

# Front-loaded contracts in health insurance market: How valuable is guaranteed renewability?

*Preliminary and Incomplete*

Svetlana Pashchenko\*

Ponpoje Porapakarm†

University of Virginia

University of Macau

March 13, 2011

## **Abstract**

Reclassification risk is considered to be a major market failure in the health insurance market. We study whether a partial elimination of this risk through guaranteed renewable contracts can significantly improve welfare? Reclassification risk arises because health conditions of individuals evolve over time. Any change in health status will lead to a change in the price of health insurance when only short-term risk-adjusted insurance contracts are available. Guaranteed renewable contracts provide protection against reclassification risk because they allow individuals to renew health insurance in the future at a fixed premium. We use a general equilibrium model to quantify the implications of introducing this type of contracts into the economy calibrated to replicate the key features of the health insurance sector in the U.S. We find that once guaranteed renewable contracts become available most of the people buying individual insurance switch to these new contracts. In addition, the number of uninsured drops substantially. However, the welfare effects from introducing guaranteed renewable contracts are small. We explore several factors potentially accounting for the small welfare effects, namely i) the degree of front-loading, ii) labor income risk, iii) actuarial unfairness, and iv) minimum consumption floor. Our quantitative results show that the consumption minimum floor can significantly affect the value of guaranteed renewable insurance since it provides a safety net in states when one's health deteriorates and health insurance becomes unaffordable.

---

\*Email: sap9v@virginia.edu

†Email: ponpojep@umac.mo

Keywords: health insurance, reclassification risk, dynamic insurance, guaranteed renewable contracts, general equilibrium

JEL Classification Codes: D52, D58, D91, E65, G22, I11

## 1 Introduction

An important feature of the health insurance market is that a typical insurance policy lasts for one year while a disease can last for any period of time. This creates a problem of reclassification risk - a risk to face a drastic increase in health premiums when health status deteriorates. The fact that standard health insurance contracts leave individuals exposed to reclassification risk is considered an important market failure in the individual health insurance market (Hendel and Lizzeri, 2003; Diamond, 1992). The goal of this paper is to evaluate how important is the lack of protection against reclassification risk for the functioning of the individual insurance market and for the welfare of consumers. More specifically, we consider how much welfare improvement can be achieved from introducing guaranteed renewable contracts in the individual health insurance market. Guaranteed renewable contracts are not the first best solution to the problem of reclassification risk. However these are the only private insurance contracts in a competitive market that can provide a protection against reclassification risks in the absence of consumer commitment. Guaranteed renewable contracts are front-loaded: consumers are required to prepay part of his future premiums and this prepayment locks him into the contract. In return a consumer is guaranteed that i) he will be able to renew his health insurance contract in the future; ii) the renewal price will be independent of his future health realizations.

Guaranteed renewable contracts are very common in life insurance. Almost all policies in the U.S. life insurance markets involve some degree of front-loading (Daily et al, 2008). Herring and Pauly (200) found an evidence that guaranteed renewable contracts are offered in the individual health insurance market. However, it is unclear whether this type of contracts can become as important for health insurance markets as for the life insurance (Hendel and Lizzeri, 2003; Diamond, 1992).

We construct a general equilibrium overlapping generations model where people face uninsurable labor income risk and medical expenses risk that can be partially insured. Several types of health insurance are available. First, some individuals have access to employer-based insurance. Second, lowest-income individuals can get Medicaid. Finally, all individuals can buy insurance policy directly in the individual market. In the individual market premiums are risk-rated i.e. depend on the current health conditions of the individuals. All policies last for one year while medical expenditures are persistent which creates the problem of reclassification risk.

Our model reflects three institutional features that are important when studying

front-loaded contracts in the U.S. health insurance markets. First, a large fraction of non-elderly adults gets their insurance from employer-based market. This market is community rated, i.e. premiums are independent of health conditions of individuals. People with permanent access to this market are protected from the risk of premium fluctuations. Also, lowest-income individuals can get public insurance from Medicaid for free. The possibility to get access to employer-based or public insurance decreases demand for contracts that provide reclassification risk protection. Second, for low-income people health insurance premiums constitute a large fraction of income (Pashchenko, Porapakarm, 2010). Front-loaded contracts are more expensive than standard ones and this makes the problem of affordability more severe. Third, for people who find themselves in the situation of high medical shock and/or low labor income government provides protection in the form of the consumption minimum floor. This consumption floor can crowd out demand for long-term health insurance contracts because it makes the payout in the state of being in bad health less valuable.

We calibrate the model using Medical Expenditure Panel Survey dataset to match the key insurance statistics for the U.S. Using the calibrated model we study quantitative implications of introducing guaranteed renewable contracts in the individual market.

We find that comparing to the situation when only standard short-term insurance contracts are available introduction of guaranteed renewable contracts can decrease uninsurance rates almost twice - from 21.3% to 13.5% due to a higher participation in the individual insurance market. Also, if both standard and guaranteed renewable contracts are available more than 80% of consumers would prefer to buy the later type of contracts. This suggests that protection against reclassification risk is an important consideration when making health insurance purchase decision. However, in terms of welfare we find that introduction of guaranteed renewable contracts brings only small ex-ante welfare gain. People who gain the most from the availability of guaranteed-renewable contracts are those with high-income. However, from the ex-ante perspective it is low income people who drive the welfare results. For this group the introduction of a new insurance option makes a small difference. Guaranteed renewable contracts cost a lot relative to their income. Also these contracts make most sense to buy when one is relatively healthy thus fixing insurance price at a low level. Because contracts are expensive one needs to accumulate a buffer stock of savings before buying it. By the time low income people accumulate enough savings, their health conditions may deteriorate making guaranteed renewable contract much less appealing. In addition, the consumption minimum floor protects people against the situation when their health deteriorates and insurance becomes unaffordable thus decreasing the need for guaranteed renewable contracts.

Our results are robust to i) the presence of the group insurance and Medicaid; ii) different degree of front-loading for guaranteed renewable contracts; iii) the degree of

actuarial unfairness in the insurance market. The welfare gains from guaranteed renewable contracts are very sensitive, however, to the size of the consumption minimum floor. If government means-tested transfers are reduced to 5% of the baseline level, the welfare gains from introducing guaranteed renewable contracts are more than 1% of annual consumption.

This paper is structured as follows. Section 2 reviews related literature. Section 3 illustrates main ideas behind guaranteed renewability using a simple example. Section 4 presents the model. Section 5 explains our calibration. Section 6 discusses the results. Section 7 concludes.

## 2 Related literature

This paper belongs to two strands of literature. First, is the literature studying how private markets can provide insurance against reclassification risk if buyers cannot commit to a contract. A seminal paper in this area is Cochrane (1995) who characterizes a set of contracts that can provide long-term health insurance in such an environment. His insight is to combine standard one-period insurance contracts with premium insurance, i.e. insurance against future premium fluctuations. One requirement for such premium insurance to work is that each consumer opens a special account that works as a clearing house between him and an insurance company. An important condition is that consumers cannot freely withdraw money from this account. One special case in these set of contracts that can work without a special account are front-loaded guaranteed renewable contracts. These contracts were studied in more details by Pauly et al (1995) who showed that guaranteed renewable contracts can provide a good degree of reclassification risk insurance without creating liquidity problem if consumers buy them while still young and healthy. On the empirical side of the literature, front-loaded contracts were studied by Hendel and Lizzeri (2003) for life insurance markets. They showed that the structure of premiums in this market is consistent with front-loaded contracts that emerge in the absence of consumer commitment. Finkelstein et al. (2005) studied front-loaded contracts in the long-term care insurance market and showed that the amount of front-loading currently existing is not enough to lock consumers into the contracts. To our knowledge our paper is the first one that studies quantitative implications of the introduction of guaranteed renewable contracts in the health insurance markets in a general equilibrium framework.

The second strand of literature this paper is belongs to is a quantitative heterogeneous agents models with incomplete markets augmented by both medical expenses shocks and health insurance markets where these shocks can be partially insured. This branch of incomplete market literature emerged recently and includes papers by Kitao and Jeske

(2009) who study subsidies for employer-based insurance, Feng (2009) who studies alternative ways to reform the U.S. health insurance system, Pashchenko and Porapakarm (2010) who study the current health reform in the U.S. These studies consider the environment when only standard one-period contracts are available in the individual health insurance market. Our contribution to this literature is to allow for both standard and guaranteed renewable contracts to be offered in the market.

### 3 Simple illustration

This section constructs a simple example that illustrates the idea behind a guaranteed renewability provision. Consider an individual whose health is good and the price he faces for the standard one-period health insurance contract is  $p_L$ . Next period with a probability  $v$  an individual can still be in good health in which case his health insurance premium will stay unchanged. However with a probability  $1 - v$  his health status may deteriorate. If this happens his health insurance premium for the standard contract will rise to  $p_H$ , where  $p_H > p_L$ . If an individual buys a standard one-period contract to insure his health expenditures he is exposed to reclassification risk - the risk that his health premium will rise from  $p_L$  to  $p_H$ .

