket medical expenditure is $[1-\omega_o(x)]x$ out of the realized total medical cost x.

[9]The utility function given in equation (1) implies that labor supply can be expressed as a function of consumption and effective wage rate:

$$n = 1 - \frac{(1-\phi)(1+\tau_c)c}{\phi(1-\tau_n-\tau_{ss})wz}. \tag{13}$$

An old agent's problem is given as

$$V_o(s) = \sum_{x'} P^o_{(x'|x)} \max_{c,a'} \left\{ u(c,1) + \beta(1-\rho_d) E\left[V_o(s') | s, x' \right] \right\} \tag{14}$$

subject to

$$(1+\tau_c)c + a' = Wel_o + TR \tag{15}$$

$$Wel_o \equiv ss + [1 + (1-\tau_k) r](a+b) - \left[1 - \omega_o(x')\right] x' - q_{med} \tag{16}$$

$$TR = \max\{0,\ (1+\tau_c)\underline{c} - Wel_o\} \tag{17}$$

$$a' \geq 0. \tag{18}$$

3.5 Recursive Competitive Equilibrium

A stationary recursive competitive equilibrium consists of individual decision rules of asset holding a', labor supply n, health insurance take-up i_{HI} and consumption c, as well as a set of firm decisions regarding capital rented K and effective labor employed L, a price system of w and r, EHI's expenditure coverage ratio ω_o, premium q_e and employer's share ε_e, private IHI expenditure coverage ratio ω_p and premium q_p, a government policy of tax rates $\{\tau_n,\ \tau_k,\ \tau_c\}$, government expenditure G, a Medicare policy $\{\omega_o,\ q_{med}\}$, a social insurance policy ($\underline{c}$), a social security policy $\{ss,\ \tau_{ss}\}$, a lump-sum transfer of accidental bequests b, and a stationary distribution of population over the state space $\Phi(s)$, such that:

a) given the price system, EHI premium and employer's share, the decision rules of K and L solve the firm's profit maximization problem;

b) given the price system, health insurance plans, accidental bequests and the government policies, the decision rules of $\{i_{HI}, a', n, c\}$ solve young and old agents' problems;

c) insurance companies are competitive. The IHI premium satisfies condition (4), and the EHI premium satisfies:

$$q_e = \frac{\int E[\omega_e(x')x'|x](i_{HI}e)\Phi(s)ds}{\int (i_{HI}e)\Phi(s)ds}. \tag{19}$$

d) the government policies satisfy the government's budget constraints (2) and (3);

e) all markets clear: $L = \int (zn)\Phi(s)ds$ and $K + D = \int (a+b)\Phi(s)ds$;

f) the resource feasibility condition is satisfied:

$$Y + K = C + X + G + K' - \delta K,$$

where C is the aggregate consumption $C = \int (c)\Phi(s)ds$, and X is the aggregate medical expenditure $X = \int (x)\Phi(s)ds$.

4 Model Specification and Calibration

To solve the model numerically and provide an adequate quantitative analysis, I begin by describing the calibration and parameterization of the model. The benchmark model is used to characterize the US economy. A summary of parameters is presented in Table 6.

4.1 Demographics

The model period is one year. The economy is populated by a continuum of agents (measure one) and they maximize expected discounted lifetime utility from consumption and leisure. The population consists of two generations – the young and the old. Young agents represent those aged between 20 and 64, and old agents include those aged 65 and above. Young agents retire with a probability ρ_o, and therefore, on average, the young agents work for $(1/\rho_o)$ years. The aging/retirement probability ρ_o is set at 1/45 so that the young on average stay in the labor force for 45 years. After retiring from the labor market, the old die and leave the economy with a death probability of ρ_d. The death probability ρ_d is set in a manner that old agents constitute 20% of the population according to the data of the Medical Expenditure Panel Survey (MEPS) as shown in Jeske and Kitao (2009). In each period, the economy has new young agents entering to balance the old agent deaths for a constant total population.