Consider how a guaranteed renewable contract can work in this environment. Suppose an individual can buy a contract at a price  $p^{GR}$  that do two things. First, it insures his medical expenditure within one period like a standard one-period contract. Second, it guarantees that next period an individual can buy health insurance at the unchanged price  $p^{GR}$  *regardless of his health status realization*. If his health status stays the same he can buy standard contract at a price  $p_L$ . However, if his health status deteriorates he can renew his guaranteed renewable contract at a price  $p^{GR} < p_L$ . Under the assumption of perfect competition in the insurance market the price of a such guaranteed renewable contract is determined in the following way:

$$p^{GR} = p_L + (1 - v)(p_H - p^{GR}). \quad (1)$$

Note, that guaranteed renewable contract is more expensive than a regular one-period contract because of the front-loading part  $(1 - v)(p_H - p^{GR})$ . This front-loading takes into account the fact that an insurance buyer can become unhealthy but the renewable premium cannot be readjusted.

## 4 Model

### 4.1 Households

#### Demographics and preferences

The economy is populated by two overlapping generations: young and old. A young individual stays young with a probability  $\zeta^y$  and becomes old with a probability  $1 - \zeta^y$ . An old individual survives to the next period with a probability  $\zeta^o$ . The population is assumed to remain constant. Old agents who die are replaced by the entry of new young agents.

An individual discounts his future utility by the discount factor  $\beta$ . Preferences are described by CRRA utility function with the risk aversion parameter  $\sigma$ :

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma}.$$

#### Health insurance

An individual's health status  $h$  is indexed by  $\{1, 2, \dots, H\}$ . The increasing numbers imply deteriorating health status. Health status evolves according to a  $H$ -state Markov process,  $G(h'|h)$ . An individual's current health status determines his current medical expenditures  $x(h)$  where  $x$  is a deterministic and strictly monotone-increasing function different for young and old.

Each young individual can buy insurance against medical expenditures in the individual insurance market where two types of contracts are offered. The first type is a standard one-year contract that covers next period medical expenditures. The price of this contract depends on the current health status of an individual and is denoted by  $p^{std}(h)$ . The second type of contract is guaranteed renewable. This contract covers the same fraction of next period medical expenditures as a standard one-year contract. In addition a guaranteed renewable contract provides an option to renew the insurance in the future at the same premium regardless of the future health status. Guaranteed renewable contracts do not have a termination date, i.e. an individual can renew the same contract for as long as he is still young. However an important condition for an individual to be able to renew this contract is a continuous participation. In other words if individual does not exercise his right to renew the contract once, he loses the guaranteed renewable right. Like the standard one-year insurance, the premium of a newly issued guaranteed renewable contract is a function of the current health status of an individual. The premium of a guaranteed renewable contract that is renewed is a function of the health status of an individual at the moment when the contract was originated.

In each period with some probability young individual gets an option to buy employer-

sponsored health insurance (ESHI). We denote by  $g$  whether an individual has this option or not:  $g = 1$  if an individual gets an ESHI offer,  $g = 0$  if he does not. The out-of-pocket premium of employer-based insurance is equal to

$$\bar{p} = (1 - \alpha)p.$$

Here  $p$  is the total premium charged to all participants in the employer-based pool.  $\alpha$  is the fraction of this premium paid by the employer.

Low-income individuals are eligible to enrol in Medicaid that provides health insurance at no costs<sup>1</sup>. To become eligible for Medicaid an individual's total resources net of out-of-pocket medical expenses must be below a certain level denoted by  $y^{pub2}$

We use  $i$  to index the current health insurance status as following:

$$i = \left\{ \begin{array}{ll} -2 & ; \text{ if uninsured} \\ -1 & ; \text{ if insured through public insurance} \\ 0 & ; \text{ if holding a standard one-period insurance or ESHI} \\ 1, 2, \dots, H & ; \text{ if holding a guaranteed renewable contract originated when his health} \\ & \text{ status equals } i. \end{array} \right\}$$

If individual holds a guaranteed renewable contract,  $i$  keeps track of an individual's health status when he first bought it. We denote the premium of a guaranteed renewable insurance as  $p^{GR}(i)$  for  $i = \{1, 2, \dots, H\}$ .

If a young person is insured, the insurance will cover a fraction of his current medical expenses denoted by  $q(i, x)$ . This fraction is a function of the current insurance status and medical expenditures.

All retired households are enrolled in the Medicare. Medicare charges a premium of  $p^{med}$ . We denote the fraction of medical expenses covered by the Medicare by  $q^{med}(x)$ .

## Labor income

A young individual supplies labor inelastically. His earnings are  $\tilde{w}z$ , where  $\tilde{w}$  is wage and  $z$  is his idiosyncratic productivity. We model the productivity and an ESHI offer status as a joint Markov process<sup>3</sup>. The productivity of the old is set to zero.

<sup>1</sup>In reality Medicaid program requires a person to meet both income eligibility and categorical eligibility. The categorical eligibility mainly requires a person to have a child or being a pregnant woman. Since our model abstracts from a family structure, we assume that Medicaid requires only income eligibility.

<sup>2</sup>Many states allow an individual to subtract his medical expenses from his income before applying for the Medicaid, called medical needy category. Our income eligibility reflects the medical needy eligibility.

<sup>3</sup>In the data the probability of getting an ESHI offer is positively correlated with labor income.

## Taxation and social transfers

Households pay income taxes  $\mathcal{T}(y)$ . The taxable income  $y$  is based on both labor income and capital income. Since the ESHI premium is tax-deductible, a household who buys a group insurance can subtract  $\bar{p}$  from his taxable income.

We also assume a social welfare system,  $T^{SI}$ . The social welfare system guarantees that a household will have a minimum consumption level at  $\underline{c}$ . This reflects public transfer programs in the U.S., for examples food stamps, Supplemental Security Income (SSI) program. Old individuals are retired and receive a social security benefit ( $ss$ )

## Optimization problem

**Retired individuals** For an old individual, his state variables are liquid capital ( $k \in \mathbb{K} = R^+ \cup \{0\}$ ) and health status ( $h \in \mathbb{H} = \{1, 2, \dots, H\}$ ). The value function of the old can be written as follows:

$$\mathbf{V}^o(k, h) = \max_{c, k'} u(c) + \beta \zeta^o E_t \mathbf{V}^o(k', h') \quad (2)$$

$$s.t. \quad k(1+r) + ss + T^{SI} = c + k' + x(1 - q^{med}(x)) + p^{med} + \mathcal{T}(y) \quad (3)$$

where

$$\begin{aligned} T^{SI} &= \max(0, \underline{c} + x(1 - q^{med}(x)) + \mathcal{T}(rk + ss) + p^{med} - ss - k(1+r)) \\ y &= rk + ss \end{aligned} \quad (5)$$

The problem of a newly retired household is slightly different from a retired household since he is still covered by his pre-retirement insurance. The difference lies in the state variables and the out-of-pocket medical expenditure. For the newly retired, the state variables are  $\{k, h, i\}$  and  $x(1 - q^{med}(x))$  in the budget constraint is replaced by  $x(1 - q(i, x))$ .

**Young individuals** The state variables for a young individual are liquid capital ( $k \in \mathbb{K} = R^+ \cup \{0\}$ ), health status ( $h \in \mathbb{H} = \{1, 2, \dots, H\}$ ), idiosyncratic labor productivity ( $z \in \mathbb{Z} = R^+$ ), ESHI offer status ( $g \in \mathbb{G} = \{0, 1\}$ ), and index for health insurance status ( $i \in \mathbb{I} = \{-2, -1, 0, 1, 2, \dots, H\}$ )

Each period an individual chooses his consumption ( $c$ ), saving ( $k'$ ), and health insurance choice for the next period ( $i^H$ ). Depending on Medicaid eligibility and ESHI offer, he can choose not to buy any insurance ( $NB$ ), buy a guaranteed renewable contract ( $BGR$ ), buy a standard individual policy ( $BI$ ), buy a group insurance ( $BG$ ), or enroll



in Medicaid ( $BM$ ). We summarize the insurance choices as following.

$$i^H = \left\{ \begin{array}{ll} BGR, BI, BG, BM & ; \quad \text{if } g = 1 \text{ and eligible for Medicaid} \\ BGR, BI, BM & ; \quad \text{if } g = 0 \text{ and eligible for Medicaid} \\ NB, BGR, BI, BG & ; \quad \text{if } g = 1 \text{ and not eligible for Medicaid} \\ NB, BGR, BI & ; \quad \text{if } g = 0 \text{ and not eligible for Medicaid} \end{array} \right\} \quad (6)$$

The value function of a working-age household can be written as follows:

$$\mathbf{V}^y(k, h, z, g, i) = \max_{c, k', i^H} u(c) + \beta \zeta^y E \mathbf{V}^y(k', h', z', g', i') + \beta(1 - \zeta^y) E_t \mathbf{V}^o(k', h', i') \quad (7)$$

$$s.t. \quad k(1+r) + \tilde{w}z + T^{SI} = c + k' + x(1 - q(i, x)) + P(h, i, i^H) + \mathcal{T}(y) \quad (8)$$

where

$$\tilde{w} = \left\{ \begin{array}{ll} w & ; \quad \text{if } g = 0 \\ w - c_E & ; \quad \text{if } g = 1 \end{array} \right\} \quad (9)$$

$$P(h, i, i^H) = \left\{ \begin{array}{ll} 0 & ; \quad \text{if } i^H = NB \text{ or } BM \\ p^I(h) & ; \quad \text{if } i^H = BI \\ p^{GR}(i) & ; \quad \text{if } i^H = BGR \text{ and } i \neq \{-2, -1, 0\} \\ p^{GR}(h) & ; \quad \text{if } i^H = BGR \text{ and } i = \{-2, -1, 0\} \\ \bar{p} & ; \quad \text{if } i^H = BG \end{array} \right\} \quad (10)$$

$$y = \left\{ \begin{array}{ll} \max(0, \tilde{w}z + rk) & ; \quad \text{if } i^H \neq BG \\ \max(0, \tilde{w}z + rk - \bar{p}) & ; \quad \text{if } i^H = BG \end{array} \right\} \quad (11)$$

$$T^{SI} = \max(0, \underline{c} + x(1 - q(i, h)) + \mathcal{T}(\tilde{w}z + rk) - \tilde{w}z - k(1+r)) \quad (12)$$

$$i' = \left\{ \begin{array}{ll} -2 & ; \quad \text{if } i^H = NB \\ -1 & ; \quad \text{if } i^H = BM \\ 0 & ; \quad \text{if } i^H = \{BI, BG\} \\ i & ; \quad \text{if } i^H = BGR \text{ and } i \neq \{-2, -1, 0\} \\ h & ; \quad \text{if } i^H = BGR \text{ and } i = \{-2, -1, 0\} \end{array} \right\} \quad (13)$$

The conditional expectation on the right-hand side of equation (7) is over  $\{h', z', g'\}$ . The second equation is the budget constraint.  $w$  is wage per effective labor unit. If the household has ESHI offer, his employer partly pays for the premium. Thus to maintain zero profit condition, the employer deducts  $c_E$  from the wage per effective labor unit. Equation (11) reflects that the premium of ESHI is tax-deductible. Equation (13) maps the current health insurance status and health insurance choices into the next period health insurance status. The income eligibility of Medicaid program requires that

$$k(1+r) + \tilde{w}z - x(1 - q(i, x)) \leq y^{pub}.$$

**Distribution of the households** To simplify the notations, we define  $\mathbb{S}$  as the space of households' state variable where  $\mathbb{S} \equiv \mathbb{K} \times \mathbb{H} \times \mathbb{Z} \times \mathbb{G} \times \mathbb{I}$  for young individuals,  $\mathbb{S} \equiv \mathbb{K} \times \mathbb{H} \times \mathbb{I}$  for just-retired individuals, and  $\mathbb{S} \equiv \mathbb{K} \times \mathbb{H}$  for retired ones. Let  $\mathbf{s} \in \mathbb{S}$  and denote  $\Gamma^y(\mathbf{s})$  as the measure of young and  $\Gamma^o(\mathbf{s})$  as the measure of just-retired and retired people.

## 4.2 Production sector

There are two stand-in firms which act competitively. Their production functions are Cobb-Douglas,  $AK^\alpha L^{1-\alpha}$ , where  $K$  and  $L$  are aggregate capital and aggregate labor and  $A$  is the total factor productivity. The first stand-in firm offers ESHI to its workers. The second stand-in firm does not.<sup>4</sup> Under the competitive markets, the second firm pays each employee his marginal product of labor. Because capital is freely allocated between the two firms, Cobb-Douglas production function implies that the capital-labor ratios of both firms are the same. Consequently we have

$$w = (1 - \alpha) AK^\alpha L^{1-\alpha}, \quad (14)$$

$$r = \alpha AK^{\alpha-1} L^{1-\alpha} - \delta. \quad (15)$$

where  $\delta$  is depreciation rate.

The first firm has to partially finance the health insurance premium for its employees. These costs are fully passed on to its employees through a wage reduction. In specifying this wage reduction we follow Jeske and Kitao (2009). The first firm subtracts an amount of  $c_E$  from marginal product per effective labor. The first firm's zero profit condition implies

$$c_E = \frac{p \left( \int \mathbf{1}_{\{i^H=BG\}} \Gamma(\mathbf{s}) \right)}{\int \mathbf{1}_{\{g=1\}} z \Gamma(\mathbf{s})}. \quad (16)$$

$\mathbf{1}_{\{\cdot\}}$  is a function mapping to one if its argument is true, otherwise the function equals zero. The total wage reduction of each employee with an ESHI offer is  $c_E z$ .<sup>5</sup>

---

<sup>4</sup>An alternative setup is that there are two islands which are different in terms of ESHI offer. Worker are allocated randomly between the two islands while there is no friction on the capital market. Inside each island, the labor market is competitive.

<sup>5</sup>The assumed structure implies a proportional transfer from high incomes to low incomes. This assumption does not affect our results since our studies focus on the individual market. An alternative structure is a lumpsum wage reduction. This alternative structure is difficult to implement in our setup since some workers will end up earning zero or negative wage.

### 4.3 Private health insurance sector

We assume that health insurance companies can observe only individual's current health status.<sup>6</sup> In addition, both individual and group insurance markets are competitive; thus the expected profit of each insurance contract is zero.

#### Standard one-period insurance

The zero profit condition implies that the premium of a standard one-period insurance is the expected medical costs of an individual covered by an insurance company multiplied by an administrative load ( $\gamma^I$ ).

$$p_I(h) = (1+r)^{-1} \gamma^I EM(h) \quad (17)$$

where

$$EM(h) = \int x(h') q(0, x(h')) G(h'|h)$$

$EM(h)$  is the expected coverage for an individual having a current health  $h$ .

#### Guaranteed renewable insurance

The price of a guaranteed renewable contract depends on the health status of an individual at the time when the contract was originated. To determine the premium, an insurer needs to assign a probability to an event that its customer will continue renewing the contract. Consider an individual with a health status  $h_t$  who chooses to buy a guaranteed renewable insurance for the first time in period  $t$ . Denote by  $\pi_{t+j}(h_{t+j}|h_t)$  an insurer's belief that he will keep renewing the same insurance contract every period up to period  $t+j$  when his health status becomes  $h_{t+j}$ . Because of the zero expected profit, the premium of the guaranteed renewable contract can be written as follows:

$$p^{GR}(h_t) = p^I(h_t) + \sum_{j=1}^{\infty} \frac{1}{(1+r)^j} \sum_{h_{t+j}=1}^H \pi_{t+j}(h_{t+j}|h_t) (p^I(h_{t+j}) - p^{GR}(h_t)) \quad (18)$$

The first term is a premium of a standard insurance contract that covers medical expenses in the next period. The second term is the extra payment for the option to renew the contract in the future. It arises because an insurance company will not be able to readjust the price in the future even if individual's health deteriorates.

---

<sup>6</sup>If insurance companies observe other state variables of individuals, the guaranteed renewable premiums will depend on these observed state variables since they provide information about the probability to renew the contract. We rule out this to simplify the problem. In addition, unlike medical expenses which can be verified through claim records or medical underwriting, it is difficult for insurers to verify other state variables, particularly assets and income.

Insurer's beliefs  $\pi_{t+j}(h_{t+j}|h_t)$  should be consistent with households' optimal decisions in equilibrium. Denote the measure of young people with health  $h_t$  who choose to buy guaranteed renewable contract for the first time in period  $t$  by  $\Gamma^y(h_t, i_t = \{-2, -1, 0\}, i_t \neq h_t, i_t^H = BGR)$ . Denote by  $\mathcal{F}(h_{t+j}|h_t, i_t = \{-2, -1, 0\}, i_t \neq h_t, i_t^H = BGR)$  the measure of people who bought a guaranteed renewable contract for the first time when their health status was  $h_t$  and then kept renewing the same contract every period from period  $t$  to period  $t + j$  when their health become  $h_{t+j}$ . Thus  $\pi_{t+j}(h_{t+j}|h_t)$  can be defined as

$$\pi_{t+j}(h_{t+j}|h_t) = \frac{\mathcal{F}(h_{t+j}|h_t, i_t = \{-2, -1, 0\}, i_t \neq h_t, i_t^H = BGR)}{\Gamma^y(h_t, i_t = \{-2, -1, 0\}, i_t \neq h_t, i_t^H = BGR)} \quad (19)$$

### Employer-based group insurance

The premium in the group insurance market does not depend on health status. Using zero expected profit, the premium can be defined as a weighted average of the expected medical costs of those who buy the group insurance multiplied by an administrative load ( $\gamma^G$ ).

$$p = (1 + r)^{-1} \gamma^G \frac{\int \mathbf{1}_{\{i^H = BG\}} \times EM(h) \Gamma^y(\mathbf{s})}{\int \mathbf{1}_{\{i^H = BG\}} \Gamma^y(\mathbf{s})}, \quad (20)$$

## 4.4 Government constraint

We assume that the government runs a balanced budget. This implies

$$\int \mathcal{T}(y) \Gamma^y(\mathbf{s}) + \int \mathcal{T}(y) \Gamma^o(\mathbf{s}) = \int (ss + xq^{med}(x) - p^{med}) \Gamma^o(\mathbf{s}) + \int T^{SI} \Gamma^y(\mathbf{s}) + \int T^{SI} \Gamma^o(\mathbf{s}) \quad (21)$$

The left-hand side is the total income tax. The first term on the right-hand side is the net expenditure on the Social Security system and Medicare for the old. The last two terms are the costs of running the means-tested welfare program, i.e. to keep households above the consumption minimum floor.