4.2 Social Insurance

To characterize the means-tested social insurance system, it is necessary to measure the consumption floor ($\underline{c}$) that the government attempts to guarantee, above and beyond medical expenses, through means-tested transfer payments. Hubbard et al. (1995) make the first approximation by calculating the consumption floor for a representative US family. 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 included in the measure of income. Medicaid (for the poor) is part of the means-tested social insurance system, but it should not be included in $\underline{c}$ because it is exclusively used to pay for medical expenses.[10]

Their estimation suggests 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. In terms of per person subsidy (6,937/3), it constituted approximately 14% of GDP per capita in 1984 (which is $16,549). As mentioned by Hubbard et al., the total benefit may change significantly with a different household condition (e.g. if there is a father in the household). Therefore, $\underline{c}$ is chosen to be 15% of GDP per capita in the benchmark model ($5,729 in 2003), and alternative values from 1% to 35% will also be evaluated.

4.3 Preferences and Production Technology

The risk aversion parameter μ is set at 3, which is widely used in the literature and consistent with the range found in empirical studies. Alternative values of μ will be examined to check the robustness of the results. The utility discount factor (β) is chosen so that the capital-output ratio equals 3. The leisure utility parameter ϕ is chosen so that aggregate labor hours equal 0.33 in the benchmark economy.

In the production function, the capital income share (θ) is set at 0.33, and the depreciation rate of capital (δ) is set at 0.06. Total factor productivity A is normalized to unity. The above parameter values are chosen to be consistent with aggregate features of the postwar U.S. economy and are commonly used in aggregative models of growth and business cycles.

4.4 Labor Productivity and EHI Offer Uncertainties

In the model, the labor productivity shock (z) process is used to capture income fluctuations. Because EHI offer, $e \in \{0,1\}$, is highly contingent on income status, the income process should be estimated jointly with the EHI offer process. Jeske and Kitao (2009) studied the joint process of wage income and EHI offer based on the MEPS data. Based on their report, five states of z, $(0.095, 0.484, 0.815, 1.238, 2.374)$, are used to approximate the labor income distribution of the economy and represent five equal-sized income

[10] In the model, medical payments are included in the transfer payments, TR, made by the social insurance system. However, by definition, the medical payments should not be included in $\underline{c}$. TR has two components, and can be expressed as follows: $TR = \underline{c} - H = \{\underline{c} - (1-\tau_{ss}-\tau_n)\hat{L}I - [1+(1-\tau_k)r](a+b)\} + X$, financial support for minimum consumption standard and support for medical care.

groups. The corresponding joint transition probabilities of (z,e) are as follows:

$$Pr_{(z',e')|(z,e)} = \begin{bmatrix} 0.201 & 0.313 & 0.110 & 0.065 & 0.046 & 0.165 & 0.074 & 0.019 & 0.005 & 0.002 \\ 0.068 & 0.436 & 0.251 & 0.079 & 0.018 & 0.051 & 0.065 & 0.022 & 0.008 & 0.002 \\ 0.024 & 0.122 & 0.489 & 0.240 & 0.052 & 0.015 & 0.019 & 0.024 & 0.013 & 0.002 \\ 0.012 & 0.060 & 0.152 & 0.527 & 0.187 & 0.011 & 0.008 & 0.010 & 0.022 & 0.011 \\ 0.009 & 0.025 & 0.048 & 0.135 & 0.724 & 0.009 & 0.004 & 0.008 & 0.008 & 0.030 \\ 0.042 & 0.045 & 0.013 & 0.007 & 0.003 & 0.715 & 0.124 & 0.033 & 0.013 & 0.005 \\ 0.025 & 0.119 & 0.038 & 0.022 & 0.004 & 0.219 & 0.372 & 0.136 & 0.040 & 0.025 \\ 0.010 & 0.044 & 0.098 & 0.035 & 0.014 & 0.140 & 0.202 & 0.285 & 0.126 & 0.046 \\ 0.008 & 0.018 & 0.034 & 0.075 & 0.029 & 0.099 & 0.138 & 0.158 & 0.305 & 0.136 \\ 0.010 & 0.017 & 0.008 & 0.013 & 0.070 & 0.088 & 0.100 & 0.094 & 0.170 & 0.430 \end{bmatrix},$$

where the first five rows from the top are the transition probabilities for current $e = 0$ with each z, and the second five rows are those for $e = 1$.