## 4.5 Competitive equilibrium with asymmetric information<sup>7</sup>

Given the government programs  $\{\underline{c}, ss, q^{med}(x), p^{med}\}$ , the insurance coverage  $\{q(i, x)\}$ , and the fraction of employers' contribution ( ), the competitive equilibrium with asymmetric information consists of the set of equilibrium prices  $\{w, r, p, p^I(h), p^{GR}(i)\}$ , wage

<sup>7</sup>We refer to this equilibrium as asymmetric information equilibrium because insurance companies observe only one state variable - health status. For the standard insurance contract health status is the only variable relevant for pricing the contract. However, for guaranteed renewable contracts other state variables also affect the expected payout for the contract and thus matter for pricing.

reduction  $\{c_E\}$ , households' value functions  $\{\mathbf{V}^y(\mathbf{s}), \mathbf{V}^o(\mathbf{s})\}$ , decision rules of the young  $\{c(\mathbf{s}), k'(\mathbf{s}), i^H(\mathbf{s})\}$  and of the old  $\{c(\mathbf{s}), k'(\mathbf{s})\}$ , the tax function  $\{\mathcal{T}(y)\}$ , time-invariant distribution  $\{\Gamma^y(\mathbf{s}), \Gamma^o(\mathbf{s})\}$ , and the set of insurers' beliefs  $\{\pi_{t+j}(h_{t+j}|h_t); j > 0, \forall t\}$  such that the following conditions are satisfied.

1. Given the set of prices and the tax function, decision rules and value functions are the solution of individuals' optimization problems.
2. Wage ( $w$ ) and rent ( $r$ ) satisfy Equation (14) and (15).
3. Labor market clears  $L = \int z\Gamma^y(\mathbf{s})$
4. Capital market clears. Denote by  $\theta_{t+j}^t(h)$  ex-post profit at time  $t+j$  of an insurance company that sold a guaranteed renewable contract at time  $t$  to individuals with health status  $h$ . This can be defined recursively as follows:

$$\theta_{t+1}^t(h) = p^{GR}(h)(1+r) - \int_{h'} \mathcal{F}(h_{t+1} = h' | h_t = h, i_t = \{-2, -1, 0\}, i_t \neq h_t, i_t^H = BGR)$$

$$\theta_{t+j}^t(h) = \theta_{t+j-1}^t(h)(1+r) - \int_{h'} \mathcal{F}(h_{t+j} = h' | h_t = h, i_t = \{-2, -1, 0\}, i_t \neq h_t, i_t^H = BGR)$$

Thus market clearing conditions can be written as follows:

$$K = \int k'(\mathbf{s})\Gamma^y(\mathbf{s}) + p \int \mathbf{1}_{\{i^H(\mathbf{s})=BG\}}\Gamma^y(\mathbf{s}) + \int \mathbf{1}_{\{i^H(\mathbf{s})=BI\}}p^I(h)\Gamma^y(\mathbf{s}) + \int (\mathbf{1}_{\{i^H(\mathbf{s})=BGR, i=\{-2, -1, 0\}, i \neq h\}}p^{GR}(h))\Gamma^y(\mathbf{s}) + \sum_{j=-\infty}^1 \int_h \theta_t^{t-j}(h)$$

5.  $c_E$  satisfies Equation (16); thus the firm offering ESHI earns zero profit.
6. The tax function  $\{\mathcal{T}(y)\}$  satisfies the government budget balance in Equation (21).
7. The standard one-period insurance premiums,  $p^I(h)$ , satisfies Equation (17), the guaranteed renewable premiums  $p^{GR}(i)$ ,  $i = 1, \dots, H$ , satisfy Equation (18), and the group insurance premium ( $p$ ) satisfies Equation (20). So health insurance companies earn zero expected profit on each contract.

8. Insurance companies' beliefs  $\{\pi_{t+j}(h_{t+j,t}|h_t); j > 0, \forall t\}$  satisfy Equation (19) if  $\Gamma^y(h_t, i_t = \{-2, -1, 0\}, i_t^H = BGR) \neq 0$ . Otherwise,

$$\pi_{t+j}(h_{t+j}|h_t) = 0 \quad ; \quad j > 0, \forall t. \quad (22)$$

The last equation is the off-equilibrium belief of insurers. When no one with health status  $h_t$  buys a guaranteed renewable contract, insurers believe that if one with health  $h_t$  buys a guaranteed renewable contract, he will not renew the contract in the next period.

## 5 Data and Calibration

### 5.1 Data

We calibrated the model using the Medical Expenditure Panel Survey (MEPS) dataset. The MEPS collects detailed records on demographics, income, medical costs and insurance for a nationally representative sample of households. It consists of two-year overlapping panels and covers the period of 1996-2006. We use eight waves of the MEPS - from 1999 to 2007<sup>8</sup>.

The MEPS links people into one household based on eligibility for coverage under a typical family insurance plan. This Health Insurance Eligibility Unit (HIEU) defined in the MEPS dataset corresponds to our definition of a household. All statistics we use were computed for the head of the HIEU. We define the head as the person who has the highest income in the HIEU. A different definition of the head (based on gender) does not give statistically different results. We use longitudinal weights provided in the MEPS to compute all the statistics. Given that all individuals are observed for at most two years, we pool together all eight waves of the MEPS. Since each wave is a representation of population in each year, the weight of each individual was divided by eight in the pooled sample.

In our sample we include all non-student heads whose age is at least 20 and whose labor income (to be defined later) is non-negative. The sample size for each wave is presented in Table 1. We use 2003 as a base year. All level variables were normalized to the base year using Consumer Price Index (CPI).

In the following, we use the fraction of people with different insurance status as targets to calibrate parameters of the baseline model. In the MEPS the question about the source of insurance coverage is asked retrospectively for each month of the year. When

---

<sup>8</sup>We do not use the first two waves of the MEPS because they do not contain the variables we use in constructing a household unit.

Panel	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	Total
Obs.	4,954	4,017	8,248	6,244	6,464	6,417	6,200	6,656	49,200

Table 1: Number of observations in eight waves of MEPS (1999-2007)

measuring the insurance status in the data we use the following approach. We define the person as having employer-based insurance if he reports having ESHI for at least eight months during the year (variables PEGJA-PEGDE). The same criteria was used when defining public insurance (variables PUBJA-PUBDE) and individual insurance status (variables PRIJA-PRIDE).<sup>9</sup> In addition, we assume that a person has an ESHI offer if he reports having an offer in at least two out of three interview rounds during a year (variables OFFER31x, OFFER42x, OFFER53x).

## 5.2 Demographics, preferences and technology

The period in the model is one year. Young agents are born at age 20 and stay young on average 45 years, so the probability to stay young,  $\zeta^y$ , is set to 44/45. The survival probability of an old  $\zeta^o$  is set such that the fraction of old in the population is equal 20%; thus  $1 - \zeta^o = 4(1 - \zeta^y)$ . To keep the total measure of population equal to one, the measure of newborn in every period is set to  $\frac{(1 - \zeta^y)(1 - \zeta^o)}{2 - \zeta^y - \zeta^o}$ .

Risk aversion parameter  $\sigma$  is equal to 3 which is in the range commonly used in macroeconomics literature. The discount factor  $\beta$  is calibrated to match the aggregate capital output ratio of 3.

The Cobb-Douglas function parameter  $\alpha$  is set at 0.33 which corresponds to the U.S.'s capital income share. Annual depreciation rate  $\delta$  is calibrated to achieve interest rate of 4.0% in the baseline economy. Total factor productivity  $A$  is normalized such that the average labor income equals one in the baseline model.

## 5.3 Labor income and offer rate

First we define labor income as a sum of wages (variable WAGEP) and 75% of income from business (variable BUSNP). This definition is the same as used in the Panel Study of Income Dynamics Dataset (PSID), which has been commonly used for income calibration in the macroeconomic literature. In calibrating labor income and offer rate we follow Kitao and Jeske (2009). We construct a joint transition matrix of labor income and

---

<sup>9</sup>For those few individuals who switch sources of coverage during the year, we use the following criteria of insurance status. If a person has both ESHI and individual insurance in one year, and each coverage lasted for less than eight months, but the total duration of coverage lasted for more than eight months, we classify this person as individually insured. Likewise, when a person has a combination of individual and public coverage that altogether lasts for more than eight months, we define that individual as having public insurance. Our results do not significantly change if we change the cutoff point to 6 or 12 months.

offer. For each wave we divide the labor income in each year into five equally size bins ( $4 \times 20\%$ ). The transition probability is the fraction of individuals who move from one bin to another in our pooled sample. The labor income level in each bin is the labor income in 2003/2004 wave normalized by its average income (\$35,624). These numbers are 0.091, 0.477, 0.802, 1.226, and 2.417. The transition matrix is shown below.