4.5 Medical Expenditure Shocks

To characterize medical expenditure shocks, a Markov process is used directly instead of an AR(1) process because of the skewness of medical expenditure. I define four medical expenditure states as "low," " fair," "high," and "very high," which represent the medical expenditure of the bottom 60%, from 60 to 95%, from 95 to 99%, and the top 1%, respectively. Jeske and Kitao (2009) have analyzed the distribution of medical expenditure and estimated the process of medical expenditure based on the MEPS. According to their report, I calculate the mean of medical expenditure of each medical expenditure group in the U.S. working-age and retired population in 2003. These expenditures were 0.9%, 10.8%, 50.0%, and 159.4% of the average income in 2003 for the four expenditure groups in the working-age population, respectively, and were 4.9%, 28.5%, 103.6%, and 226.5% of the average income in the retired population. Therefore, I set the four-state medical expenditure shocks, X_y and X_o for the young and the old respectively, as the above percentages of average labor income in the model (see Tables 2 and 3).

The MEPS ha provided two-year panels since 1996, which allows estimation of transitions in medical expenditure states. Monheit (2003) uses the 1996/97 MEPS data 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. In this study, the transition probabilities for the Markov chain of medical expenditures are calibrated based on the estimation from Jeske and Kitao (2009). The results are reported in Tables 4 and 5.

Table 2: State of medical expenditure – for the young (X_y)

State	Expenditure range	Average ($ in 2003)	As of average income (2003)
Low	bottom 60%	310	0.9%
Fair	60 – 95%	3,597	10.8%
High	95 – 99%	16,629	50.0%
Very High	top 1%	53,013	159.4%

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

Table 3: State of medical expenditure – for the old (X_o)

State	Expenditure range	Average ($ in 2003)	As of average income (2003)
Low	bottom 60%	1,630	4.9%
Fair	60 – 95%	9,474	28.5%
High	95 – 99%	34,455	103.6%
Very High	top 1%	75,329	226.5%

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

4.6 Health Insurance

Based on the MEPS, private health insurance provides various expenditure coverage rates depending on the age and amount of medical expenditure. I use the report provided in Jeske and Kitao (2009) to set the expenditure coverage rates of PHI (both IHI's $\omega_p(x)$ and EHI's $\omega_e(x)$) as $(.528\ .702\ .765\ .845)$ for the young agent's four medical expenditure states, respectively, and set Medicare's $\omega_o(x)$ as $(.315\ .511\ .637\ .768)$ for old agents' four medical expenditure states. Every old agent is assumed to be enrolled in Medicare. According to the report, "Medicare: A Primer 2010," from the Kaiser Family Foundation, Medicare premiums contributes only 12% of the total Medicare expenditure. The ratio of total the Medicare cost is used for setting the premium q_{med} in the model.

The PHI serves as the primary insurance in the benchmark economy. The markup ψ of PHI in the benchmark economy is chosen so that there are 75% of non-elderly agents taking up PHI (including EHI and IHI), which is set to match the PHI coverage among the 21-64 age group according to the 2003 MEPS. According to the 1996-2008 MEPS

Table 4: Transition probabilities of X_y

	Low	Fair	High	Very High
Low	0.784	0.199	0.014	0.003
Fair	0.337	0.591	0.062	0.009
High	0.173	0.562	0.200	0.065
Very High	0.105	0.376	0.286	0.233

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

Table 5: Transition probabilities of X_o

	Low	Fair	High	Very High
Low	0.762	0.217	0.019	0.003
Fair	0.368	0.551	0.062	0.018
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).

data the PHI take up ratio shows a slightly declining trend over time. The ratio was 77% in 1996, 75% in 2003 - 04, and fell to 73% in 2008. I choose the 2003 ratio to calibrate ψ so that the year is consistent with the medical shock and EHI offer processes, which are set based on the report in Jeske and Kitao (2009).

4.7 Social Security and Government Taxation

The social security payment is set as 45% of average labor income according to the study by Whitehouse (2003). Based on İmrohoroğlu and Kitao (2009 and 2010), the consumption tax rate is set at 5%, the capital income tax is 30%, the total labor income tax rate is 35% (including Social Security tax and Medicare tax) and the government debt to output ratio is set at40%.