	ESHI offer next year					no ESHI offer next year				
ESHI offer	.455	.165	.071	.047	.032	.150	.058	.011	.007	.004
	.064	.491	.219	.062	.024	.043	.076	.012	.007	.002
	.021	.148	.533	.187	.044	.016	.021	.020	.006	.004
	.013	.042	.175	.572	.161	.006	.008	.009	.009	.005
	.011	.015	.036	.170	.739	.002	.004	.004	.006	.012
no ESHI offer	.020	.031	.011	.005	.002	.748	.130	.032	.016	.005
	.015	.083	.044	.015	.003	.232	.428	.120	.043	.017
	.012	.040	.080	.032	.010	.096	.257	.318	.107	.048
	.010	.016	.027	.078	.043	.060	.132	.199	.262	.173
	.000	.028	.010	.039	.078	.050	.061	.110	.188	.436

The first and sixth rows correspond to the first quintile of current income while the first and sixth columns are the first quintile of the next year income. The transition matrix produces a high persistence of an ESHI offer status. The probability of getting an offer next year when having an offer today is 0.931 while the probability of having no ESHI offer when having no offer today is 0.879. The probability to get an ESHI offer also increases with income. We assume that a newborn draws the initial pair of  $\{z, g\}$  from the invariant distribution.

## 5.4 Health status and Medical expenses

The total medical expenses are deterministic, and monotone increasing function of health status and we define health status based on medical expenses (variable: TOTEXP). Our medical expenses are the total amount paid for the healthcare services. It includes both out-of-pocket payments and payments made by insurance companies but does not include over-the-counter drugs. In our calibration, there are five health statuses corresponding to five bins of medical expenses ( $3 \times 30\%$ ,  $9\%$ ,  $1\%$ ). The medical expenses normalized by the average labor income for each health status are  $\{0.001, 0.016, 0.075, 0.318, 1.483\}$  for young households and  $\{0.021, 0.083, 0.251, 0.917, 2.317\}$  for retired households. We use the same method to construct the transition matrix of health status. The transition matrix of young household is



0.619	0.264	0.092	0.022	0.002
0.261	0.432	0.260	0.044	0.003
0.094	0.257	0.517	0.122	0.010
0.070	0.142	0.414	0.341	0.034
0.013	0.096	0.274	0.372	0.245

 ,

while the transition matrix of retired household is

0.626	0.225	0.111	0.037	0.001
0.257	0.416	0.265	0.058	0.005
0.131	0.324	0.427	0.108	0.011
0.090	0.170	0.455	0.242	0.043
0.056	0.174	0.388	0.336	0.046

 .

Our model does not have an age dimension, instead we label all people under 65 year as young. In reality even among people younger than 65 year there is a noticeable difference in medical expenses. To account for this we make the following adjustment. In our sample the average medical expenses among people aged 35-64 is 2.27 times higher than the average medical expenses among people aged 20-35. We scale the newborn's initial distribution to make its average medical expenses 2.27 times less than the average medical expenses at the invariant distribution. So 82.5% of newborns have either health status 1 or 2. Our medical shock process produce the average medical expense of 7.0% and 20% of average income among the young and old respectively.

## 5.5 Government constraint

In calibrating the tax function  $\mathcal{T}(y)$  we use a nonlinear relationship specified and estimated by Gouveia and Strauss (1994):

$$\mathcal{T}(y) = a_0 [y - (y^{-a_1} + a_2)^{-1/a_1}]$$

Here  $a_0$  controls the marginal tax rate faced by people with the highest income,  $a_1$  determines the progressivity of the tax code. We set  $a_0$  and  $a_1$  to the Gouveia and Strauss original estimates (0.258 and 0.768 correspondingly). The parameter  $a_2$  is used to balance the government budget.

The consumption minimum floor  $\underline{c}$  in the baseline economy was calibrated so that the fraction of households with assets less than \$5,000 in the model is the same as in the data. Based on 1989-2001 Survey of Consumer Finance (SCF) dataset this fraction is 20.0% (Kennickell, 2003). To match this fraction,  $\underline{c}$  is set to 0.893 of the Federal Poverty Line or \$8,548. Social security replacement rate is set to 45% of the average labor income based on applying Social Security benefit formula.

## 5.6 Medicaid Program and Insurance sector

For Medicaid program each state has its own rules to determine the income eligibility . As of 2009, 14 states had income eligibility threshold below 50% FPL, 20 states had it between 50% to 99% FPL, and 17 states had it higher than 100% FPL (Kaiser Family Foundation, 2008).<sup>10</sup> In our baseline model, we set  $y^{pub}$  to 89.3% FPL to match the fraction of people insured by Medicaid.

In our baseline model, we assume that only standard one-year contracts are offered in the individual market. To match the fraction of those buying individual insurances, we use an administrative load of an individual insurance policy ( $\gamma^I$ ). We set an administrative load for the group insurance  $\gamma^G$  to be the same as in the individual insurance.<sup>11</sup> In our baseline model,  $\gamma^I = \gamma^G = 14\%$ . The premiums of group insurance paid by employees are ranging from 11% to 23% (Sommers, 2002). We set the share of health insurance premium paid by the firm to 80%.

We report the fraction of non-elderly adult with different insurance status in Table 2 together with the numerical results from the baseline model.

	uninsured	public ins	individual ins	ESHI	fraction with ESHI offer
data	21.45%	9.10%	8.15%	61.30%	64.00%
model	21.30%	9.18%	8.05%	61.48%	62.73%

Table 2: Percentage of non-elderly adult with different insurance status (2003/2004)

We use the MEPS to find the fraction of health costs covered by an average insurance policy. We estimate the following equation

$$InsCov = \beta_0 + \beta_1 x + \beta_2 x^2 + \Theta D_{year}$$

separately for private insurance, Medicaid and Medicare.  $InsCov$  is medical expenses paid by insurance (variables: TOTPRV, TOTMCD, TOTMCR) and  $D_{year}$  are year dummy variables. We include only people with positive medical expenses when estimating this regression. Then we use our estimates to compute the coverage ratio for each health status and truncate the ratio to be between 0 and 1. Table 3 reports the coverage ratios by health status for different insurance types.

<sup>10</sup>FPL is the Federal Poverty Line.

<sup>11</sup>In reality the administrative costs in ESHI are lower than the costs in individual insurance market. However, changing  $\gamma^G$  has only small effect on the ESHI takeup rate since the large portion of premium is paid by employers. In addition, different choice of  $\gamma^G$  has very small effect on households' decisions to buy individual insurance whether standard or guaranteed renewable.

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$
Medicaid: $q(-1, x)$	1.00	1.00	0.70	0.52	0.50
non-public insurance: $q(i, x)$ for $i = \{0, 1, \dots, 5\}$	0.00	0.40	0.71	0.78	0.81
Medicare: $q^{med}(x)$	0.00	0.35	0.56	0.64	0.65

Table 3: Coverage ratio by insurance types

## 5.7 Performance of the baseline model

Our baseline model can match all targets we explained above. Table 2 compares the aggregate health insurance statistics produced by the model with the data. To evaluate the performance of our baseline model, we use health insurance statistics not targeted by our calibration. Figure 1 and 2 show the decomposition of health insurance status along the dimension of labor income and health status. Our model does a good job in replicating fractions of people in different insurance statuses along the dimension of income.<sup>12</sup> However the model does not do so well along the dimension of health status. In particular, we cannot match the hump shape profile of the fraction of people with ESHI. This results from the fact that in our model ESHI offer rate does not depend on health status while in the data ESHI as a function of health status has a hump shaped profile. In the data the majority of the healthiest group is young households while the group with poorest health is mostly composed of people near retirement. Comparing to the middle ages, these two groups tend to have lower incomes and are less likely to get an ESHI offer. Since the joint process of income and an ESHI offer is independent of the health shock in our current calibration, the offer rate among people with health status 1 and 5 is too high in our model.<sup>13</sup>

## 6 Results and discussions

This section discusses how the baseline economy changes once guaranteed renewable contracts are introduced.

Figure 3 compares the premiums of standard and guaranteed renewable contracts. Guaranteed renewable contracts tend to be more expensive than standard ones. The difference in prices between two types of contracts is a negative function of health status.

<sup>12</sup>We can fine tune the individual insurance take-up rate among the lowest income quintile by introducing a small fixed administrative loading as in Pashchenko and Porapakkarm (2010).

<sup>13</sup>In the new version of our model we will take into account the full joint distribution of income, ESHI offer, and health status.

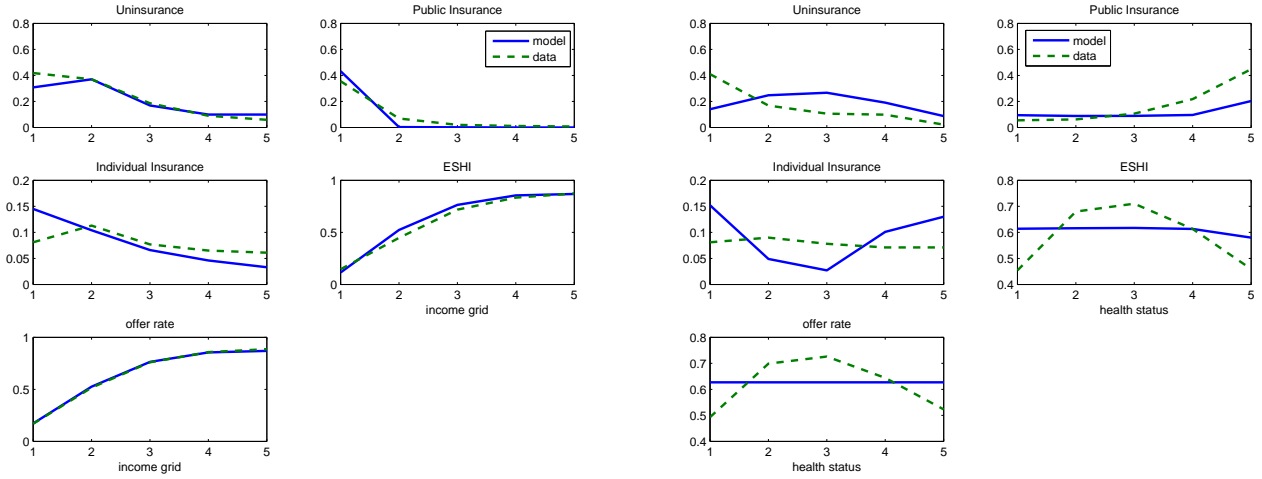


Figure 1: Insurance decision by labor income

Figure 2: Insurance decision by health status

For example, for the healthiest group the premium for a guaranteed renewable contract is almost three times higher than the standard premium. On the other hand, for people with the poorest health premiums for guaranteed renewable and standard insurance are the same. This happens because for this group of people health status cannot deteriorate so the price for guaranteed renewable contract does not include the premium for renewability.

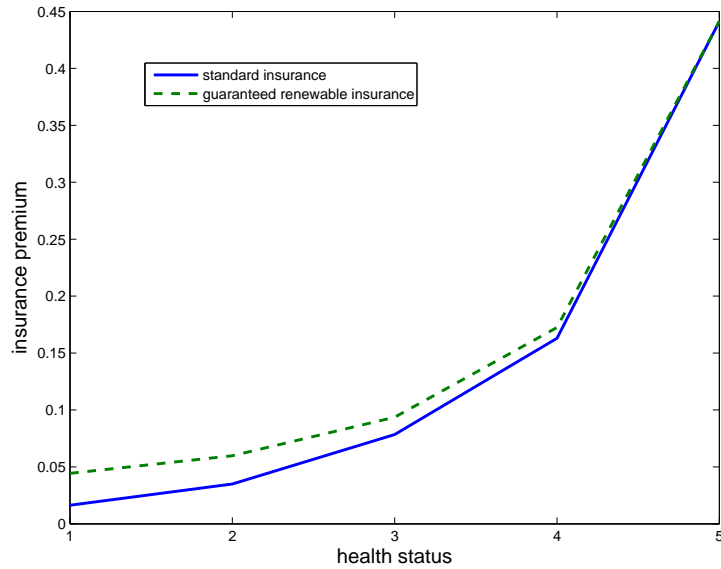


Figure 3: Premiums in individual market

## 6.1 Effects on health insurance decision

The first column of Table 4 shows how households' decisions about insurance purchase change after guaranteed renewable contracts are introduced. The fraction of uninsured decreases substantially, going down from 21.3% to 13.5%. The fraction of people with individual insurance increases twice, from 8% to 16%. Thus, around 40% of previously uninsured people find it worthwhile to buy individual insurance once guaranteed renewability option becomes available. This suggests that guaranteed renewability makes the individual insurance market more attractive. Indeed, more than 80% of individually insured people choose to buy guaranteed renewable contract while less than 20% continue with standard contracts.

	Benchmark	No MCD	No ESHI	No MCD, ESHI
<b>Baseline (only standard contracts)</b>				
Individually insured (%)	<i>8.0</i>	8.7	34.5	36.1
- by standard contracts	<i>8.0</i>	8.7	34.5	36.1
- by GR contracts	-	-	-	-
Uninsured (%)	<i>21.3</i>	29.8	56.1	63.9
Publicly insured (%)	<i>9.2</i>	-	9.3	-
Insured by ESHI (%)	<i>61.5</i>	61.4	-	-
Aggregate capital	<i>3.587</i>	3.600	3.660	3.672
<b>With GR contracts</b>				
Individually insured (%)	16.0	16.7	67.7	69.0
- by standard contracts	3.0	3.0	19.0	19.6
- by GR contracts	13.0	13.7	48.7	49.4
Uninsured (%)	13.5	21.9	23.0	21.8
Publicly insured (%)	9.2	-	9.3	-
Insured by ESHI (%)	61.4	61.4	-	-
Aggregate capital	3.579	3.592	3.634	3.646

Table 4: Insurance statistics before and after introduction of GR contracts

For the experiments in column 3-6, we remove either MCD, or employers' sponsored health insurance, or both from the baseline economy. The resulting equilibriums are reported in the upper half of the table. Then we introduce the guaranteed renewable contracts into these hypothetical economies and report the results in the lower half of the table.

Figure 4 and Figure 5 show the decomposition of health insurance decision by income quintile and health status. Guaranteed renewable contracts crowd out the standard contract and reduce the fraction of uninsured for almost all income quintiles. In addition, Figure 5 shows that once guaranteed renewable contracts become available the participa-

tion in the individual market increases for both people in good and bad health meaning that risk-sharing increases. More specifically, the percentage of uninsured among people in the worst health status decreases from 8.7% to 6.0%, while for people in the best health this number goes down from 14.0% to 11.5%.

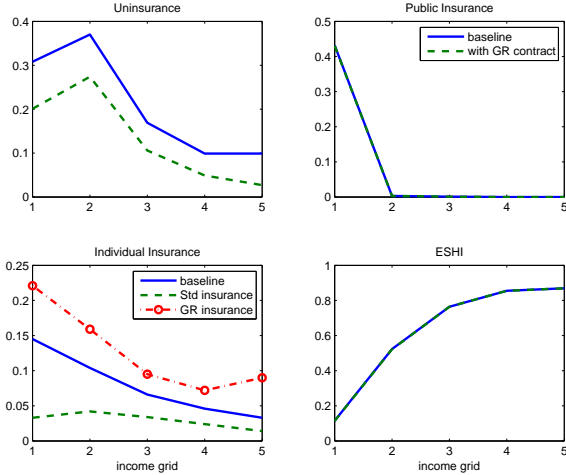


Figure 4: Insurance decision by labor income

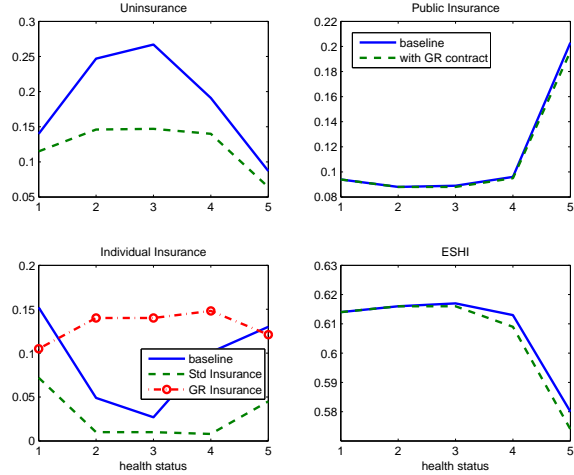


Figure 5: Insurance decision by health status

The demand for guaranteed renewable contracts can be affected by the presence of alternative insurance arrangements such as Medicaid and employer-based insurance. Both Medicaid and ESHI provide insurance at risk-independent rate. Medicaid provides insurance at no costs while premiums for ESHI are community rated. Thus an agent with a high probability of getting access to any of these insurance arrangements may be less interested in buying guaranteed renewable contracts. This happens because for him the risk of paying risk-adjusted premiums when his health status is bad are reduced.

To understand the effect of Medicaid and ESHI on the demand for guaranteed renewable contracts we considered various counterfactual experiments. The last column of the low panel of Table 4 illustrates the effect of guaranteed renewable contracts when Medicaid and ESHI are removed. Note, that the removal of these two institutions lead to very different consequences depending on whether guaranteed renewable contracts are available or not. When guaranteed renewable contracts are available, the removal of both employer-based pool and Medicaid does not lead to a significant change in the fraction of uninsured; this fraction slightly increases from 21.3% to 21.8%. This is in a sharp contrast with the situation when both employer-based pool and Medicaid are absent and only standard insurance contracts are available. in this case the fraction of uninsured triples, going up from 21.3% to 63.9%.

## 6.2 Welfare analysis of guaranteed renewable insurances

Table 5 illustrates ex-ante welfare changes when guaranteed renewable contracts are introduced. Despite the substantial decrease in the number of uninsured, there is a small welfare loss when guaranteed renewable contracts are offered. A newborn in the baseline economy needs a compensation equivalent to 0.0158% of his annual consumption if he has to live the economy with guaranteed renewable contracts. This result is due to the fact that once guaranteed renewable contracts become available precautionary savings decline and aggregate capital stock decreases. The negative consequences of decreasing capital outweighs the positive consequences of having a new insurance mechanism.