Table 6: Summary of parameters for the benchmark economy

Parameter	Description	Values	Target/Note
Preferences			
β	discount factor	0.962	capital-output ratio = 3
μ	relative risk aversion	3	
ϕ	utility parameter	0.400	average labor hours = 0.33
Technology and production			
θ	capital income share	0.33	
δ	depreciation rate of capital	0.06	
Demographics			
ρ_o	probability of aging/retiring	0.222	average years of working = 45
ρ_d	probability of death after retirement	0.889	share of old population = 0.2
Government			
τ_c	consumption tax rate	0.05	
$\tau_n + \tau_{ss}$	total labor tax	0.35	
τ_k	capital tax	0.30	
ss	Social Security payment	45% of average earnings	
$\underline{c}$	social insurance consumption floor	15% of GDP per capita	
D	government debt	40% of GDP	
Health insurance			
q_{med}	Medicare premium	12% of average Medicare cost	
ψ	PHI premium markup	0.035	PHI take up ratio = 0.75

5 Quantitative Analysis

The model is solved for its steady-state equilibrium, and simulations are performed for quantitative analysis. This section first describes the equilibrium features in the benchmark economy and demonstrates that Starr-McCluer's empirical finding is generated by the model.[11]

This model, which has risk-averse agents, as in a standard consumption-saving model, with taking into account institutional factors, suggest that social insurance and EHI can account for the positive insurance-saving correlation. Counterfactual experiments are also performed to understand the roles of the two institutions better. Implications for empirical tests are discussed as well.

5.1 Is a Positive Insurance-Saving Correlation Puzzling?

5.1.1 Features of the Benchmark Economy

The benchmark economy represents the US economy, particularly the features of the health insurance market. Given that the model is calibrated to match the capital-output ratio, average labor supply, and the PHI take-up ratio among the young agents, the fraction of total population covered by health insurance (including EHI, IHI, and Medicare) is 80% (first panel of Table 7). In addition, the second panel of Table 7 further shows asset holdings according to health insurance type for insured agents compared with those of uninsured agents (whose asset holdings are normalized to one). Those covered by EHI, on average, hold 61% more assets than the uninsured, and those covered by PHI hold 22% more. Consequently, the unconditional means have shown that young agents, who have insurance coverage (either EHI or IHI), save more than those without insurance coverage. All old agents are covered by Medicare and their asset holdings are less than those of the uninsured (young) agents (see a_{med}/a_{un} in Table 7), because old agents are retired and no longer encounter any income uncertainty. However, old agents, face a probability of leaving the economy (death), and therefore – they dissave.

Table 8 presents insurance coverage and take-up ratios. The majority of PHI is employment-based, which is a feature of the US health insurance market. If EHI is offered, most agents (96%) will accept it (see the 4th column of Table 8) since the premium of EHI is highly subsidized by employers. The take-up ratio of EHI offers is

[11]Given the equilibrium prices, the solved individual decision rules and shock processes are adopted to simulate an individual's period choices for 200,000 rounds. The first 15,000 observations are discarded to prevent the bias caused by the initial condition, and the remaining observations are used to approximate the cross-sectional distribution in the economy.

Table 7: Benchmark: Aggregate features

Capital-output ratio	Interest rate	Aggregate labor hours	Total insured ratio
3	4.87%	0.33	0.80

Asset holdings by insurance status

a_{EHI}/a_{un}	a_{IHI}/a_{un}	a_{PHI}/a_{un}	a_{med}/a_{un}
1.61	1.22	1.54	0.70

Notes: a_i/a_{un} is the ratio of average asset holdings of agents covered by type i health insurance to that of the uninsured. PHI includes EHI and IHI. $\mu = 3$ and $\underline{c} = .15\bar{y}$.

slightly lower than that (99%) in Jeske and Kitao (2009). Because agents are considered to adjust their labor supply as an additional tool to smoothen consumption, they can rely less on health insurance. This result is consistent with the report in Fronstin (2007) that states, from 1995 to 2005, if EHI from a spouse's employers and former employers are included, the take up ratio is about 95%.[12] In contrast, only 37% of those without an EHI offer purchase a private IHI plan, so that the proportion of individuals with PHI coverage is 75% in the working-age population.