To isolate the pure effect of guaranteed renewable contracts we consider a partial equilibrium environment, i.e. we fix the interest rate ( $r$ ), wage ( $w$ ), and income tax ( $a_2$ ) as in the baseline economy but allow premiums to change to clear all health insurance markets. The results are presented in the third row of Table 5. The partial equilibrium analysis shows that there is a welfare gain from guaranteed renewable insurances but it is small: a newborn in the baseline economy is willing to give up only 0.0077% of his annual consumption in order to be born in the economy with guaranteed renewable insurances. This number is slightly higher if employer-based insurance and Medicaid are not available but it still constitutes less than 0.1% of annual consumption.

	General Eq	Partial Eq (fixed tax)
Benchmark	-0.0158%	+0.0077%
No Medicaid	-0.0151%	+0.0115%
No ESHI	-0.0841%	+0.0089%
No Medicaid, no ESHI	-0.0816%	+0.0095%

Table 5: Consumption equivalent variation after introducing GR contracts

The number is the percentage of consumption a newborn in the baseline economy is willing to give up in order to be able to live in the new economy. A negative number means the newborn is worse off in the new economy.

Figures 6 and 7 show that welfare gains are small across people with different health status and different labor income. People with high labor income tend to gain the most from guaranteed renewable contracts but even for this group consumption equivalent variation is around 0.03% in partial equilibrium

We consider several factors potentially accounting for these small welfare gains; namely i) different degree of front-loading, ii) labor income risk, iii) actuarial unfairness of premiums, and iv) minimum consumption floor. To abstract from the offsetting effects of the change in aggregate capital and tax rates we provide further analysis in the partial

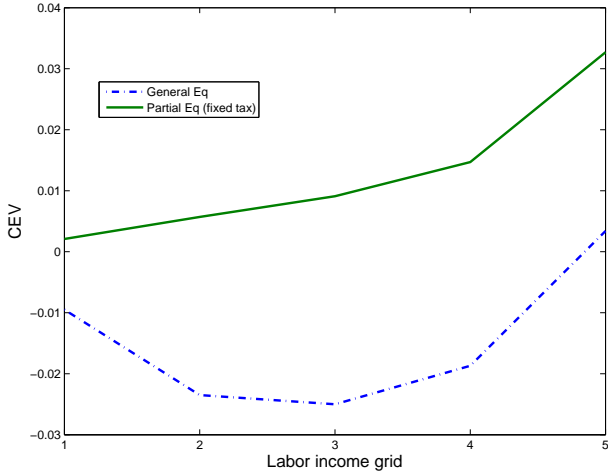


Figure 6: CEV by labor income

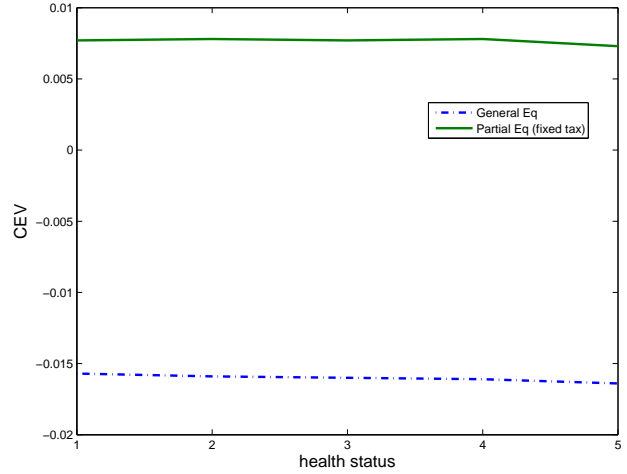


Figure 7: CEV by health status

equilibrium environment.

Our numerical results are summarized in the second column of Table 6. Since Medicaid and ESHI can affect the demand for guaranteed renewable insurance, we present results for the case when these institutional features are removed in the third column of Table 6.

### Different degree of front-loading

Guaranteed renewable contracts are front-loaded and it may be the case that the amount of front-loading is in sharp contrast with what would be optimal from the point of view of intertemporal consumption smoothing. In general, if guaranteed renewable contracts are more front-loaded they provide more reclassification risk insurance because they lock more consumers into the contract and thus have better risk composition as time goes by. This comes at a cost of being more expensive and also being further away from the optimal intertemporal allocation of resources. In other words there is a tradeoff between better insurance against reclassification risk and better intertemporal allocation. This tradeoff may become worse in the environment with uninsurable labor income risks. In such an environment consumers want to keep a buffer stock of savings against negative labor income shock and thus may be less interested in front-loaded contracts that require prepayments for risks that will be realized far into the future.

To understand whether the tradeoff between optimal consumption smoothing and reclassification risk insurance plays an important role in consumers' valuation of guaranteed renewable contracts we consider two sets of experiments. In the first set of experiments we reduce the degree of front-loading by increasing the price that renewable contract guarantee first to 125% and then to 200% of the original price. In other words, if in the original contract an individual is guaranteed to be always able to buy health insurance



	CEV (partial eq, fixed tax)	
	Medicaid, ESHI	No Medicaid, no ESHI
Benchmark	0.0077%	0.0095%
<i>Effect of front-loading</i>		
- 125% of $p^{GR}$	?	0.0085%
- 200% of $p^{GR}$	?	0.0071%
- $IES = 0.10$	0.0030%	0.0044%
- $IES = 0.75$	0.0165%	0.0216%
<i>Effect of labor income risk</i>		
- No labor income risk	0.0320%	0.0961%
<i>Effect of actuarial unfairness</i>		
- No administrative load	0.0133%	0.0128%
- No administrative load, no labor income risk	0.0273%	0.0835%
<i>Effect of consumption floor</i>		
- 0.50¢ (\$4,212)	0.0390%	0.0405%
- 0.25¢ (\$2,106)	0.1341%	0.1359%
- 0.05¢ (\$421)	1.3184%	1.3661%

Table 6: Consumption equivalent variation for introducing GR contracts into different versions of baseline model

The above welfare change are between the equilibrium in baseline economy with a setup corresponding to each experiment and the economy with the same setup except having guaranteed renewable insurances.

at the unchanged price, now he is just guaranteed his price will never increase more than 25% or 100% of the price of the first purchase.

Table 6 shows that lowering the degree of front-loading makes welfare gains smaller: the consumption equivalent variation decreases to 0.0085% and 0.0071% for the case of 125% and 200% contracts correspondingly. This suggests that contracts with less protection against reclassification risk are less valuable despite the smaller amount of front-loading. However, these effects are small.

In the second set of experiments, we change consumers' concern about consumption fluctuations. To do this we substitute standard CRRA utility function with Epstein-Zin preferences with the unchanged risk aversion (equal to 3). Then we disentangle the intertemporal elasticity of substitution (IES) from the risk aversion. First, we decrease IES from 0.3 to 0.1 making consumers more concerned about consumption smoothing. This decreases welfare gains from guaranteed renewable contracts to 0.003% since now front-loading becomes more inconvenient. Second, we increase IES from 0.3 to 0.5 thus making consumers more tolerant to consumption fluctuations. This increases welfare

gains from guaranteed renewable contracts to 0.016% since front-loading does not hurt intertemporal allocation so much. However, in all these experiments the effect is small. Thus the tradeoff between front-loading and optimal consumption smoothing is not the main reason for why people do not value guaranteed renewable contracts much.

### **Labor income risk**

Another possible explanation for the small welfare gains from guaranteed renewable contracts is labor income risk. People facing uninsurable and persistent labor income shocks may value long-term health insurance less. This happens because to be effective guaranteed renewable contracts require periodic payments. Individuals who experience a bad income shock may find his next payment unaffordable and thus have to terminate the contract. Table 6 presents results for the case when labor risk is entirely eliminated and everyone's income is constant and equal to the average labor income. In this case the welfare gains from guaranteed renewable contracts increase (from 0.007% to 0.0320%) but their magnitude is still small.

### **Actuarial unfairness of premiums**

Next, we consider whether actuarial unfairness plays an important role in the valuation of guaranteed renewable contracts. These contracts are front-loaded and thus in absolute terms the same administrative load as in the standard one-period contract constitutes a larger amount of money. We consider the case when administrative loads are entirely eliminated from both standard and guaranteed-renewable contracts. In this case the welfare gains also increase comparing to the benchmark case (0.0133% comparing to 0.0077%) but again the magnitude is small.

### **Minimum consumption floor**

The consumption floor provides support for people who deplete all resources. This includes people who experienced high medical costs and now face unaffordable insurance premiums. Guaranteed renewable contracts insure people against the later event. The availability of public insurance may reduce the value of these private contracts. Table 6 shows welfare effects when the consumption minimum floor in the baseline economy is decreased to 50%, 25% and 5% of the original level. The resulting change in welfare gains is substantial. When consumption floor decreased to 5% of the baseline level, consumption equivalent variation exceeds 1%. This indicated that government provided means-tested transfers noticeably crowd out demand for guaranteed renewable contracts.