In addition, PHI coverage is generally increasing by income level, as presented in the second panel of Table 8. This pattern is primarily driven by the greater probability of receiving an EHI offer with a better job position (i.e., a higher labor productivity level in the model). The PHI take up ratio in the top income group (93%) is slightly lower than that in the second highest income group (95%), because the impact of the medical shock on income is relatively less for the high-income agents that reduces the demand for health insurance.

5.1.2 Empirical Testing

Although the statistics of mean asset holdings show that the insured save more than the uninsured, to identify the effect of private health insurance on savings exclusively and to test the precautionary saving hypothesis, empirical studies use econometric methods that

[12]Fronstin (2007) reported that among those workers eligible for EHI, between 84 percent to 86 percent had coverage in their own name from their own employer. Approximately 10 percent were covered by a different employer, which in most cases was a spouse's employer, and in some cases was a former employer. The remainder (generally less than 2 percent) either purchased insurance on their own or were covered by a public program.

Table 8: Benchmark: Health insurance coverage (working-age population)

Insurance type	PHI insured ratio	EHI insured/ total PHI	IHI insured/ total PHI	EHI take-up (if offered)	IHI take-up (w/o EHI)
Ratio	0.75	0.81	0.19	0.96	0.37

PHI coverage across income levels

Income level	Bottom 20%	2nd 20%	3rd 20%	4th 20%	Top 20%
Coverage	0.40	0.60	0.86	0.95	0.93

Note: PHI includes both EHI and IHI.

control for other characteristics. I follow this approach with the model economy, and therefore I am able to provide a comparison with the empirical finding in the literature.

I use the data generated from model simulation for regressions (with a sample size of 185,000 observations for each regression). The regression model is set as follows:

$$a_{i,t} = \alpha PHI_{i,t} + \beta' Q_{i,t} + \varepsilon_{i,t}, \tag{20}$$

where $a_{i,t}$ is a young agent i's asset holdings at time t, $PHI_{i,t}$ is a dummy variable of private 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.[13] According to the standard consumption-saving model, a negative coefficient of PHI (i.e. $\alpha < 0$) would be interpreted as verification of the existence of precautionary saving. In the model economy, household characteristic vector Q simply contains two factors: labor income (which is primarily determined by the labor productivity shock) and medical expenditure.[14]

The regression result for the benchmark economy is reported on the first row of Table 10. The coefficient of health insurance coverage (including EHI and IHI) is also significant positive and consistent with Starr-McCluer's (1996) finding. However, the interpretation of the result based on this model differs significantly from the conventional interpretation in that a significant and positive coefficient of health insurance in the above regression implies a rejection of the existence of precautionary saving. This

[13] See the control variables used in Starr-McCluer (1996), for examples.

[14] The unit for asset holdings, labor income, and medical expenditures is \$1,000. Using this kind of regression model as a basis, Starr-McCluer (1996) estimated the above asset holding equation (20) by controlling for the estimated permanent income, health problems, and other household characteristics as independent variables in $Q_{i,t}$, and reported a significant positive coefficient of PHI using US cross-section data for the working-age population.

interpretation is not always correct. As shown in the above exercise, in the model economy, the regression model is unable to actually reveal the existence of precautionary saving in an economy with a social insurance system and an employment-based health insurance system.

5.1.3 The Mechanism

The reason for the invalidity of the empirical test is that the regression model can only capture the net saving effect of health insurance, rather than the exclusive effect on precautionary saving.

This model suggests two institutional factors, the social insurance and the EHI systems, can account for the positive saving effect of PHI.

As discussed in Hubbard et al. (1995), the social insurance system creates a strong disincentive to save because it reduces the risk as well as the need for precautionary savings, particularly among those low-income agents. For the same reason, social insurance also substitutes the service provided by PHI, and therefore creates a positive correlation of PHI take-ups and savings by reducing both. In addition, the availability of health insurance coverage (e.g., EHI from employers) moderates the fluctuation of disposable resources caused by medical expenditure shocks and therefore reduces the likelihood of accessing the social insurance that increases the expected return of asset holdings and leads to a positive effect on savings.

The nature of EHI also creates a positive correlation between insurance coverage and savings. Because the EHI offer is uncertain (highly contingent on employment/income status) and mean-reverting, agents currently covered by health insurance are in a good state and therefore will save for a precautionary motive to smooth their consumption in case they move to the bad state without EHI.

In what follows, I first demonstrate that the result is robust with alternative risk aversion settings, and then I further diagnose the failure of the standard regression model by performing counter-factual experiments. Implications of this model for the assessment of the empirical approaches to testing the precautionary saving hypothesis will be also discussed.

5.1.4 Robustness Check

Economies with alternative risk aversion are evaluated. In particular, a less risk-averse case with $\mu = 2$ and a more risk-averse case with $\mu = 4$ are investigated. The same empirical exercise is applied to each economy. Table 9 shows the aggregate features of the two alternative economies. As expected, with all other parameters fixed, a lower μ

Table 9: Robustness check: Aggregate features

Economy with $\mu = 2$				
Capital-output ratio	Interest rate	Aggregate labor hours	Total insured ratio	a_{PHI}/a_{un}
2.92	5.30%	0.32	0.71	1.62

Economy with $\mu = 4$				
Capital-output ratio	Interest rate	Aggregate labor hours	Total insured ratio	a_{PHI}/a_{un}
3.19	4.35%	0.33	0.84	1.65

Notes: a_{PHI}/a_{un} is the ratio of average asset holdings of agents covered by PHI to that of the uninsured. PHI includes both EHI and IHI.

leads to less precautionary savings and therefore a lower capital-output ratio as well as higher interest rate; the total health insurance take up ratio is also lower. in contrast, a higher μ leads to a higher capital-output ratio, a lower interest rate and a higher health insurance take up ratio. In Table 10 the second row presents the regression result of the economy with $\mu = 2$, and the third row presents the result of the economy with $\mu = 4$. The coefficients of the health insurance coverage are significant and positive in both cases with alternative risk aversion.

5.2 Implications for Empirical Testing – Roles of the Institutions

It is natural to ask in what condition a regression model like the above is appropriate for testing precautionary saving. Counterfactual experiments are performed in this subsection to examine the roles of each institutional factor that can affect insurance-saving pattern. First I investigate an economy with minimal social insurance and an economy without EHI. Various degrees of social insurance in economies with and without EHI are further studied to thoroughly examine the appropriateness of the empirical testing. An income-tested social insurance (compared with the means-tested system in the benchmark) is also examined.

5.2.1 Counterfactual Experiment: Eliminating Social Insurance

With a positive probability, the medical expenditure shock will bring an agent's net wealth to a negative value that leads to negative consumption under the borrowing con-

Table 10: Regression results: Robustness check

Explanatory variable	**HI coverage**	Labor income	Medical shock
The benchmark ($\mu = 3$)			
Coefficient	**2.86**	0.74	−0.34
Robustness check: $\mu = 2$			
Coefficient	**3.72**	0.67	−0.49
Robustness check: $\mu = 4$			
Coefficient	**3.68**	0.74	−0.28

Notes: (1) social insurance system: $\underline{c} = .15\bar{y}$.
(2) All coefficients are significant at the 5% level.

straint in the model; there must be some social assistance to prevent this negative consumption situation. For a counterfactual experiment, instead of eliminating the entire social insurance system, which would cause a technical problem, I consider a minimal social insurance system, setting the wealth floor $\underline{c}$ as 1% of average income. All other parameters are kept the same as those in the benchmark.

The aggregate features are presented in Table 11. Without the original social insurance, agents can barely rely on this social assistance when they experience a bad shock, and therefore have a stronger incentive to save and to purchase health insurance. Consequently, a higher capital-output ratio and a higher total insured ratio (which is driven by a higher PHI take-up ratio) are observed. The unconditional mean of asset holdings of agents covered by PHI is now higher than that of uninsured agents. This result greatly deviates from the benchmark.

The same regression model is applied to control for other factors and the result is shown in the second row of Table 12. In contrast to the benchmark, the regression in this economy with minimal social insurance does show a significant negative coefficient of PHI coverage, which supports the precautionary saving hypothesis.