To illustrate the role of the minimum consumption floor in more details Figures 8 and 9 show how welfare gains from guaranteed renewable contracts change across people

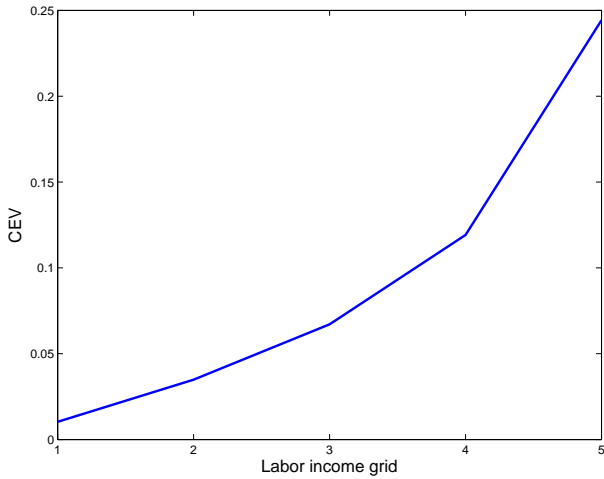


Figure 8: CEV by labor income ( $\underline{c} = \$4, 212$ )

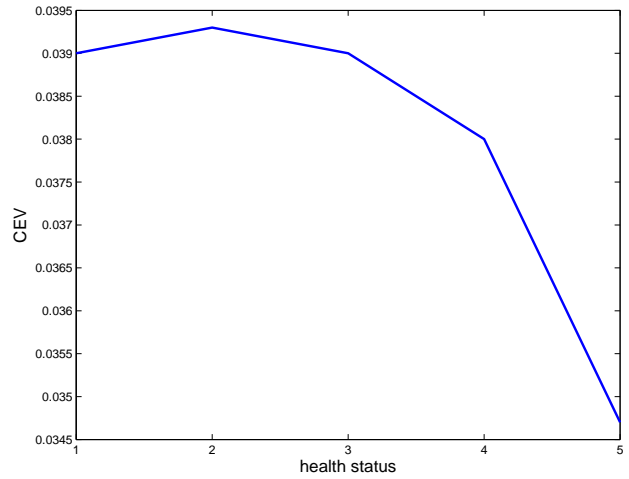


Figure 9: CEV by health status ( $\underline{c} = \$4, 212$ )

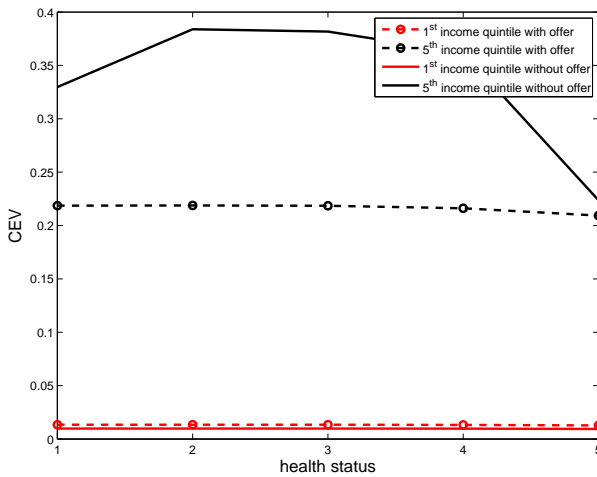


Figure 10: CEV by offer status ( $\underline{c} = \$4, 212$ )

with different income level and health status when consumption floor is twice less than in the baseline model (or  $\$4, 212$ ). Now people with good health benefit much more from the availability of guaranteed renewable contracts than people with poor health. This is in contrast with the baseline model, where health status does not significantly affect the welfare effect of the guaranteed renewable contracts (see Figure 7). Note, that people in bad health never value guaranteed renewable contracts much because for them the insurable event has been already realized. The difference in the relationship between health and welfare gains from guaranteed renewable contracts happens because of people in bad health. Previously people in good health didn't find guaranteed renewable contracts so valuable because if their health becomes bad they will be taken a good care of by the government. Now that generosity of consumption floor declines, deterioration of health can become painful and thus people value guaranteed renewable contracts more.

Another important consideration for valuation of guaranteed renewable contracts is

employer-based health insurance. This market is community rated, so a deterioration of health does not lead to increase in premiums for people with access to employer-based pools. Thus people who have access to employer-based market or who are likely to get access there should value guaranteed renewable contracts less. Indeed, Figures 8, 9, and 10 shows that there is a sharp contrast in consumption equivalent variation for people who have and do not have offer of ESHI. For people with access to employer-based market introduction of guaranteed renewable contracts makes almost no difference in welfare. In contrast, for people without access to ESHI guaranteed renewable contracts bring noticeable welfare gains.

The group that gains the most from the guaranteed renewable insurance is the healthy rich who has no ESHI offer: when the minimum consumption floor is only 5% of the baseline model, \$421, the welfare gain among this group is as high as 6.0%. This happens for three reasons. First, guaranteed renewable contracts allow healthy people to fix the price of their future health insurance at a lower level. Second, not having an ESHI offer is a persistent state meaning the probability to get access to community rated insurance in the future is not high. Third, guaranteed renewable premium constitutes only a small fraction of income for this group.

### **6.3 Implication to the health insurance reform**

TO BE COMPLETE

## **7 Conclusion**

TO BE COMPLETED

## References

- [1] Aiyagari, S. R. (1994), *Uninsured idiosyncratic risk and aggregate saving*, Quarterly Journal of Economics, 109(3), 659-684.
- [2] Bewley T. F. (1986), *Stationary monetary equilibrium with a continuum of independently fluctuating consumers*, In W. hildenbrand and A. Mas-Colell (Eds.), Contributions to Mathematical Economics in Honor of Gerald Debreu, Amsterdam: North-Holland.
- [3] Buchmueller, Thomas and Alan Monheit (2009), *Employer-Sponsored Health Insurance and the Promise of Health Insurance Reform*, NBER Working Paper No.14839
- [4] Cochrane, John (1995), *Time-consistent Health Insurance*, The Journal of Political Economy, Vol.103, No.3.
- [5] Cochrane, John (2009), *Health-Status Insurance. How Market Can Provide Health Security*, The CATO Institute Policy Analysis, No.633.
- [6] Daily, Glenn, Igal Hendel, Alessandro Lizzeri (2008), *Does the Secondary Life Insurance Market Threaten Dynamic Insurance*, American Economic Review, 2008, vol. 98, issue 2, pages 151-56
- [7] Finkelstein, Amy, Kathleen McGarry and Amir Sufi (2005), *Dynamic Inefficiencies in Insurance Markets: Evidence from Long-term Care Insurance*, American Economic Review, 2005, v95(2,May), 224-228.
- [8] Gouveia, M., Strauss, R.P. (1994). *Effective Federal Individual Income Tax Functions: An Exploratory Empirical Analysis*. National Tax Journal 47, 317-339.
- [9] Hendel, Igal and Alessandro Lizzeri (2003), *The Role of Commitment in Dynamic Contracts: Evidence from Life Insurance*, The Quarterly Journal of Economics, February 2003.
- [10] Gruber, Jonathan (1998), *Health Insurance and the Labor Market*, NBER Working Paper No.6762.
- [11] Herring, Bradley and Mark Pauly (2006), *Incentive-Compatible Guaranteed Renewable Health Insurance Premiums*, Journal of Health Economics 25 (2006) 395-417
- [12] Imrohoroglu (1992), *Welfare cost of inflation under imperfect insurance*, Journal of Economic dynamic and Control, 16(1), 953-969.

- [13] Jeske, Karsten, and Sagiri Kiao (2007), *U.S. Tax Policy and Health Insurance Demand: Can a Regressive Policy Improve Welfare?*, *Journal of Monetary Economics*, 56(2), 210-221.
- [14] Kaiser Family Foundation (2008), *Tax Subsidies for Health Insurance: An Issue Brief*, available at <http://www.kff.org/insurance/7779.cfm>.
- [15] Kennickell, A.B., 2003. *A Rolling Tide: Changes In the Distribution of Wealth in the U.S., 1989-2001*. Working paper, Federal Reserve Board.
- [16] Marquis, M. Susan, Melinda Beeuwkes Buntin, José J. Escarce, Kanika Kapur, Thomas A. Louis and Jill M. Yegian (2006), *Consumer Decision Making In The Individual Health Insurance Market*, *Health Affairs*, 25, no.3
- [17] Pashchenko, Svetlana (2010), *Getting Sick and Paying for it*, *Chicago Fed Letter*, no.274
- [18] Pashchenko, Svetlana and Ponpoje Porapakarm (2010), *Quantitative Analysis of Health Insurance Reform: Separating Community Rating from Income Redistribution*, manuscript, University of Virginia.
- [19] Patel, Vip and Mark V. Pauly(2002), *Guaranteed Renewability And The Problem of Risk Variation In Individual Health Insurance Markets*, *Health Affairs*, no.10
- [20] Pauly, M. V., H. Kunreuther, and R. Hirth (1995), *Guaranteed Renewability in Insurance*, *Journal of Risk and Uncertainty*, 10, 143–156.
- [21] Selden, Thomas and Didem Bernard (2004), *Tax Incidence and Net Benefits in the Market for Employment-Related Health Insurance: Sensitivity of Estimates to the Incidence of Employer Costs*, *International Journal of Health Care Finance and Economics*, 4(2), 167-92.
- [22] Sommers, J.P., 2002. *Estimation of Expenditures and Enrollments for Employer-Sponsored Health Insurance*. Agency for Healthcare Research and Quality, MEPS Methodology Report 14.