5.2.2 The Size of Social Insurance Benefits

Health insurance has a positive saving effect by reducing the likelihood of accessing the social insurance, although it also has a negative saving effect by substituting precautionary savings. The net effect on saving , as captured by the above regression, is therefore ambiguous.

Table 11: Counterfactual experiments: Aggregate features

(1) Economy with minimal social insurance				
Capital-output ratio	Interest rate	Aggregate labor hours	Total insured ratio	Asset holdings a_{PHI}/a_{un}
3.53	3.36%	0.36	0.95	0.66
(2) Economy without EHI				
Capital-output ratio	Interest rate	Aggregate labor hours	Total insured ratio	Asset holdings a_{PHI}/a_{un}
2.96	5.16%	0.33	0.66	0.82

Notes: a_{PHI}/a_{un} is the ratio of average asset holdings of agents covered by PHI to that of the uninsured. PHI includes both EHI and IHI. The social insurance $\underline{c} = .15\bar{y}$ in the benchmark and in case (2); $\underline{c} = .01\bar{y}$ in case (1).

I perform experiments with various sizes of social insurance benefits represented by alternative settings of the wealth floor $\underline{c}$, for further investigation. The same empirical approach is applied to each economy, and the results are presented in Table 13. The results indicate that when the social insurance is large, i.e., cases of $\underline{c}$ set at 15% average income and above, the positive saving effect dominates and the (net) saving effect of health insurance captured by the regression becomes positive.

5.2.3 Counterfactual Experiment: Eliminating EHI

An alternative experiment is eliminating the EHI system. Without the EHI offer, the total insured ratio is lower than in the benchmark because agents have to purchase IHI with no subsidy (see the second panel of Table 11). It is also observed that the unconditional mean of asset holdings of agents covered by PHI is higher than that of uninsured agents.

The same regression model is applied and the result is shown in the third row of Table 12. The regression result of this economy without EHI also presents a significant negative coefficient of PHI coverage, which supports the precautionary saving hypothesis.

Because the EHI offer is uncertain and contingent on employment status, an agent receiving the EHI offer currently will have an incentive to save as a precautionary measure against the possibility of moving to a worse job position lacking EHI. This feature reinforces the positive saving effect of health insurance. The counterfactual experiment suggests that the positive net saving effect of PHI coverage is no longer maintained when the EHI system is eliminated.

Table 12: Regression results: Counterfactual experiments

Explanatory variable	**HI coverage**	Labor income	Medical shock
The benchmark			
Coefficient	**2.86**	0.74	−0.34
Counterfactual (1): minimal social insurance			
Coefficient	−**8.57**	0.98	−0.37
Counterfactual (2): EHI unavailable			
Coefficient	−**3.92**	0.81	−0.70

Notes: Social insurance: $\underline{c} = .01\bar{y}$ in case (1); $\underline{c} = .15\bar{y}$ in case (2). All coefficients are significant at the 5% level.

Experiments with various sizes of social insurance benefits in economies without EHI are also performed to provide a further investigation. The same empirical approach is applied to each economy, and the results are presented in Table 14. In the case that EHI is unavailable, only when the social assistance is large, e.g., $\underline{c}$ set at 25% and 30% of average income in the last two columns of Table 14, a positive saving effect of PHI coverage will be observed.

5.2.4 Alternative Social Insurance Scheme: Income-testing

In the benchmark and the analysis above, the scheme of social insurance is set up as that in Hubbard et al. (1995), which is means-tested. In addition to the fact that the social insurance reduces the need for precautionary savings, the means test also discourages savings. To discover whether the means-testing scheme affects the result, I consider an alternative, an income-tested social insurance system, in the model economy for comparison. The transfer scheme, equation (12), in the benchmark model is changed to an income-testing scheme as follows:

$$TR = \max\{0,\ (1+\tau_c)\underline{c} - \tilde{y}\}, \tag{21}$$

where $\tilde{y}$ is the net income after tax and medical expenditure and is defined as

$$\tilde{y} = (1-\tau_{ss}-\tau_n)\hat{LI} + (1-\tau_k)\,r(a+b) - (1-\hat{\omega})\,x'$$

for young agents, and

$$\tilde{y} = ss + (1-\tau_k)\,r(a+b) - \left[1-\omega_o(x')\right]x' - q_{med}$$

Table 13: Regression results: Various sizes social insurance benefits

Variable	Size of social insurance system ($\underline{c}$)						
	$\underline{c} = .01\bar{y}$ (minimal)	$.05\bar{y}$	$.10\bar{y}$	$.15\bar{y}$ (bench)	$.20\bar{y}$	$.25\bar{y}$	$.30\bar{y}$ (large)
HI coverage	**−8.57**	**−3.28**	**−0.80**	**2.86**	**2.78**	**3.51**	**6.25**
Labor income	0.98	0.98	0.93	0.74	0.68	0.61	0.36
Medical shock	−0.37	−0.38	−0.35	−0.34	−0.41	−0.37	−0.31

Notes: (1) $\bar{y}$ is average income.
(2) All coefficients are significant at the 5% level.

Table 14: Regression results: Economies without EHI

Variable	Size of social insurance system ($\underline{c}$)				
	$\underline{c} = .10\bar{y}$	$.15\bar{y}$	$.20\bar{y}$	$.25\bar{y}$	$.30\bar{y}$
HI coverage	**−11.86**	**−3.93**	**−0.89**	**0.21**	**0.43**
Labor Income	0.79	0.81	0.68	0.61	0.56
Medical Shock	−0.72	−0.70	−0.82	−0.87	−0.87

Notes: (1) $\bar{y}$ is average income.
(2) All coefficients are significant at the 5% level.

for old agents. Asset holdings now are not considered for receiving the social insurance benefits. Medical expenditures remain covered by social insurance to prevent consumption from becoming negative. The income floor $\underline{c}$ remains set at 15% of average income, and the regression result appears in the second panel of Table 15. The PHI coverage still has a significant and positive effect on saving, which indicates that the substitution effect of the social insurance on saving is more important than the means test. The alternative income-testing scheme does not change the result from that in the benchmark.

6 Concluding Remarks

Considering a standard model of precautionary saving, a puzzling positive correlation between private health insurance coverage and household asset holdings in the US has been reported by Starr-McCluer (1996). This study suggested that the puzzling finding can be explained by the existence of two institutions: a large social insurance (safety

Table 15: Regression results – alternative social insurance scheme

Explanatory variable	**HI coverage**	Labor income	Medical shock
The benchmark			
Coefficient	**2.86**	0.74	−0.34
Income-tested social insurance			
Coefficient	**3.81**	0.54	−0.16

Notes: (1) social insurance system: $\underline{c} = .15\bar{y}$.
(2) All coefficients are significant at the 5% level.

net) system and an employment-based health insurance system. In order to analyze this issue, I built a dynamic stochastic general equilibrium model that incorporates these two institutions with heterogeneous agents making decisions regarding saving, labor supply, and health insurance endogenously. I showed that the model can generate the same empirical finding as found in Starr-McCluer (1996). This result does not depend on the assumptions of heterogeneity of risk aversion/preferences.

These findings call into question the appropriateness of the empirical approaches directly based on the standard consumption-saving theory for testing the precautionary saving hypothesis. Applying the empirical approach in the model economy, the regression result is consistent with Starr-McCluer's empirical finding, but the positive coefficient of PHI coverage does not imply the nonexistence of precautionary saving. In fact, households do have a motive to engage in precautionary saving in the model economy. The regression result must be interpreted carefully, because the regression model captures the net saving effect of health insurance, rather than the effect on precautionary savings exclusively. To appropriately test for the existence of precautionary saving or investigate the substitution effect of insurance on precautionary savings, it is necessary to control for the effects caused by these institutional factors. The counter-factual experiments have demonstrated that if either the social insurance or the EHI system is eliminated, the regression would generate a negative coefficient of PHI coverage that supports the precautionary saving hypothesis. The analysis in this study indicates that an economy with a low-level social assistance and without the feature of employment-based insurance coverage would be a better environment for conducting an empirical study regarding this issue. Nevertheless, in practice it is generally difficult to distinguish the effect on saving caused by the institutions from the effect of insurance on precautionary saving. Further research is required to resolve this difficulty.

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